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Ecosystems Services of Tidal Shorelines

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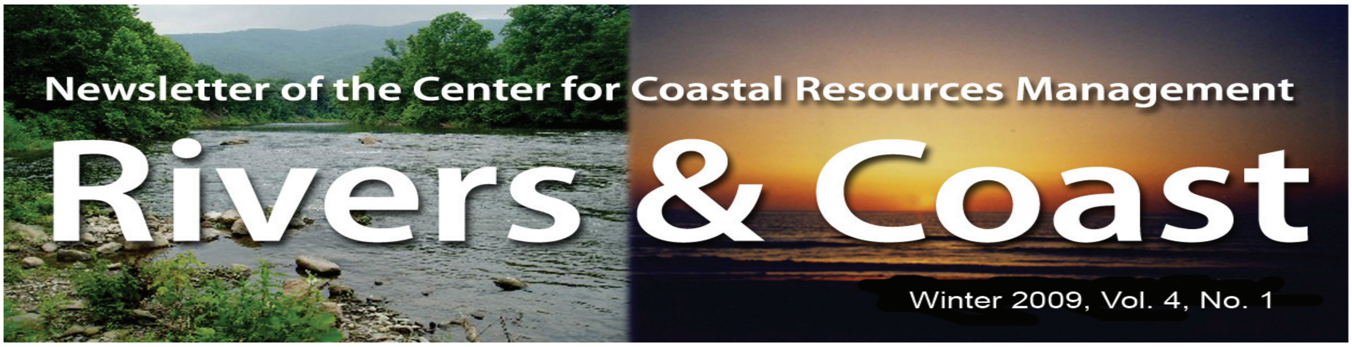

As part of our mission to support integrated and adaptive management of coastal resources, VIMS has been working on the development of new guidance for shoreline resource management. One such effort has been focused on the existing Wetlands Guidelines. Originally written in the early 1970s, the scientific information and rationales are still generally sound but lack an integrated perspective based on current understanding. This newsletter is the first of two that highlight the kind of changes necessary to update tidal wetlands guidance. This issue includes a discussion of the ecosystem services of tidal shorelines and a new wetland classification scheme. The classification scheme shows where the old wetland types "fit" and includes a brief summary of the ecosystem services provided by each wetland class. The next issue will highlight criteria for making sustainable decisions about Virginia's tidal wetlands.

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Ecosystems Services of Tidal Shorelines

The tidal shoreline ecosystem is made up of wetlands, upland and riparian lands, nearshore waters, and in some cases beaches and dunes. These natural resources, separately and in combination, perform many ecological functions centered on water quality, habitat and sediment stabilization. These valuable functions are referred to as ecosystem services.

Tidal shorelines are the site of complex interactions between terrestrial and aquatic systems. The tidal shoreline system is exceptionally important habitat for a wide variety of organisms, some living primarily on land, others that live in water and a few that are found only in the intertidal zone between land and water. Some functions, such as the provision of intertidal habitats, are specific to wetlands. Other functions, such as the production of vegetative material to support estuarine foodwebs, are provided by several vegetated components of the shoreline system: vegetated wetlands, SAV and natural riparian buffers.

Ecosystem Services: Components of nature, directly enjoyed, consumed, or used to yield human well-being.

Boyd and Banzhaf 2006 Resources for the Future DP-0602.

Natural riparian buffers and vegetated marshes provide important filtration capacity for nutrients and pollutants carried in runoff and groundwater. Nutrients are taken up by the plants and converted to primary production. Sediment trapping is also a function of the vegetated shoreline.

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Shorelines have natural erosion resilience in the form of wetlands, beaches and dunes and nearshore flats. These same features are adaptable to coastal storms and flooding.

The interactions and functions of shorelines occur both across and along the shore. Interactions along the shore can occur at site-specific, creek, river and larger scales. Larger scales may be defined as a reach, a discrete portion of a shoreline somewhat homogeneous in its physical characteristics and upon which there are mutual interactions of the forces of erosion, sediment transport, and accretion.

Shorelines are transient ecosystems. Physically they are the transition between uplands and water. Temporally, they respond to climate, geologic, biologic and chemical processes. There are two certainties of shorelines:

1) shorelines change, and

2) humans seek to manage shorelines.

Ecosystem services of tidal wetlands: tidal wetlands classification

The original classification of tidal wetlands (called wetland types), that is incorporated into the Wetlands Guidelines reflected years of research at VIMS in the 1960's and 70's. That classification is indicative of a "natural history" system that described wetland communities by dominant plant(s) and attributes of primary productivity, habitat, erosion control, water quality and flood buffering. The basic science of the existing system is still sound, but it does not capture the current understanding of tidal wetlands in the ecosystem.

Salt/ brackish emergent low marsh

VIMS has developed a classification system that reflects this current understanding in order to promote better decision-making regarding tidal wetlands. The wetland classes still reflect the dominant plant or plant community if vegetated, and substrate if non-vegetated, but also landscape position and relative elevation. These changes are intended to capture the role of the various tidal wetlands classes in the provision of water quality, habitat and sediment stabilization ecosystem services. The provision of these services is based upon the wetland structure and landscape position.

The primary physical factors that determine tidal wetlands vegetation structure are waterlogged soils and salinity. Water and salinity both create stressful conditions for plant survival. In general, for marsh plants, the vegetation in lower intertidal areas is set by physical factors such as tidal inundation and salinity, whereas the vegetation in high intertidal areas is set by competition. The terms "high" and "low" marsh refer to the relative elevation within the intertidal zone. Low marsh areas are tidal communities that are flooded semi-diurnally, or twice daily. High tidal marsh communities are irregularly flooded.

There are close to 300,000 acres of tidal wetlands in Virginia influenced by tides that range from about 1 foot in the Rappahannock near Fredericksburg, to 4 feet on the upper Mattaponi, and by salinities that range from 32 ‰ at the coast to 0 ‰ at the upstream limits of tide. The general distribution of tidal wetlands from brackish to fresh follows the salinity distribution. Plant species composition shifts along estuarine salinity gradients, with salt-tolerant halophytic plants dominating salt and brackish marshes and non-halophytic wetland plants dominating tidal freshwater habitats (Odum and Hoover 1988, Mitsch and Gosselink 2000). The diversity of plant species increases with decreasing salinity.

By and large, localities on the Eastern Shore, with ocean bay frontage, and on the lower reaches of the James, York, Rappahannock and Potomac Rivers have brackish wetlands. However, each tributary river and creek acts as a miniature estuary with decreasing salinity moving upstream. This means that freshwater marshes can be found in localities where brackish marshes are most common.

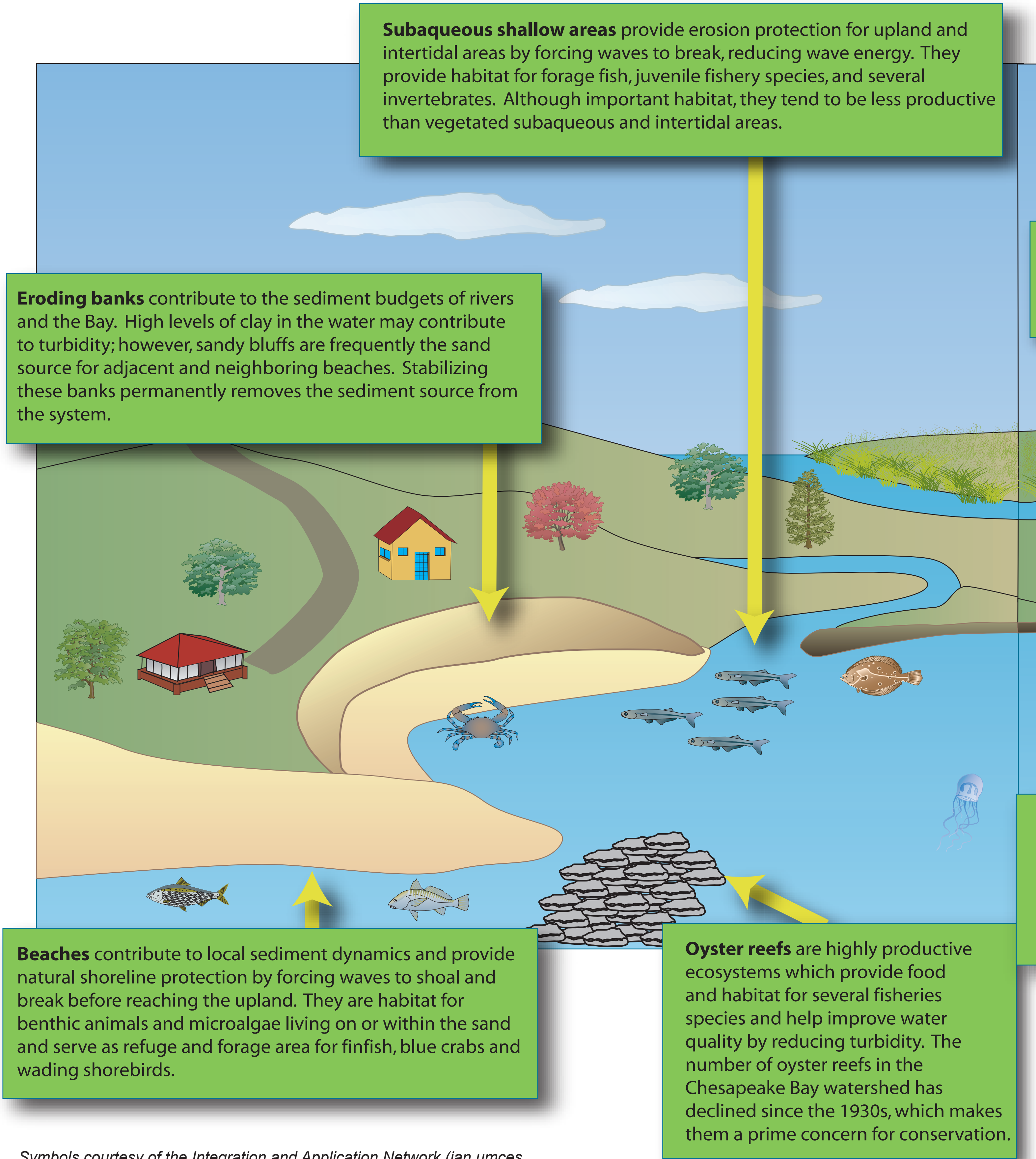
On pages 6 and 7 is a table that shows the new wetlands classes with a brief listing of ecosystem services along with the existing types and where they would fall into the new classes.

Citations

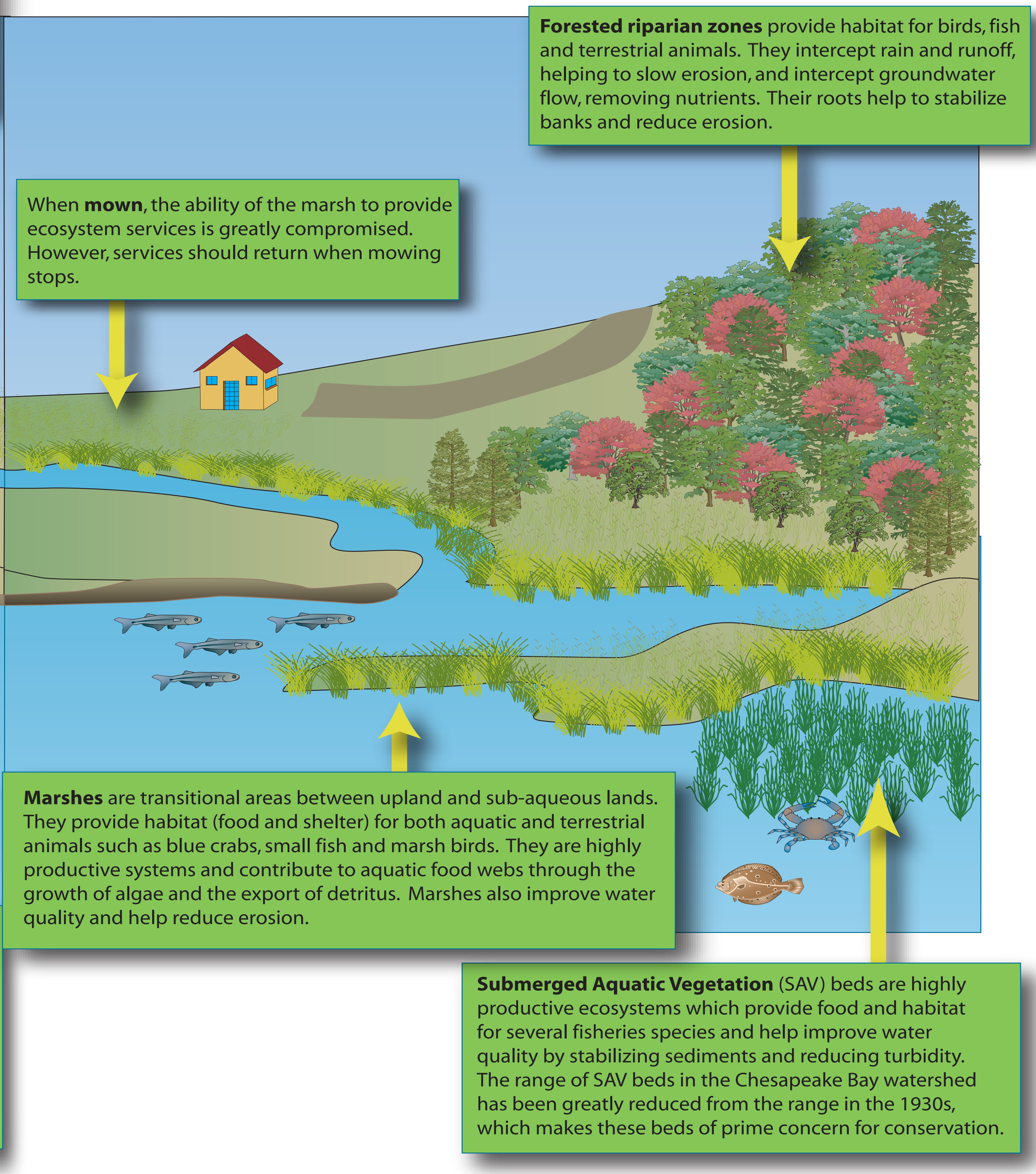
Mitsch, W. J., and J. G. Gosselink. 2000. Wetlands. Van Nostrand Reinhold, New York, New York, USA.

Odum, W. E., and J. K. Hoover. 1988. A comparison of vascular plant communities in tidal freshwater and saltwater marshes. Pages 526–534 in D. D. Hook et al., editors. The ecology and management of wetlands. Croom Helm, London, UK.

Salt/Brackish emergent high marsh



Symbols courtesy of the Integration and Application Network (ian.umces.edu/symbols/), University of Maryland Center for Environmental Science


Forested riparian zones provide habitat for birds, fish and terrestrial animals. They intercept rain and runoff, helping to slow erosion, and intercept groundwater flow, removing nutrients. Their roots help to stabilize banks and reduce erosion.
When **mown**, the ability of the marsh to provide ecosystem services is greatly compromised. However, services should return when mowing stops.
Marshes are transitional areas between upland and sub-aqueous lands. They provide habitat (food and shelter) for both aquatic and terrestrial animals such as blue crabs, small fish and marsh birds. They are highly productive systems and contribute to aquatic food webs through the growth of algae and the export of detritus. Marshes also improve water quality and help reduce erosion.
Submerged Aquatic Vegetation (SAV) beds are highly productive ecosystems which provide food and habitat for several fisheries species and help improve water quality by stabilizing sediments and reducing turbidity. The range of SAV beds in the Chesapeake Bay watershed has been greatly reduced from the range in the 1930s, which makes these beds of prime concern for conservation.

Vegetated

Proposed Classes	Existing Communities
Salt/Brackish emergent low marsh Subclass: Smooth Cordgrass Services: Habitat: primary production, finfish/ crustacean nursery and refuge, waterbird forage, structure provides for the persistence of other natural resources like high marsh and marsh mussels in otherwise uninhabitable environment Water Quality: Sediment trapping, nutrient uptake Sediment Stabilization: wave attenuation	Smooth cordgrass
Subclass: Mixed Services: Habitat: primary production, some finfish/ crustacean nursery and refuge, waterbird forage Water Quality: Sediment trapping, nutrient uptake Sediment Stabilization: less than smooth cordgrass	Brackish water mixed Black needlerush
Salt/Brackish emergent high marsh Services: Habitat: primary production less than smooth cordgrass, some aquatic and terrestrial animal forage, some bird nesting and refuge Water Quality: Nutrient uptake, storm sediment trapping Sediment Stabilization: Some wave attenuation	Saltmeadow Big cordgrass Reed grass Saltwort Brackish water mixed
Scrub/shrub (woody veg. <6 m) Services: Habitat: less primary production, some terrestrial animal forage, some bird nesting and refuge Water Quality: Nutrient uptake, carbon sink Sediment Stabilization: Soil stabilization	Salt bush Freshwater mixed (shrubs)
Tidal Fresh emergent non-persistent Services: Habitat: Moderate primary production with rapid decomposition, resident and anadromous finfish nursery and refuge, large predatory fish, crustacean forage and refuge, waterfowl and bird forage Water Quality: Nutrient uptake and seasonal sink, some sediment trapping Sediment Stabilization: Some wave attenuation	Arrow arum-pickerelweed Yellow pond lily (spatterdock) Freshwater mixed

Tidal fresh emergent non-persistent

Proposed Classes	Existing Communities
Tidal Fresh emergent persistent Services: Habitat: Moderate primary production, some finfish nursery and refuge especially smaller prey fish, crustacean forage and refuge, terrestrial animal forage Water Quality: Nutrient uptake and sink, sediment trapping Sediment Stabilization: Soil stabilization	Broad-leaf cattail Reed grass Big cordgrass Freshwater mixed
Tidal forested (woody veg. >6m tall) Subclass: Bald Cypress Habitat: Mammal use, bird nesting, refuge and forage, finfish forage, fallen trees provide structure for fish use Water Quality: Nutrient sink and uptake from tidal water, groundwater and runoff, some sediment trapping, carbon sink Sediment Stabilization: Soil stabilization Subclass: Mixed Hardwood Habitat: Mammal use, bird nesting, refuge and forage, fallen trees provide structure for fish use Water Quality: Nutrient sink and uptake from tidal water, groundwater and runoff, some sediment trapping, carbon sink Sediment Stabilization: Soil stabilization	Freshwater mixed

Non-Vegetated

Sandy intertidal Habitat: Benthic animals buried in sand, finfish and crab forage at high tide, bird forage. Sediment stabilization: Erosion control via wave run-up, interacts with offshore sand bars and on-shore berms and dunes.	Intertidal beach Sand flat
Non-vegetated intertidal other Habitat: Some primary production of benthic algae, high levels of secondary production and great diversity in benthic animals, forage for crabs, finfish and shorebirds Sediment stabilization: Some wave run-up, small grained sediments susceptible to erosion.	Sand/Mud mixed flat Mud flat
Shell-Rock-Rubble Habitat: Hard substrate for attached animals, oyster shell is substrate for fouling organisms, finfish, crustacean and shorebird forage Water Quality: Oysters filter suspended material from the water. Sediment Stabilization: Erosion control via wave reduction.	Intertidal oyster reef

Legislative Perspective

Effects of multiple management efforts on ecosystem services

- Environmental management programs have a shared goal: protect the environment.
- Environmental management programs have varying missions that focus on water quality, habitat, human health and safety and ecologic and economic sustainability and combinations thereof.
- Despite the shared goal and similar missions, lack of coordination and integration results in continued adverse impacts on shoreline ecosystem service.
- A preferred environmental action may require one, or more management authorities to permit work in, or impacts to, jurisdictional resources to achieve a beneficial outcome.
- Efforts to identify and resolve roadblocks to integrated shoreline management will be necessary to stem the continued loss of ecosystem services.

Smooth cordgrass