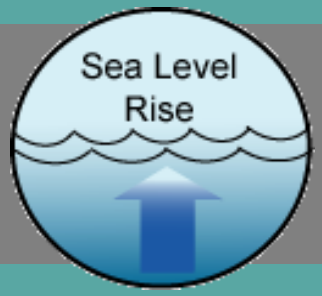
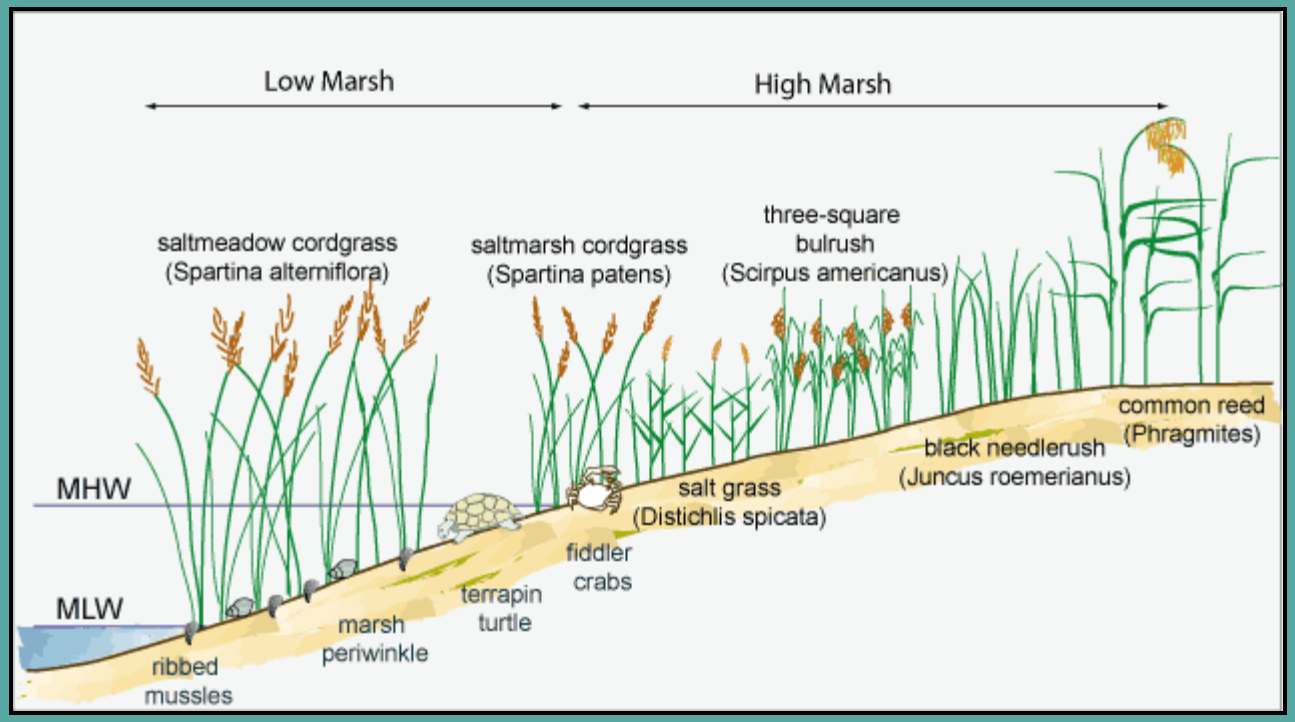
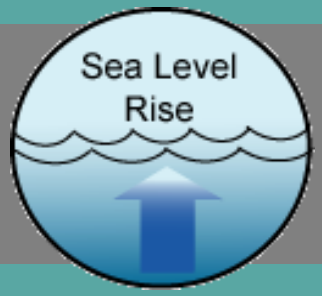


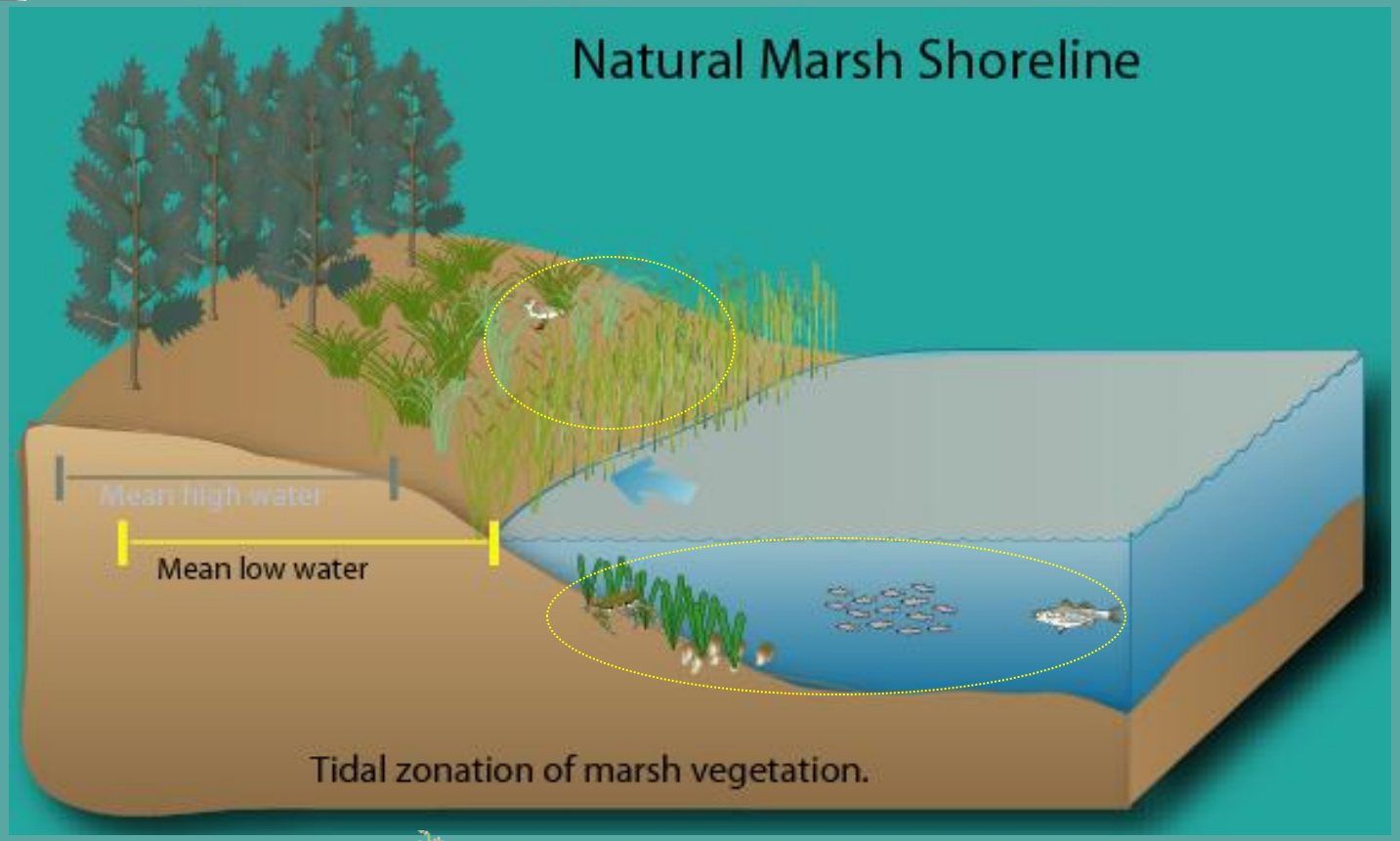
Sea Level Rise



Tidal zonation of salt-marsh vegetation. As sea level rises, the plant communities respond to changes in water level by migrating inland to higher elevations. The following model will help to illustrate marsh migration as well as the function of marsh and wetland plants in stabilizing shorelines against erosion caused by coastal processes such as waves and sea level rise. Figure courtesy of USGS.

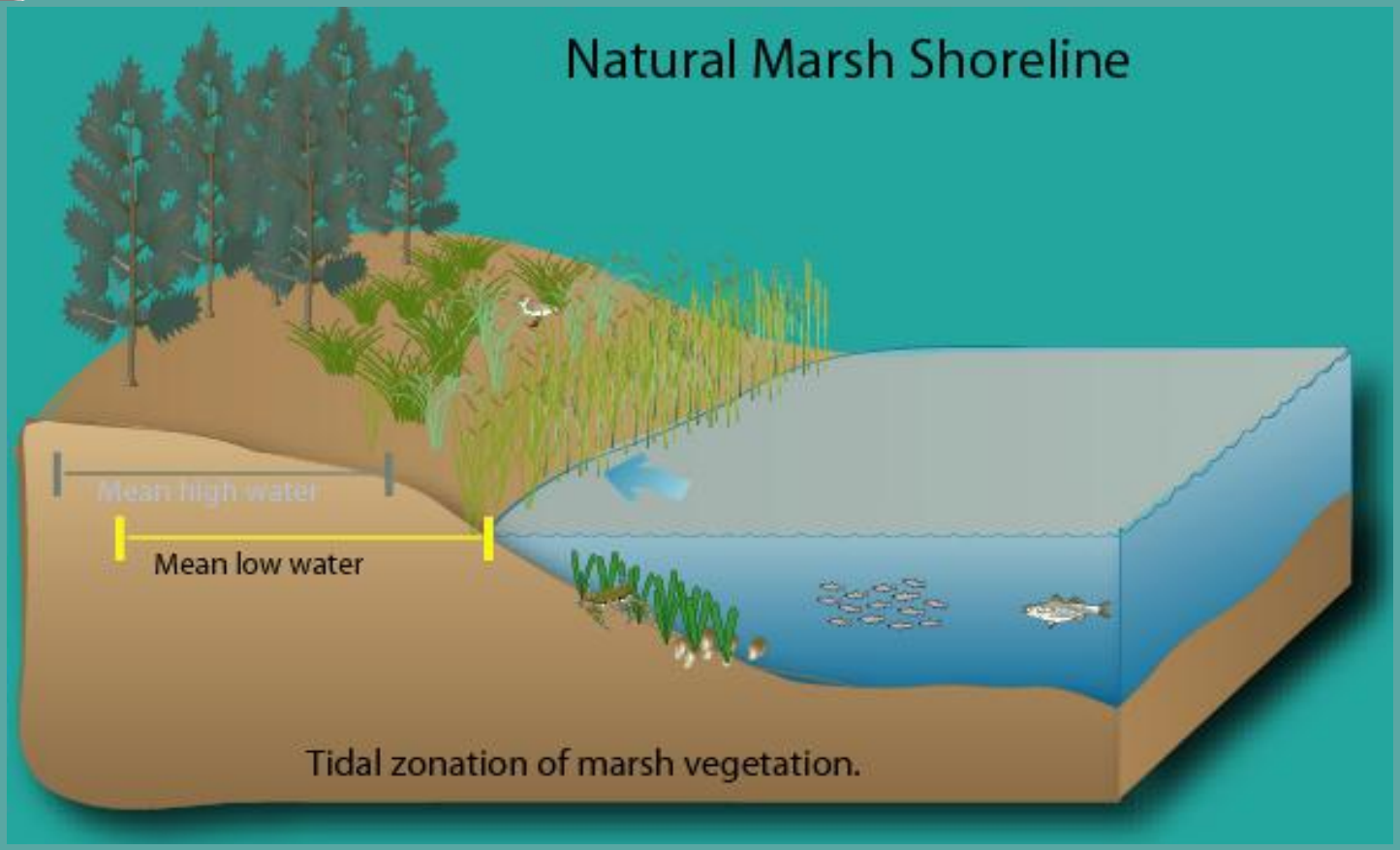


Sea Level Rise

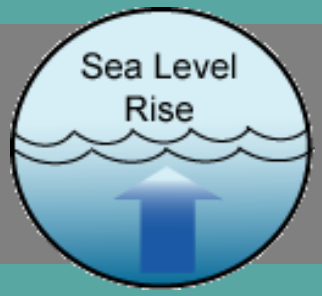


Marsh vegetation provides habitat for crab, oysters, juvenile fish and shorebirds, creating a complex food web….

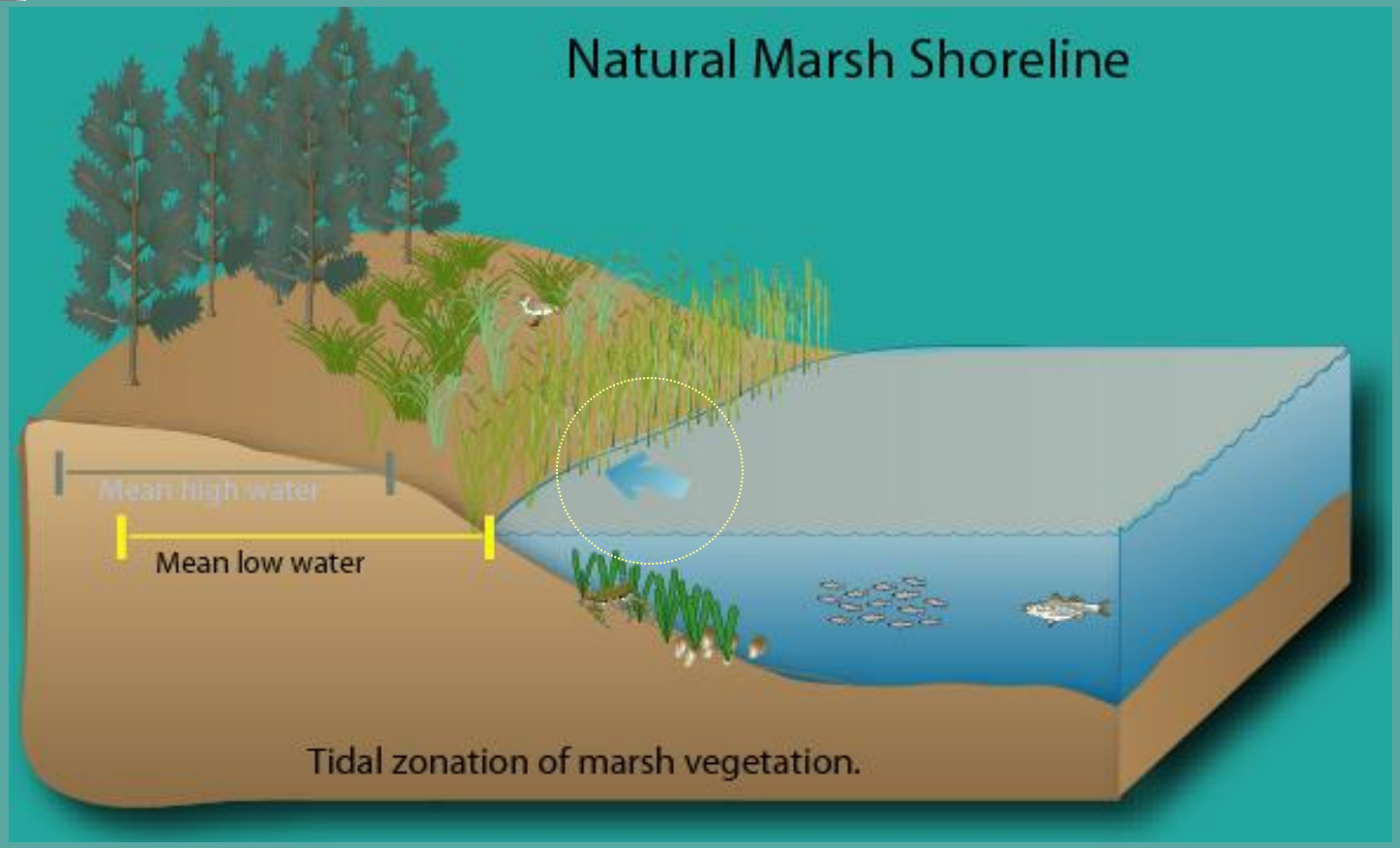
Sea Level Rise



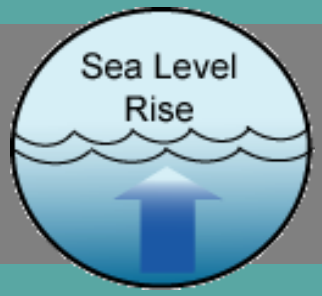
This model illustrates how a natural vegetated shoreline responds to coastal processes, such as wave action and sea level rise. Highlighted here is the mean low water line.



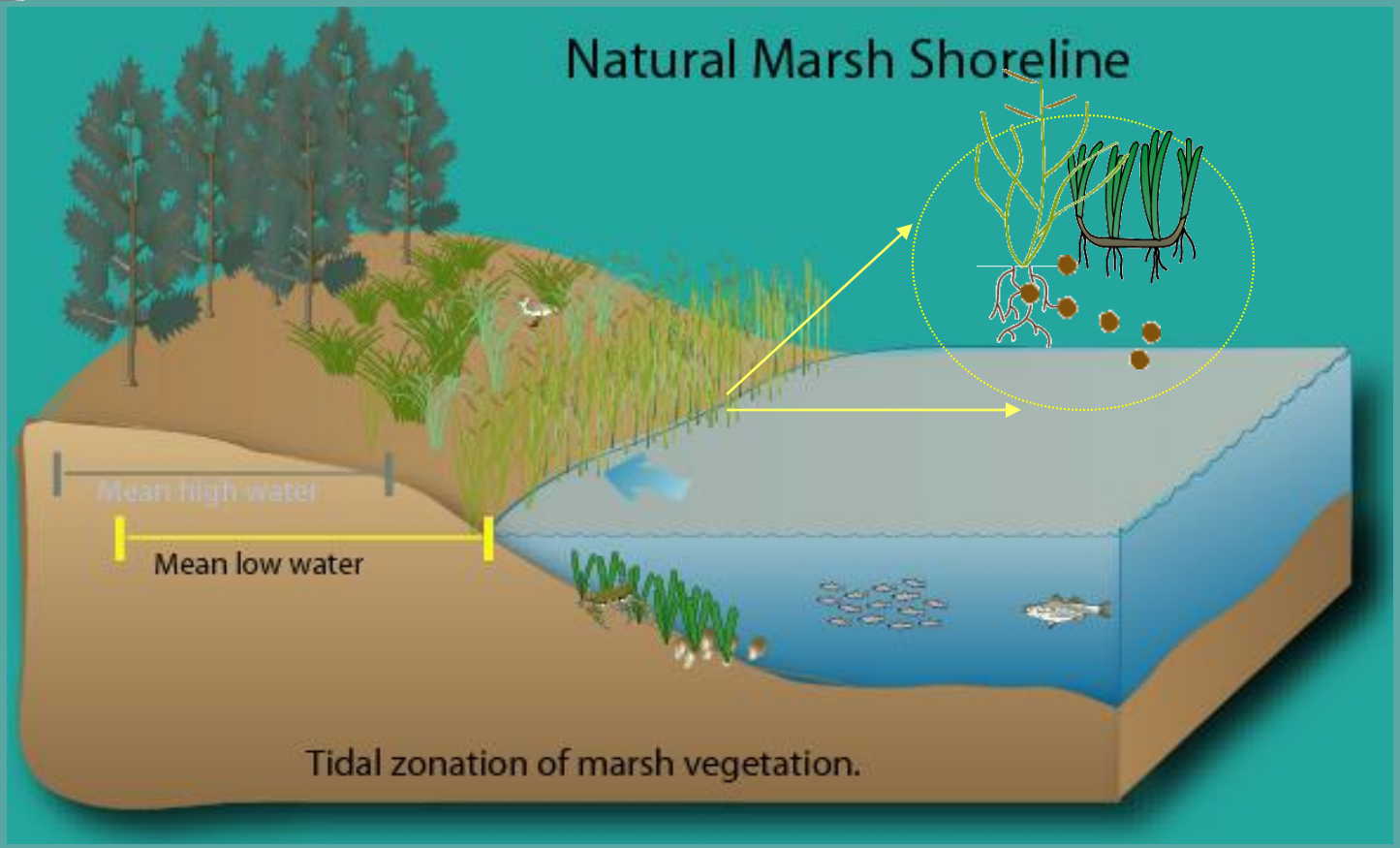
Sea Level Rise



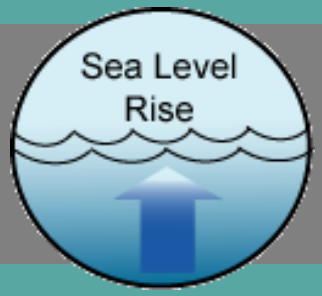
Shoreline and near shore vegetation, along with bank slope, baffle wave energy (absorbs & slows down)



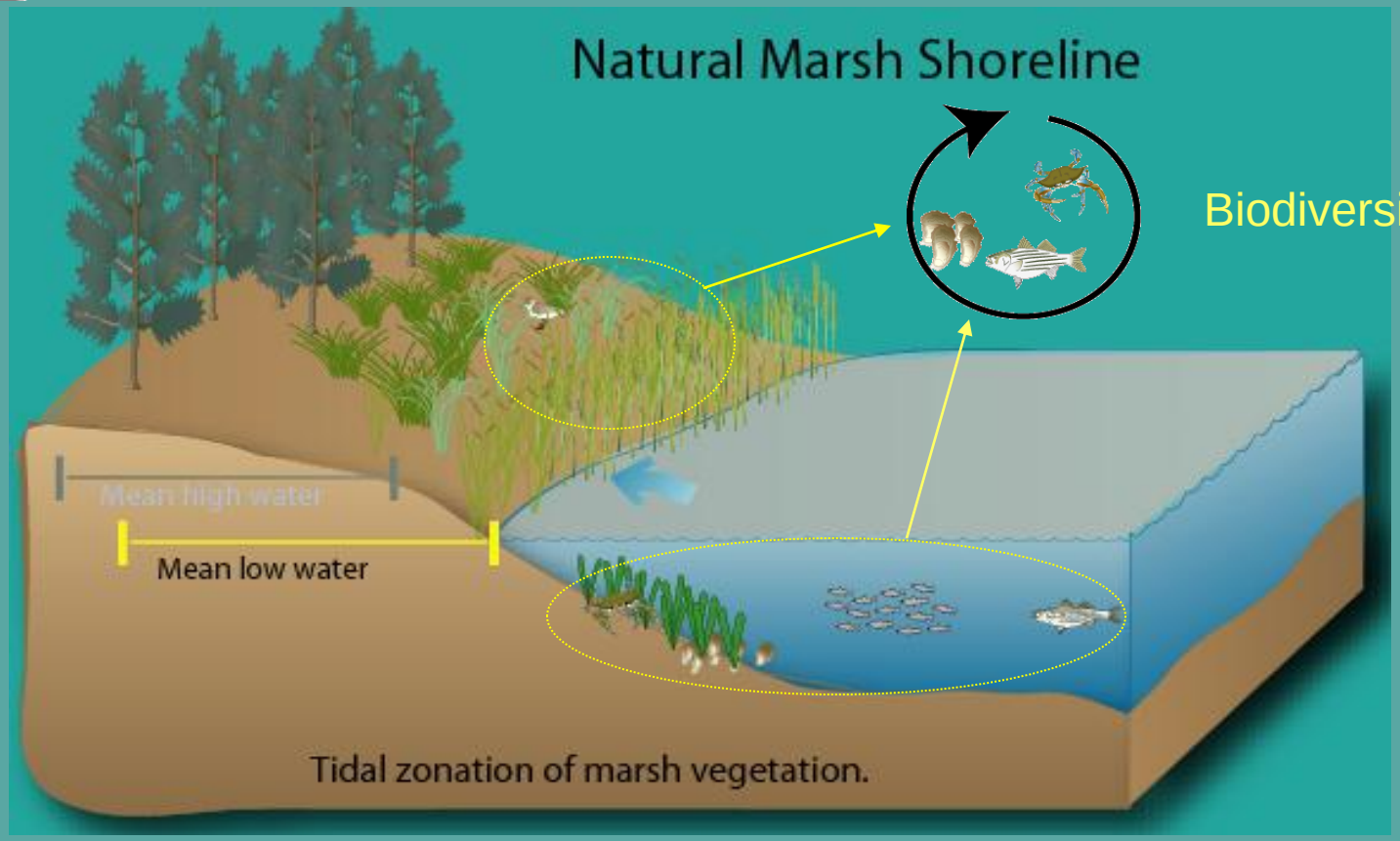
Sea Level Rise



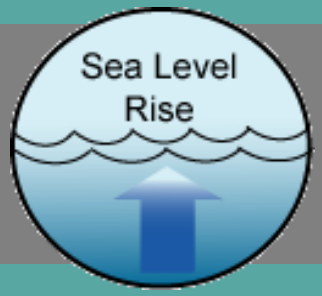
Marsh and wetland vegetation provide an important function by trapping sediment and depositing plant debris , forming a fiberous, organic substrate called “peat.” This organic, moist soil indicates it is a wetland or marsh and is classified as a hydric soil.



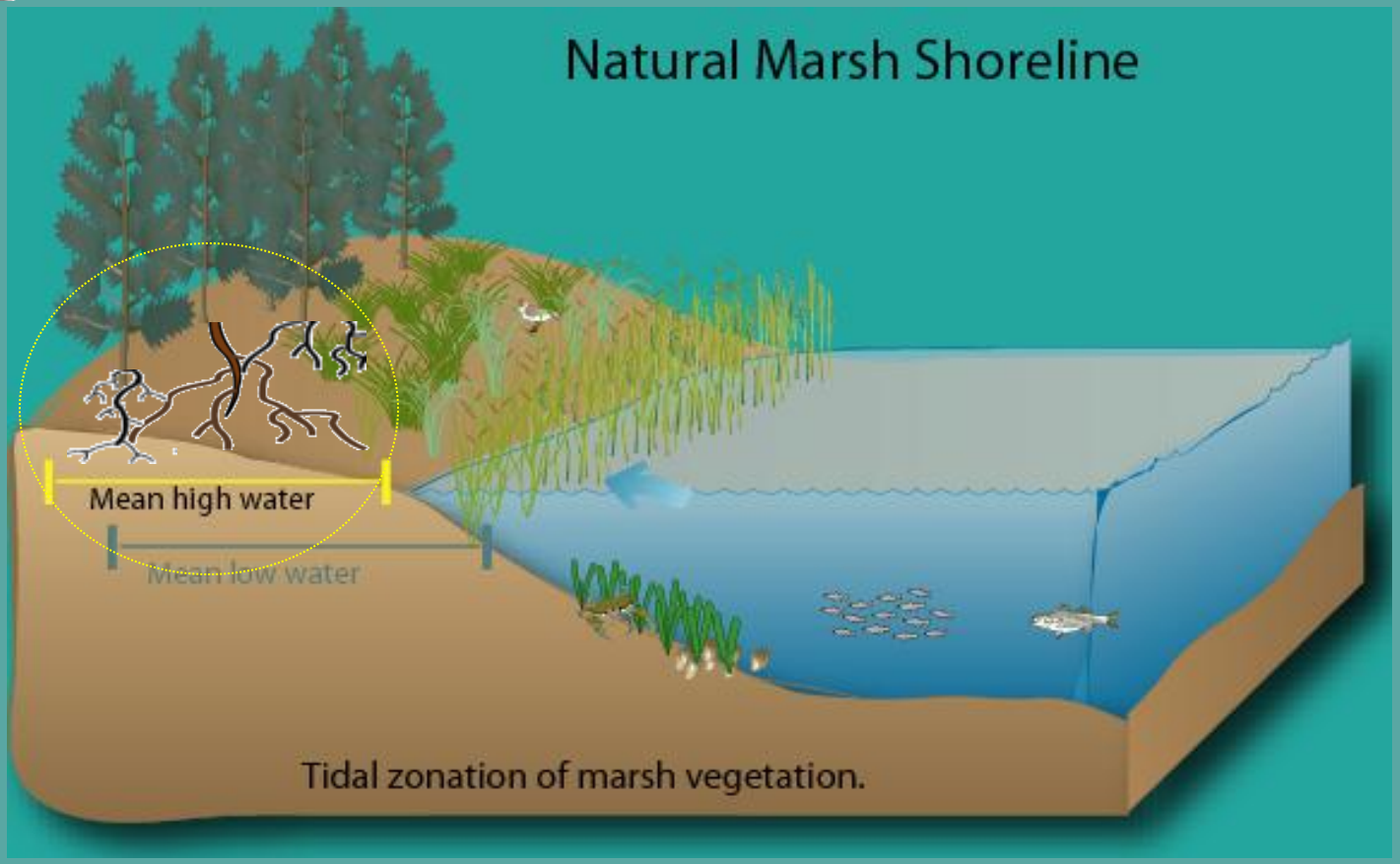
Sea Level Rise



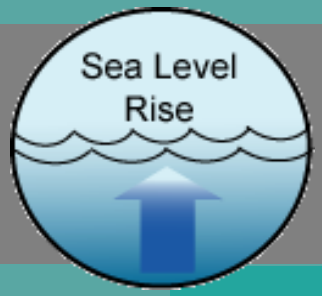
….resulting in good biodiversity  .



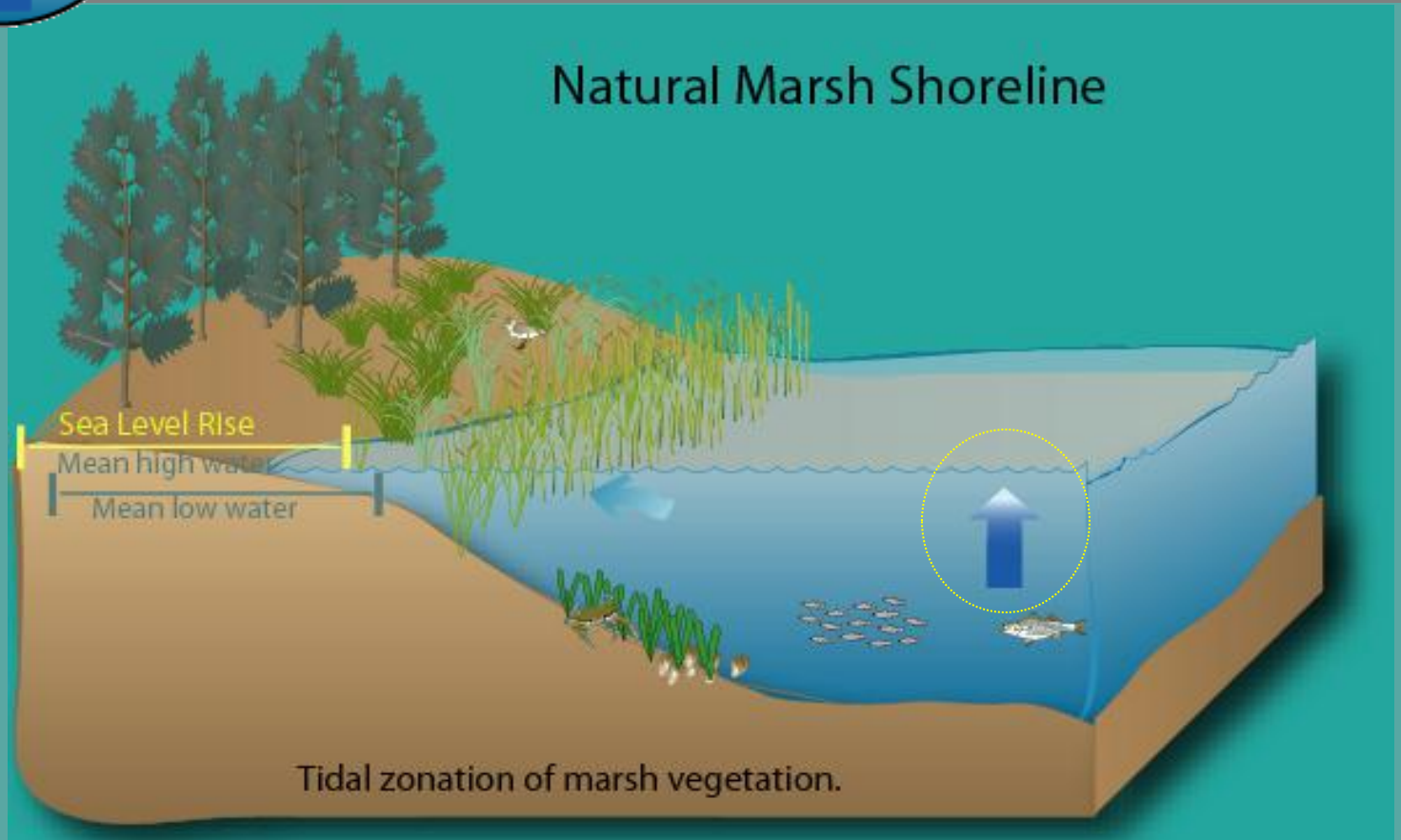
Sea Level Rise



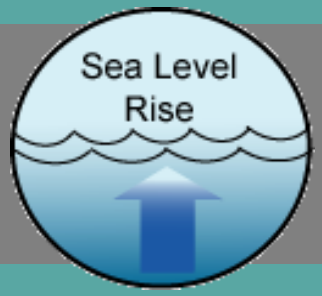
This image highlights the mean high water line at high tide. Tree  roots help stabilize shore banks and filter storm runoff.



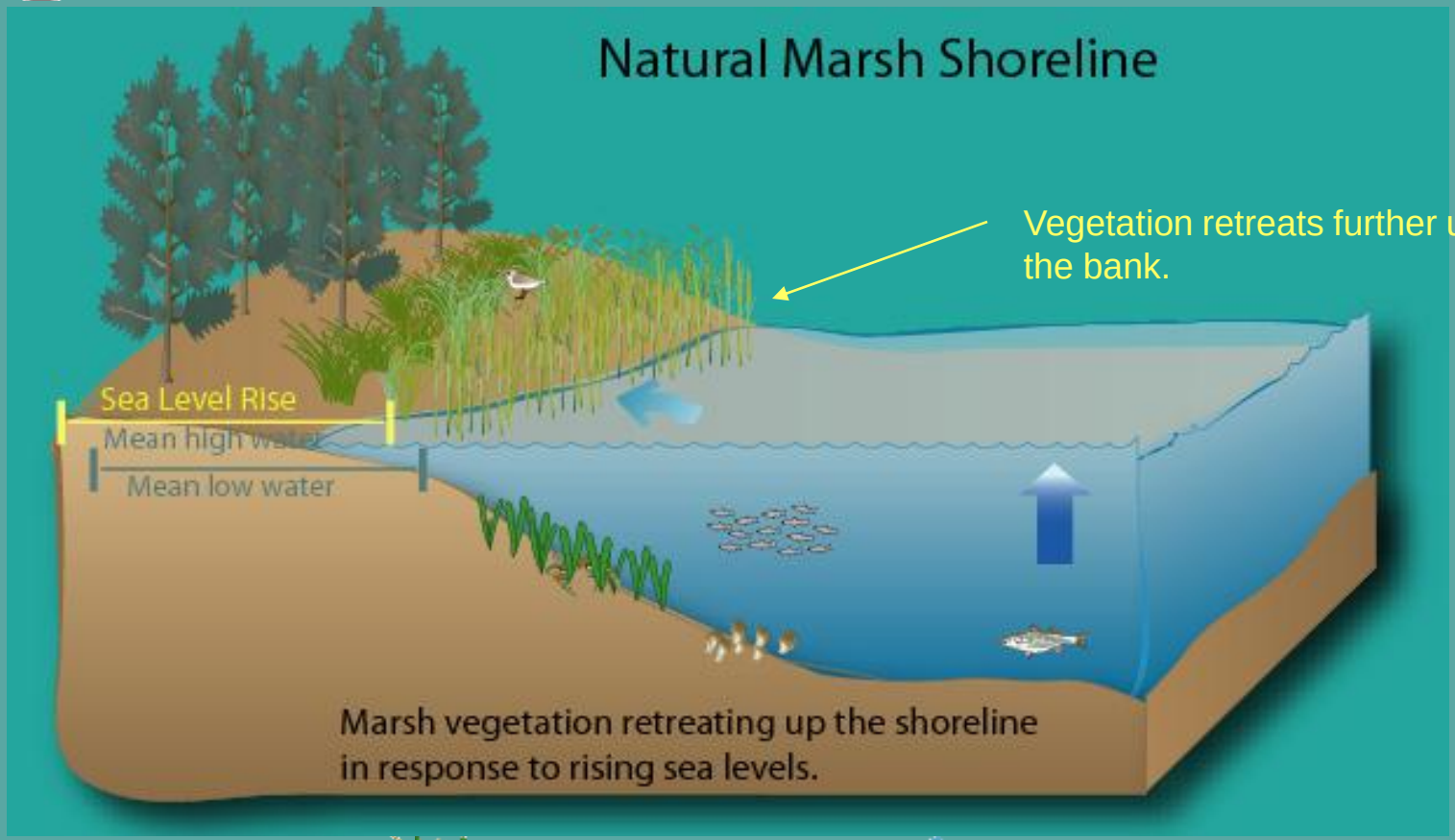
Sea Level Rise



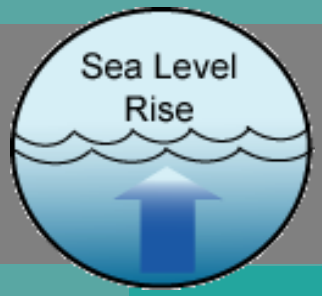
This diagram illustrates how the marsh can respond to rising sea levels ⬆ If sea level rise is gradual, marsh plants continue to trap sediment and plant debris, building up the peat and also the shoreline. As the upland becomes wetter and wetter, vegetation can begin to inhabit these areas and retreat up the bank…



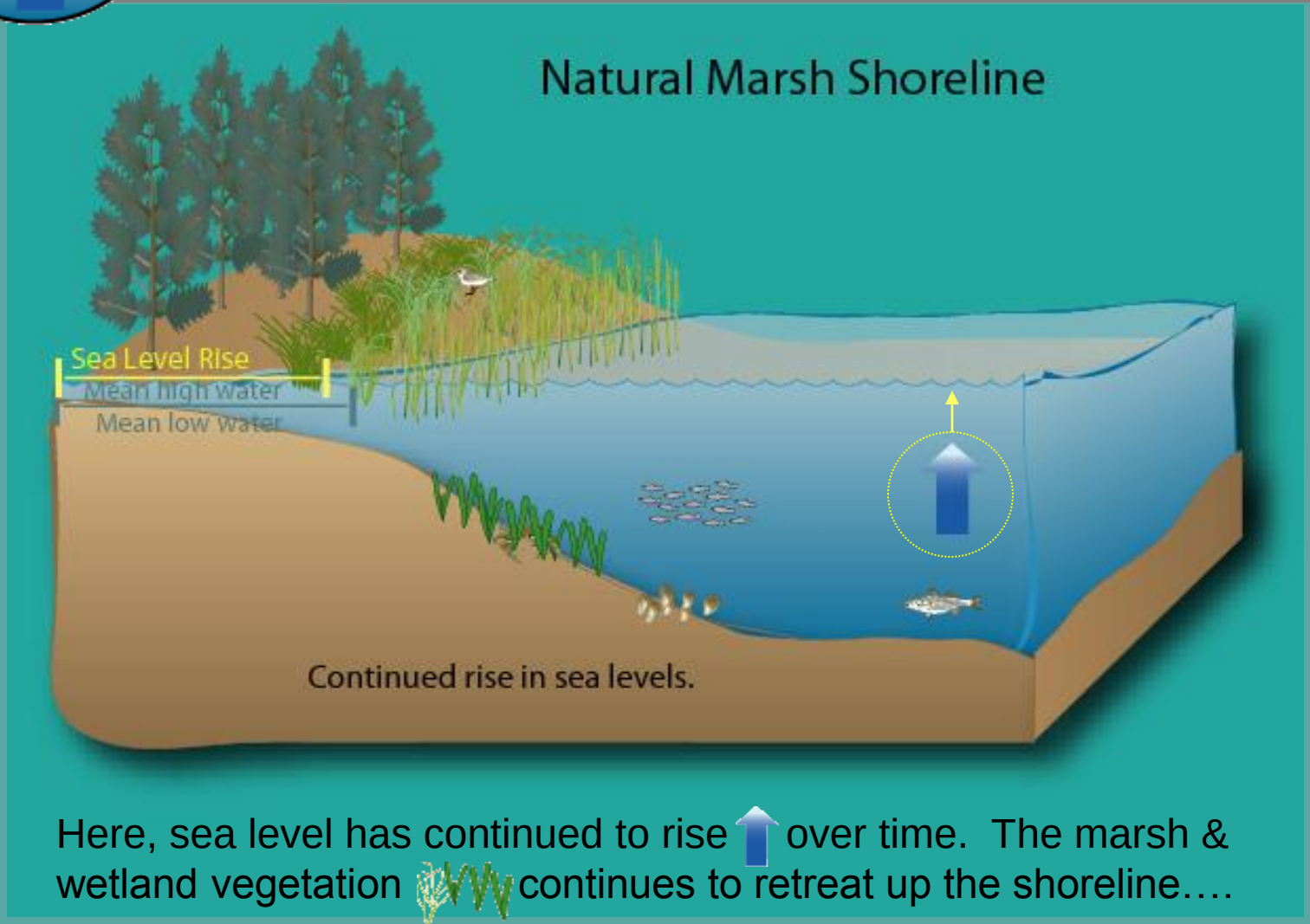
Sea Level Rise



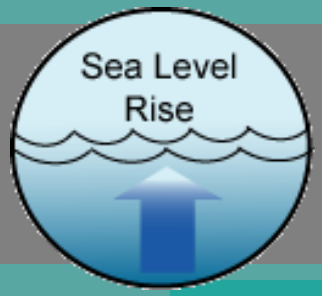
Marsh vegetation continues to baffle incoming wave energy and provide habitat for diverse species



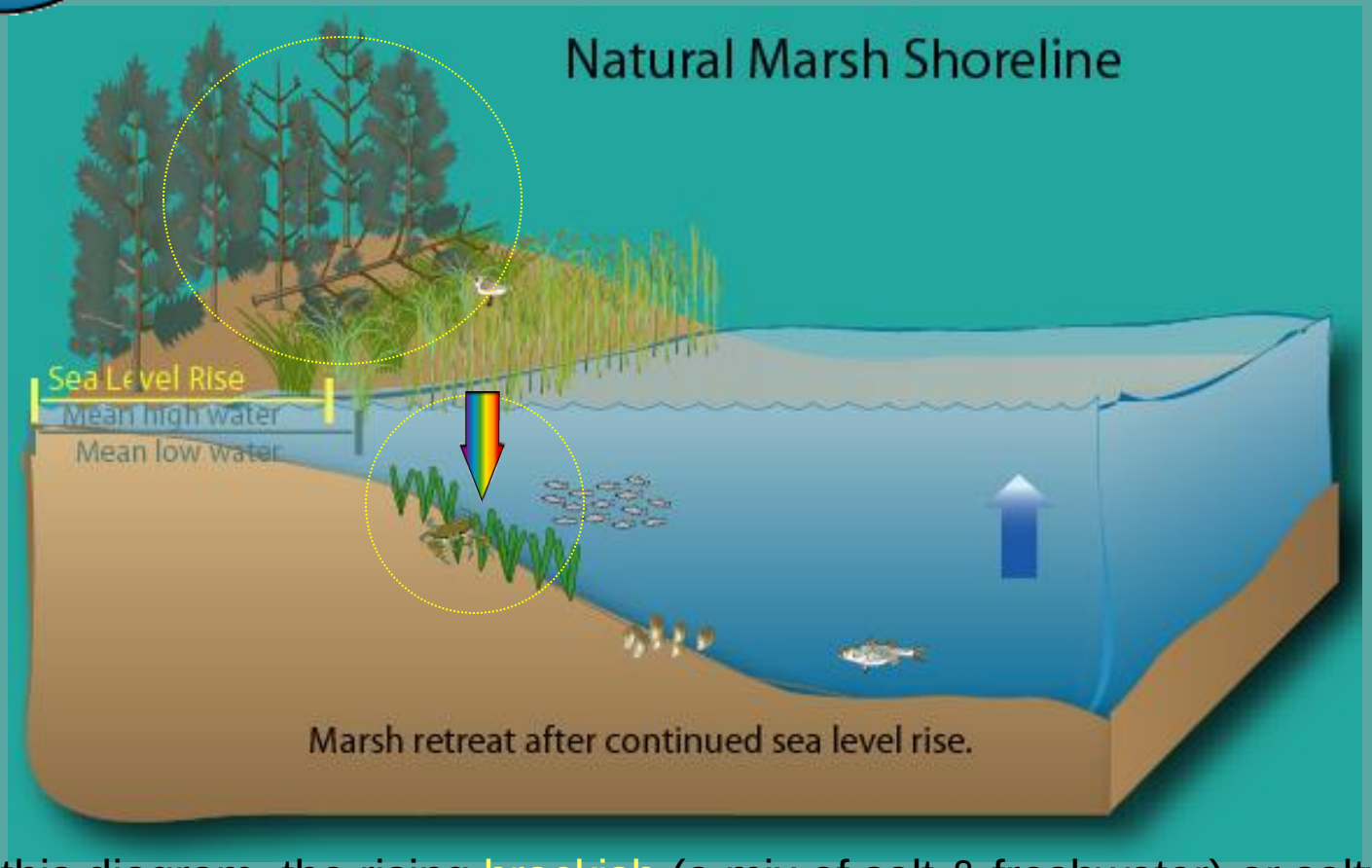
Sea Level Rise



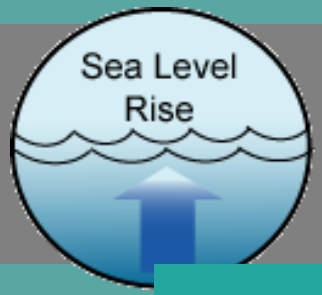
Here, sea level has continued to rise over time. The marsh & wetland vegetation continues to retreat up the shoreline….



Sea Level Rise

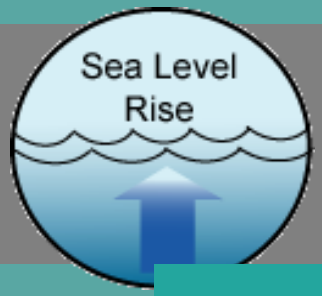


In this diagram, the rising brackish (a mix of salt & freshwater) or salty rising sea waters have begun to inundate the soil, causing some trees to die off . Notice that the submerged aquatic vegetation SAV's) retreat shoreward as well, to grow in a zone that sunlight can penetrate



Sea Level Rise

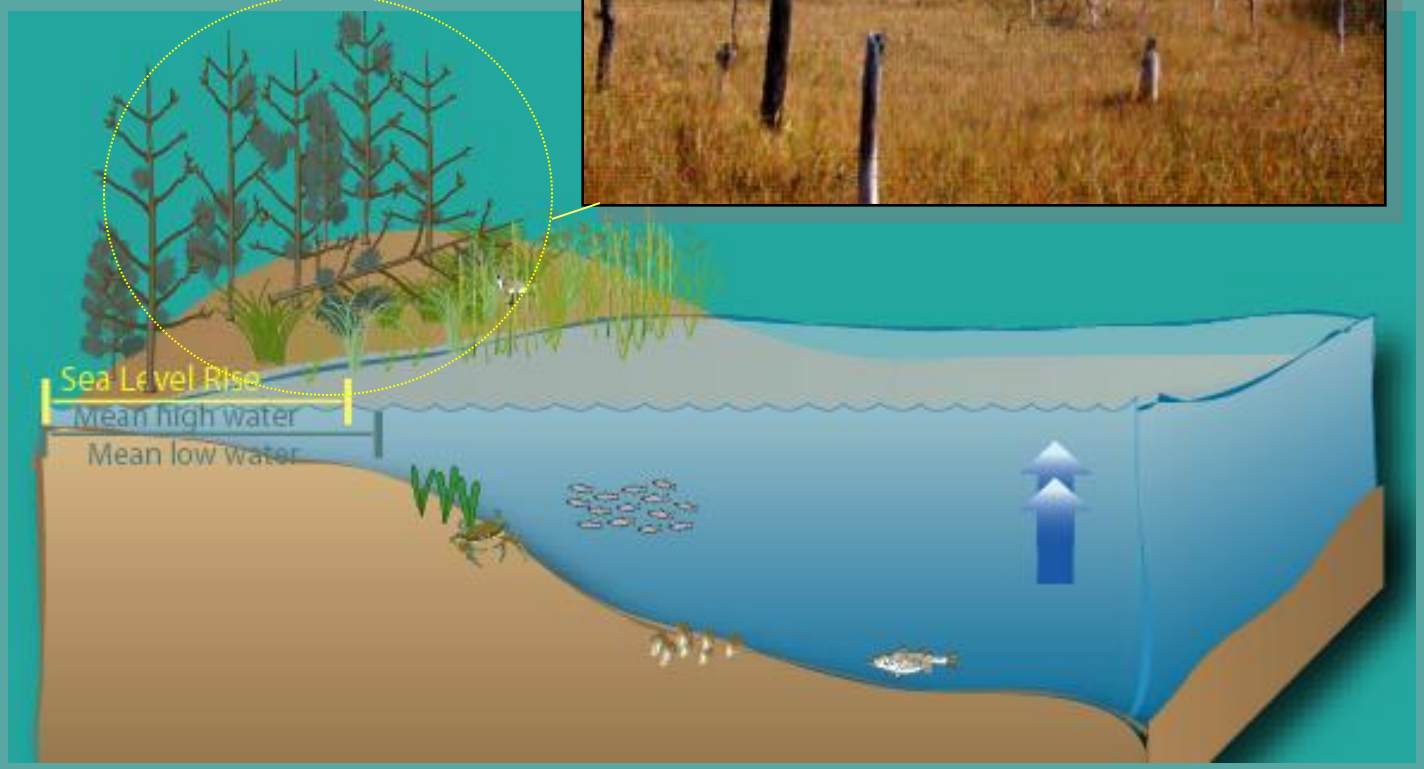
This example shows sea level inundation rising rapidly and salt water intrusion causes more trees to die off and the marsh vegetation is not keeping pace rising sea levels…



Sea Level Rise

Marsh vegetation is decreased and the shoreline starts to erode and the near shore area deepens causing sediments to remain suspended in the water column, increasing turbidity (cloudiness) and sunlight cannot penetrate. Thus, SAV's may not be able to continue to inhabit this area.

Sea Level Rise Impacts at Blackwater National Wildlife Refuge



Tree die-off at the Blackwater National Wildlife Refuge due to saltwater intrusion. This photo is an example of a swamp (forested wetland) transitioning into a tidal marsh (grass dominated). This picture shows the nature response of wetlands to rising sea level.

Sea Level Rise Impacts at Blackwater National Wildlife Refuge

The Blackwater National Wildlife Refuge on the Eastern Shore of the Chesapeake Bay occupies an area less than 1 meter above sea level. Since 1938, approximately 8,000 acres of marsh have been lost in the Refuge. This loss is due to both natural (sea level rise) and human related (burning off wetlands decrease peat levels, nutria introduction, etc) impacts The Refuge has been featured prominently in studies of the impact of sea level rise on coastal wetlands. Most notably, the refuge has been sited by the Intergovernmental Panel on Climate Change (IPCC) as a key example of "wetland loss".

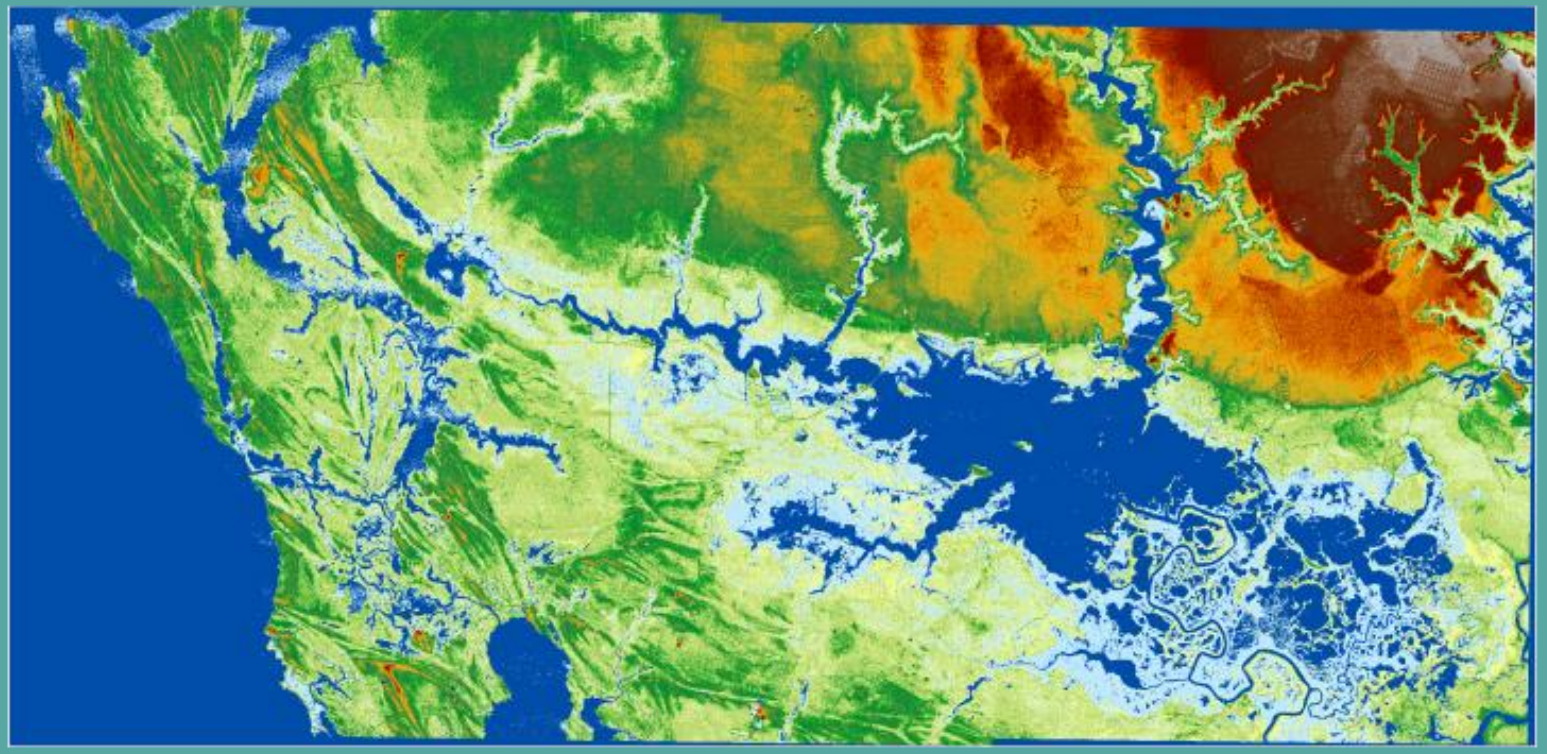
Photo courtesy of USGS.

Sea Level Rise Impacts at Blackwater National Wildlife Refuge

High Marsh

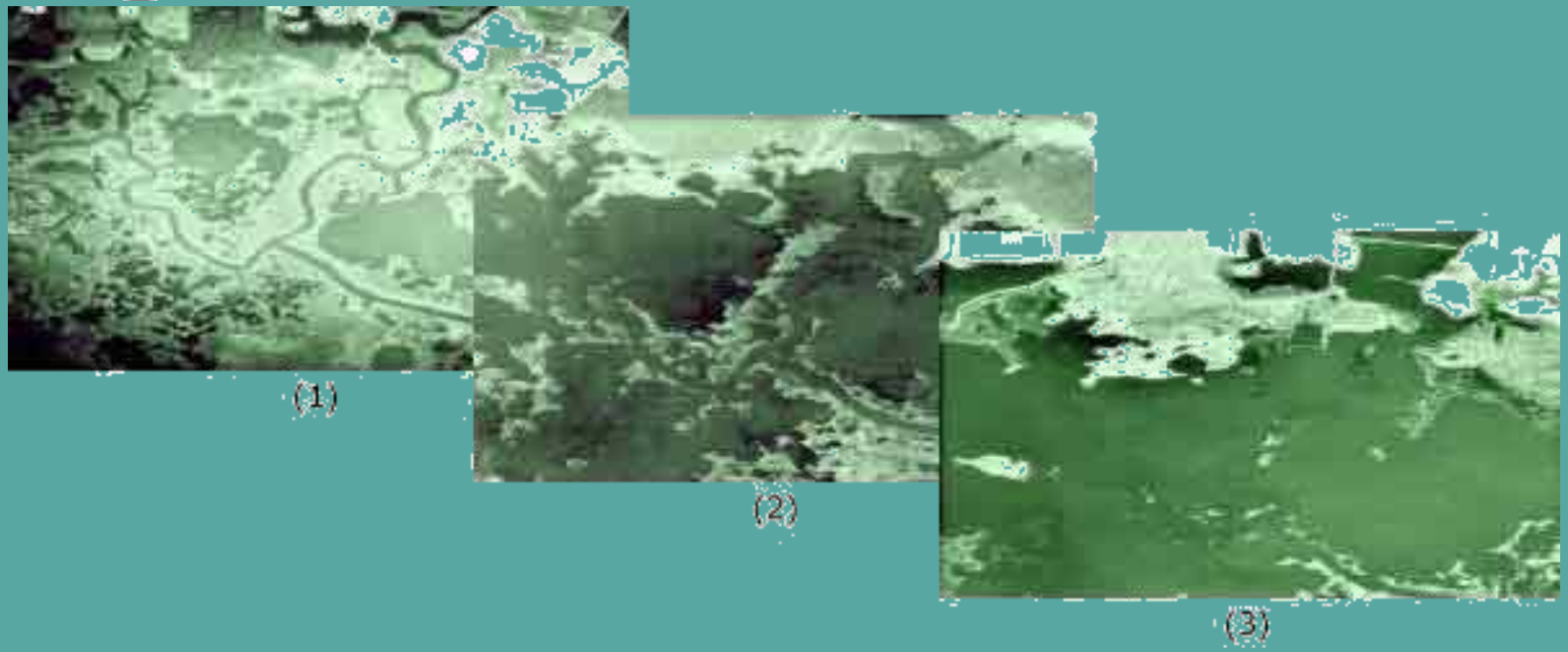
Intertidal/ Low Marsh

Open Water



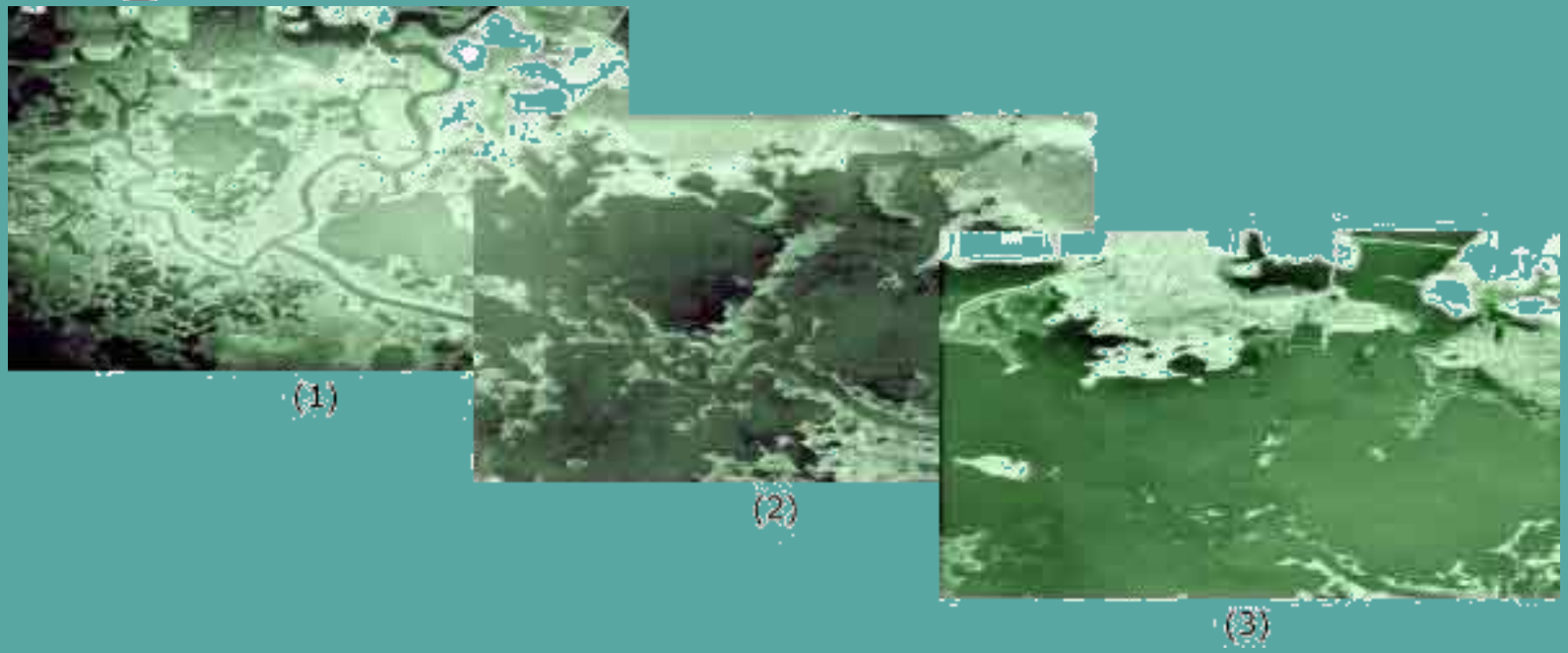
This map is a digital elevation model (DEM) created from LIDAR (Light Detection & Ranging). LIDAR is a technique of flying over head and using a laser to map the topography of the land. The data for Maryland is within approximately 15 cm accuracy. This image of the Blackwater National Wildlife Refuge was taken on March 25, 2002. This detailed DEM shows the area of the Blackwater NWR is particularly low lying.

Sea Level Rise Impacts at Blackwater National Wildlife Refuge



These historical aerial photos of the Blackwater NWR show steady loss of marsh over time. Photo (1), taken in 1938, shows ponds & channels within the marsh system. Photo (2), taken in 1974, shows evidence of significant open water expansion; ponds are breached & integrity of channels is compromised. Photo (3), taken in 1989, shows the expansion of open water; discrete features have disappeared.

Sea Level Rise Impacts at Blackwater National Wildlife Refuge



Approximately 130 acres of marsh are inundated each year at Blackwater National Wildlife Refuge. Rates of sea-level rise along the Atlantic and Gulf coasts of the United States may exceed the ability of the wetland ecosystems to adjust to increasing water depth and salinity.