Not surprisingly, humans can have significant impacts on the chemical cycling of tidal wetlands, including the salt marsh. Activities on land – clearing, erosion and subsequent sedimentation, and the introduction of pollutants – can alter salt marsh productivity by altering chemical balances. Tide gates and dikes affect how and when freshwater reaches the salt marsh and can also alter the nutrient balance of the downstream salt marsh.

Knowing more about how the salt marsh works – even those parts that you can't see, can help coastal communities appreciate and protect this vital natural resource. Salt marshes support a myriad of life – and life forms, including the invisible but essential bacteria.

Increasingly, tide gates are being replaced in favor of salt marsh restoration

Center for Coastal and Watershed Systems, Yale School of Forestry and Environmental Studies

Connecticut Sea Grant

TIDEWATER INSTITUTE

OUR PRODUCTIVE SALT MARSHES

INVISIBLE ENGINES of the SALT MARSH

Photo: Judy Preston

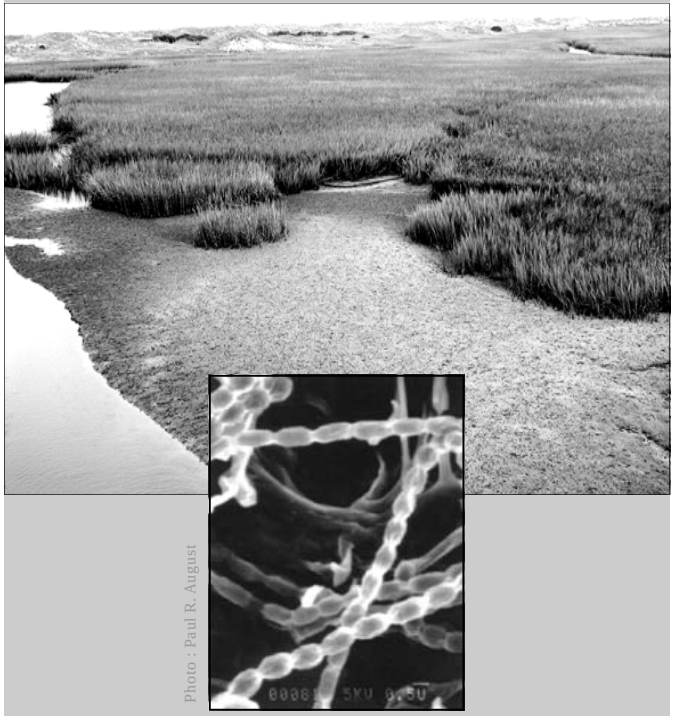

Photo : Paul R. August

The Essential Bacteria

What makes tidal wetlands so valuable, and among the most productive ecosystems on the planet?

Photo: Judy Preston

The answer is complex, but at least one of the wonders of a healthy salt marsh is its ability to produce abundant vegetation, which in turn fuels multiple life cycles throughout the salt marsh ecosystem, and beyond. While plants are the major source of organic matter – and food – in the marsh, few other organisms can eat it as is. The process of converting dead plant material into "food" or energy for other organisms is the invisible engine of marsh productivity.

This is accomplished through complex chemical processes with the help of invisible organisms – billions of them. Bacteria are the real workhorses of the productive marsh ecosystem, especially those working below ground -- without sun, underwater, and in most cases, even without air. These are tough working conditions!

If you think about it, the green plants that make up our familiar tidal wetlands occupy just the surface of the marsh. You need only observe tidal creeks at low tide to see how much of the marsh is made up of that dark, wet "soil" below. Closer observation reveals the make up of this soil to be full of broken up plant material, or peat. It is also pretty saturated with water, even at low tide, which means all but a thin layer at the marsh's surface is absent of oxygen, or anoxic.

Redox stands for oxidation-reduction; one cannot happen without the other. This process refers to the chemical exchange of electrons, or energy, between one element and another in the soil, and results in a number of chemical reactions. This process is initiated when soil bacteria eat the organic matter that originated as our familiar above ground salt marsh plants.

Redox reactions are more familiarly known through such everyday processes as the tarnishing of silver (corrosion), and the series of reactions that occur when iron or steel rusts. Oxidation-reduction reactions are the most important reactions in saturated soils, like those found in the salt marsh. Redox reactions are responsible for turning sulfur, contained in seawater, into sulfide in marsh soils where there is no oxygen. This produces that familiar rotten egg smell of the marsh. In this case, sulfur-reducing bacteria in the soil water use sulfur as an energy source and chemically change sulfates to produce Hydrogen Sulfide (H2S).

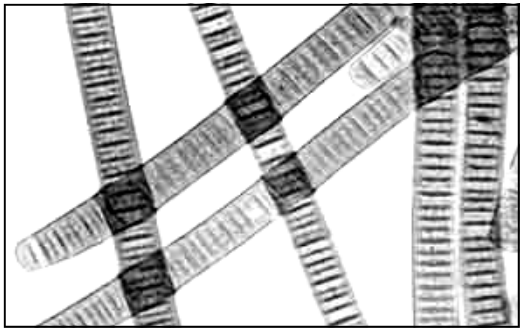

Photo: NASA

Specialized bacteria work in the saturated soils of salt marshes and carry out chemical reactions in these soils that are called redox reactions.

Redox reactions are responsible for many other chemical processes occurring in salt marsh soils -- both in the presence, and absence of oxygen -- and in conjunction with the billions of bacteria that also live there. Bacteria are the most abundant and diverse organisms on earth, performing a multitude of functions, many in extreme environments. If you stir up some salt marsh mud and smell sulfur in the air, you may be able to see bacteria – thin layers of green, purple or deep black.

The cycling of nutrients in wetlands is different than in forests or in the ocean. More nutrients are tied up in sediments and peat in wetlands, and there are seasonal variations in the amount of nutrients that a wetland holds onto, or releases to the benefit of other ecosystems (such as the near shore ocean). And wetlands are frequently linked to upstream or upland ecosystems through complex chemical processes and exchanges, making an estuary's watershed an important part of a tidal wetland's health.

Photo: Bob Perron

An estuary's watershed an important part of a tidal wetland's health.