OREGON MARINE SCIENTIST AND EDUCATOR ALLIANCE

Seagrass Ecology Reading

What factors are causing the decline of seagrasses? How will a decrease in the number of seagrass shoots affect the ecosystem? Can anything be done to stop the decline? These are just some of the questions that guide the research of Dr. Fiona Tomas Nash and Dr. Ryan Mueller. These scientists at Oregon State University's Hatfield Marine Science Center are trying to determine the health of seagrass beds in Oregon. This article provides some background information for you to understand why Drs. Nash & Mueller chose to research seagrasses. In future activities, you will gather data using the same techniques they use and analyze data they gathered in the field.

Seagrass Biology

Seagrasses are unique flowering plants that have evolved to live in sea water. Seagrasses belong to a group of plants known as angiosperms (flowering plants).

Like terrestrial (land living) plants, a seagrass can be divided into its veins, stem, roots, and reproductive parts such as flowers and fruits. Algae do not have veins in their leaves nor do they possess roots or produce flowers or seeds.

They are called "seagrass" because most have ribbon-like, grassy leaves. There are many different kinds of seagrasses and some do not look like grass at all. Seagrass species range from the size of your fingernail to plants with leaves as long as 7 meters. The shapes and sizes of leaves of different species of seagrass include an oval shape, a fern shape, a long spaghetti like leaf and a ribbon shape. Species that have a paddle or fern shaped leaf are called *Halophila*. Ones that have a ribbon shaped leaf are the *Cymodocea*, *Thalassia*, *Thalassodendron*, *Halodule* and *Zostera*. Spaghetti-like seagrass is called *Syringodium*. At the base of a leaf is a sheath, which protects young leaves. At the other end of a leaf is the tip, which can be rounded or pointed. A prophyllum is a single leaf arising immediately from the horizontal rhizome instead of from an erect shoot. This feature is unique to the genus *Zostera*.

Seagrass leaves lack stomata (microscopic pores on the underside of leaves) but have a thin cuticle to allow gas and nutrient exchange. They also possess large thin-walled aerenchyma. The aerenchyma are commonly referred to as veins as they carry water and nutrients throughout the plant. Aerenchyma is a specialized tissue having a regular arrangement of air spaces, called lacunae, that both provides buoyancy to the leaves and facilitate gas exchange throughout the plant. Leaves have a very thin cuticle, which allows gas and some nutrient diffusion into them from the surrounding water. Veins can be across the leaf blade or run parallel to the leaf edge. Also within the leaves are chloroplasts, which use the sun's light to convert carbon dioxide and water into oxygen and sugar (photosynthesis). The sugar and oxygen are then available for use by other living organisms.

The roots and horizontal stems (rhizomes) of seagrass are often buried in sand or mud. They anchor the plant, store carbohydrates and absorb nutrients. Roots can be simple or branching and all have fine hairs to help absorb nutrients. Rhizomes are formed in segments with leaves or vertical stems rising from the joins, called nodes or scars. Sections between the nodes are called internodes. They can sprout new stems from the rhizome at each node. Thus, seagrasses depend upon the growth of rhizomes to increase the area they occupy. This vegetative growth is the most common mode of growth for seagrasses.

Although the rhizome mainly runs horizontally, some lateral branches are more or less erect and bear leaves (erect shoots). Sometimes the leaves are on a special type of stalk, called a petiole.

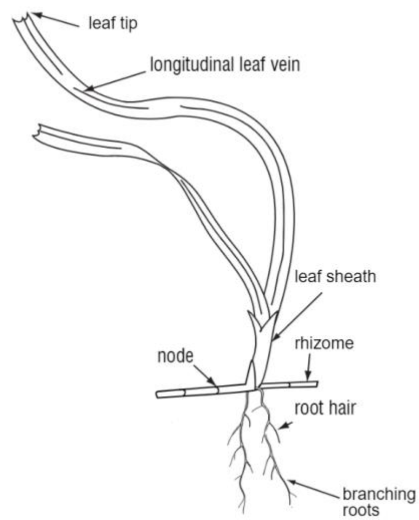


Figure 1: Seagrass Anatomy

Seagrass Ecology

Seagrass communities are one of the most productive and dynamic ecosystems globally. Seagrasses may significantly influence the physical, chemical and biological environments in which they grow by acting as ‘ecological engineers’. They provide habitats and nursery grounds for many marine animals and act as substrate stabilisers.

Seagrass meadows are highly productive. They have been documented to create habitat complexity compared with unvegetated areas, providing up to 27 times more habitable substrate, as well as providing refuge and food for a range of animals. About 40 times more animals occur in seagrass meadows than on bare sand.

Seagrass meadows are important intertidal habitats that contribute organic matter to the estuarine food web. Decomposing seagrasses provide food for benthic (bottom- dwelling) aquatic life. The decaying leaves are broken down by fungi and bacteria which in turn provide food for other microorganisms such as flagellates and plankton. Microorganisms provide food for the juveniles of many species of marine animals such as fish, crabs, prawns and molluscs. They also serve many important ecological functions such as sediment stabilization, nutrient processing, trapping of detritus, and provision of important habitat for many species of estuarine animals (especially for juvenile salmon and Dungeness crab) that are commercially, recreationally and ecologically valuable. Due to the vital niche that eelgrass meadows fill in estuarine systems, the health of these communities is widely considered to be indicative of the overall health of an estuary.

The rhizomes and roots of the grasses bind sediments on the substrate, where nutrients are recycled by microorganisms back into the marine ecosystem. The leaves of the grasses slow water flow, allowing suspended material to settle on the bottom. This increases the amount of light reaching the seagrass meadow and creates a calm habitat for many species.

Seagrasses are nutrient sinks, buffering or filtering nutrient and chemical inputs to the marine environment. Seagrasses uptake nitrogen and phosphorus from coastal run-off that, in overabundance, can lead to algal blooms that can impair water quality.

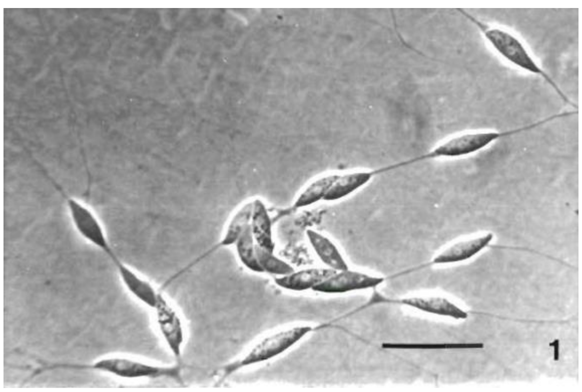
Figure 2: Eelgrass meadows form canopies that provide habitat complexity for many estuarine animals. A sockeye salmon uses eelgrass as cover in a nearshore habitat in British Columbia's Flora Bank. Photo: indiegogo.com

Threats To Seagrasses

Seagrasses are vulnerable to physical disturbances, such as wind-driven waves and storms. However, the direct and indirect effects of human activities account for most losses of seagrass beds in recent decades. Some fast growing seagrass meadows are able to rebound from disturbances, but many grow slowly over the course of centuries and are likely to be slow to recover and are thus most vulnerable.

Nutrients, such as those from fertilizers and pollution, wash off the land and into the water, causing algal blooms that block sunlight necessary for seagrass growth. Sediment washing into the water from agriculture and land development can also damage seagrass beds by both smothering the seagrass and blocking sunlight. Similarly, dredging can both directly remove seagrass plants and cause lower light levels because of increased amounts of sediments in the water. Boat anchors and propellers can leave "scars" in a seagrass bed—killing sections of the seagrass and fragmenting the habitat. This fragmentation of seagrass beds can increase erosion around the edges, as well as influence animal use and movement within the seagrass bed.

Disease has also devastated seagrasses. In the early 1930s, a large die-off of up to 90 percent of all eelgrass (*Zostera marina*) growing in temperate North America was attributed to a "wasting disease". This die-off was so severe that a small snail specialized to live on eelgrass went extinct as a result. The disease was caused by the slime mold-like protist, *Labyrinthula zosterae*, which also ravaged eelgrass populations in Europe. This disease still affects eelgrass populations in the Atlantic and has contributed to some recent losses, though none as catastrophic as in the 1930s. Eelgrass leaves that are weak or stressed are more susceptible to the disease, developing brown spots and lesions that reduce the plant's ability to photosynthesize, eventually killing the plant. Healthy plants are thought to be resistant to the disease, indicating the importance of reducing other stressors like pollution. Lower seawater salinity may also increase susceptibility to the *Labyrinthula* pathogen.



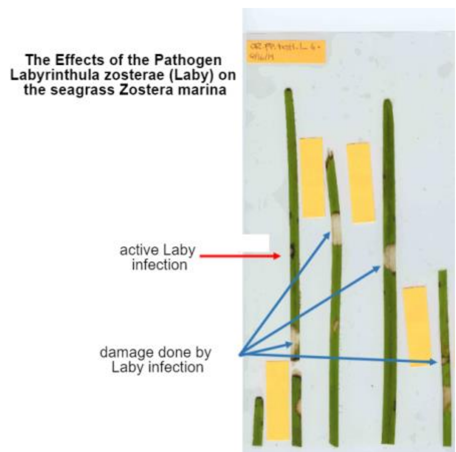


Figure 3: Left- *Labyrinthula zosterae* (aka Laby) cells (bar 25 μm), the pathogen that causes seagrass wasting disease. Photo credit: Muehlstein (1989) Right- Damage done to eelgrass by the Laby pathogen.

Episodes of warm seawater temperatures can also damage seagrasses. Temperature affects how enzymes and metabolism work, influencing how organisms grow. Increased temperature also increases seagrass light requirements, influences how quickly seagrasses can take up nutrients in their environment, and can make seagrasses more susceptible to disease. Large eelgrass declines have been observed in the Chesapeake Bay in years in which water temperatures have persisted for several days above 30°C (86°F), the thermal limit for this species.

Removal of fish can also lead to seagrass death by disrupting important components of the food web. When large predators are removed, intermediate predators can become more abundant, and they in turn cause the decline of the smaller organisms that keep the blades of the seagrasses clean. This has been observed most strikingly in the Baltic sea with the disappearance of cod due to overfishing and corresponding increases in smaller fishes and crustaceans which limited epiphyte-grazing invertebrates, resulting in seagrass decline.

Drs. Tomas Nash and Mueller Research

Drs. Fiona Tomas Nash and Ryan Mueller sampled two sites in Yaquina Bay near Newport. They collected data on eelgrass shoot density, wasting disease presence, and the severity of the wasting disease. They are hoping the data will reveal how healthy the seagrass beds are, and how far in the bay the wasting disease has spread.

Sources:

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