Johnson's Seagrass:
the Rodney Dangerfield of Seagrasses
(gets no respect, survives harsh conditions, little or no known sex)

by Michael Durako and Fritz Wettstein

Come along as we reveal mysteries of the *Halophila* seagrasses and unravel the intrigue of *Halophila johnsonii*, Johnson's seagrass.

Johnson's seagrass, *Halophila johnsonii*, is a small, rare seagrass that is known to occur only in lagoons along the southeast coast of Florida. The National Marine Fisheries Service (NMFS) recently proposed that Johnson's seagrass be listed as a threatened species under the En-dangered Species Act. The NMFS also proposed that lagoon areas near five southeast Florida inlets be designated as critical habitat for it. The designation of critical habitat areas will focus management efforts on protecting sites that are deemed critical to the survival of this species. These proposals have raised concerns over potential future conflicts between the actions needed to ensure this seagrass's protection and activities associated with inlet maintenance and port development. Based on what is known about the abundance and distribution of Johnson's seagrass, the situation is analogous to having a small number of *only female* pandas left on earth. If Johnson's seagrass were an animal, it would unquestionably be considered endangered.

In addition to its rarity, the survival of the plant is threatened by an ironic twist of fate. This species is most abundant in the hazardous environments of developed ocean inlets. Because the seagrass has no known seed production, storms or channel dredging can eliminate significant populations. Protection by the Endangered Species Act will help ensure that more can be learned about this mysterious seagrass, and that human impacts, such as channel dredging and reduced water quality, do not threaten it.

What follows is a general description of the genus *Halophila* and some of the unique characteristics of *Halophila johnsonii*, Johnson's seagrass.

General Characteristics of the *Halophila* Seagrasses

Presently, there are twelve recognized seagrass species in the *Halophila* genus (closely related marine plants that are not really grasses). *Halophila* seagrasses grow in warm-temperate and tropical seas, bays, and lagoons worldwide, and are one of five Florida seagrass genera. The species *Halophila decipiens*, or paddle grass, grows in the warm waters of the Atlantic, Indian, and Pacific oceans — making it the only world-ranging member of the genus. In addition to being found over a wide area, *Halophila* seagrasses cover the greatest range of water depths in which seagrasses are found. Long documented as growing with other seagrasses in shallow estuaries and on intertidal shoals exposed at low tides, *Halophila* seagrasses have recently been found growing on the ocean floor in waters greater than 100 feet deep.

Halophila seagrasses have several physical traits that differ from other seagrasses. They are best distinguished by a unique connection of the leaves to the rhizome (the lateral root stem). Either a pair, or a star-shaped cluster, of leaves are attached to the rhizome at each node (growing point; see Figure 1). Also, most *Halophila* seagrasses are tiny (less than 4 inches tall), shallow-rooted, and much less bulky than seagrasses such as *Thalassia testudinum* (turtle grass) or *Syringodium filiforme* (manatee grass). Their small stature has led many to believe that they are not important to the marine ecosystems. This is not true. Because scientific studies have historically concentrated on larger seagrasses and their sea meadow communities, mysteries of the *Halophila* genus have only recently begun to be unveiled.

Studies of *Halophila* seagrasses have revealed important contributions to marine ecosystems. Although *Halophila* seagrasses are small, their growth rates, use as food by grazing marine animals, and rate of decomposition are comparatively high. Rapidly growing leaves, rhizomes, and roots are quickly cycled through an ecosystem as food and nutrients. From watching feeding behavior and examining stomach contents of marine animals, scientists know that green

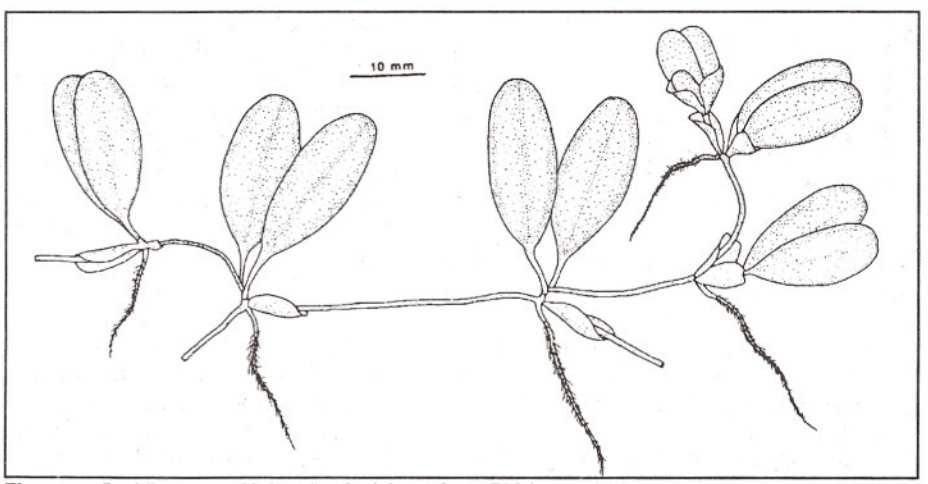

Figure 1. Paddle grass, *Halophila decipiens* (from Phillips and Mensez, 1988).

sea turtles, West Indian manatees, and dugongs feed on these seagrasses. Since they are the only seagrass capable of forming extensive seagrass meadows in deep waters, *Halophila* seagrasses are important contributors to marine ecosystems.

Within the genus, methods of producing new plants vary. Some have male and female flowers on different plants (called dioecious plants, meaning "two houses"); some have male and female flowers on the same plant (called monoecious, meaning "one house"). Both types are capable of producing numerous seeds. One species, *Halophila johnsonii*, or Johnson's seagrass, appears to be sterile or capable only of producing unpollinated seeds, which may become clones identical to the female parent. High seed production and lateral growth rates enable most *Halophila* seagrasses to quickly cover and stabilize bottom sediments. Scientists have never observed new *Halophila* plants to grow from root or stem fragments of another plant. This vegetative reproduction is common in other seagrasses.

Pertinent Facts about *Halophila johnsonii*, (Johnson's seagrass)

Johnson's seagrass (see Figure 2) is the least known, and arguably the rarest, seagrass in the world. At this point, scientists do not know how it

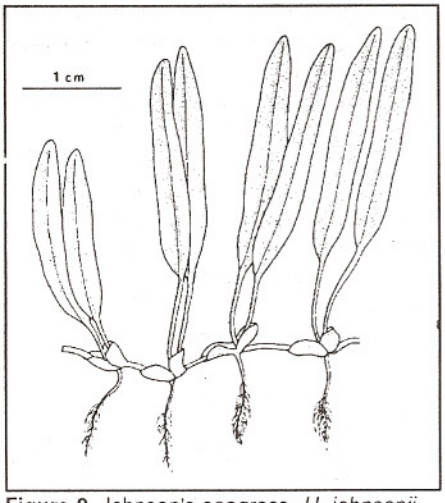

Figure 2. Johnson's seagrass, *H. johnsonii* (from Phillips and Menez, 1988),

reproduces, since they have found only female plants. This mystery — coupled with the fact that Johnson's seagrass grows primarily near inlets where strong currents, moving sand, and human activities appear hostile to a tiny marine plant — does not paint a rosy picture for the future of Johnson's seagrass.

As recently as 1980, a pair of botanists, N. J. Eiseman and C. McMillan, had enough information to describe Johnson's seagrass as a new species. Due to its small size (less than an inch tall), limited range, and similarity to another small seagrass, early seagrass experts either overlooked the tiny seagrass or lumped it in with another small *Halophila*. When first seen in the Indian River lagoon, scientists thought it was a local form of the wide-ranging paddle grass, *H. decipiens*. Later, botanists studying Johnson's seagrass found it to be most closely related to a Pacific *Halophila*, *H. ovalis*, in both physical characteristics and genetics. Now it is known that Johnson's seagrass is one of seven Florida seagrass species, and the only seagrass restricted to Florida's southeastern coast. Table 1 gives a comparison of Johnson's seagrass and paddle grass characteristics.

Comparison of Johnson's seagrass and paddle grass.

Johnson's seagrass (*H. johnsonii*)	Paddle Grass (*H. decipiens*)
leaves linear with smooth edges	leaves more rounded with sawtooth edges
no hairs on leaf surface	minute, prickle hairs on leaf surface
leaf veins make 45-degree angles	leaf veins make 60-degree angles
like *H. ovalis*, probably dioecious flowering (different male and female plants) since only female flowers have been found on plants	monoecious flowering (both male and female flowers occur on the same plant)
tolerates broad ranges of salinity (brackish to seawater) and temperatures	tolerates a narrower range of seawater salinity and temperature
narrow home range in southeastern Florida	wide pantropical range
grows in shallow waters in intense sunlight and in deeper channels	grows in waters with diminished sunlight and at depths over 100

Scientists have shown that the physical traits of Johnson's seagrass represent true genetic differences. Leaf shapes and sizes in some plants, such as the sassafras tree, can vary greatly according to environmental conditions (low light = larger, mitten-shaped leaves; intense light and dry conditions = smaller leaves with simpler shapes), making it appear as if there could be two genetically different plants. Growing plants with the different growth forms under the same conditions often reveals that these differences are due to environmental conditions and that the plants are one and the same. Grown under controlled conditions, the small, strap-shaped, smooth leaves of Johnson's seagrass remain true to form, and distinctive from paddle grass. In addition, scientists have found that Johnson's seagrass produces isozymes (proteins directly encoded from genetic material) that are far different from those produced by paddle grass and more closely related to those of *H. ovalis*.

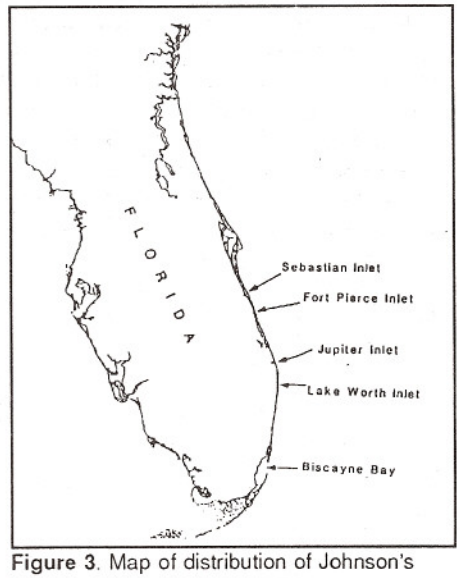

Figure 3. Map of distribution of Johnson's seagrass (from Kenworthy, 1992).

The home range and habitat of Johnson's seagrass contribute greatly to both its mystery and rarity. Because seagrass seeds are usually dispersed by currents, most seagrasses can range far and wide. Johnson's seagrass, however, is restricted to Florida's coastal lagoons from Sebastian Inlet in south Brevard County to Miami's Biscayne Bay (see Figure 3). Within this narrow range it is the least abundant seagrass, with the largest, densest patches growing near Sebastian Inlet. Abundance decreases with distance from inlets and can vary dramatically by season and year.

Compounded with its restricted range, a preference for growing on sandy shoals near inlets gives Johnson's seagrass the most limited distribution of any known seagrass. Scientists believe this could be related to either the plant's limited reproductive strategy or loss of clear water habitat. The limited niche may be related to the small plant's struggle to compete with larger seagrasses and algae for space in the marine environment.

Johnson's seagrass grows where it does not have to compete with other vegetation. It occurs primarily on sandy intertidal shoals that are often exposed at low tide. This suggests that Johnson's seagrass possesses a tolerance for conditions that few seagrasses can withstand: drying out at low tide, intense sunlight, and dramatic temperature changes. It can also gain a toehold in deeper sandy areas where the speed of the current is fast enough to otherwise erode sand on the bottom. Salinity tolerance ranges from full seawater strength to mixed salt/fresh water characteristic of estuaries. Its presence in inlets and on shoals — where sunlight is abundant and tides bring clear seawater into the lagoon — shows either an affinity for clean water or a tolerance for changing conditions. Understanding the mysterious life history of Johnson's seagrass may reveal whether it was once more widely distributed when the east coast Florida lagoons were pristine and clear, or whether it is uniquely adapted to inlet habitats. Not able to compete with taller, longer-lived turtle or manatee grasses, or with faster-growing paddle grass, Johnson's seagrass may have found a niche in the ever-changing habitat opportunities of inlet shoals and channels.

As with its restricted range, the habitat requirements of Johnson's seagrass may be related to little-understood reproductive strategies. The wide tolerance to changing environmental conditions and possible sterility provide evidence that the plant may be the result of a genetic cross between two other species. The lack of known seed production means that the plant can only survive by continuously branching out to cover lagoon bottoms. Thus, if a storm or other catastrophic event damages seagrass beds, Johnson's seagrass may not recover. Paddle grass, with its heavy seed production and faster growth rate, can quickly re-colonize open lagoon bottoms. Large seagrasses with greater energy reserves, such as turtle grass (*Thalassia testudinum*), may better withstand burial by new sediments or long turbulent periods when photosynthesis is reduced. Because it is at a disadvantage growing in seagrass meadows, Johnson's seagrass seems capable of growing only where it has a slight edge — in inlets and channels. In such unstable habitat conditions, the survival of this small, fragile seagrass seems precarious.

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