Should the Florida Seagrass *Halophila johnsonii* be listed as Threatened Under the US ESA?: Science-Based Questions

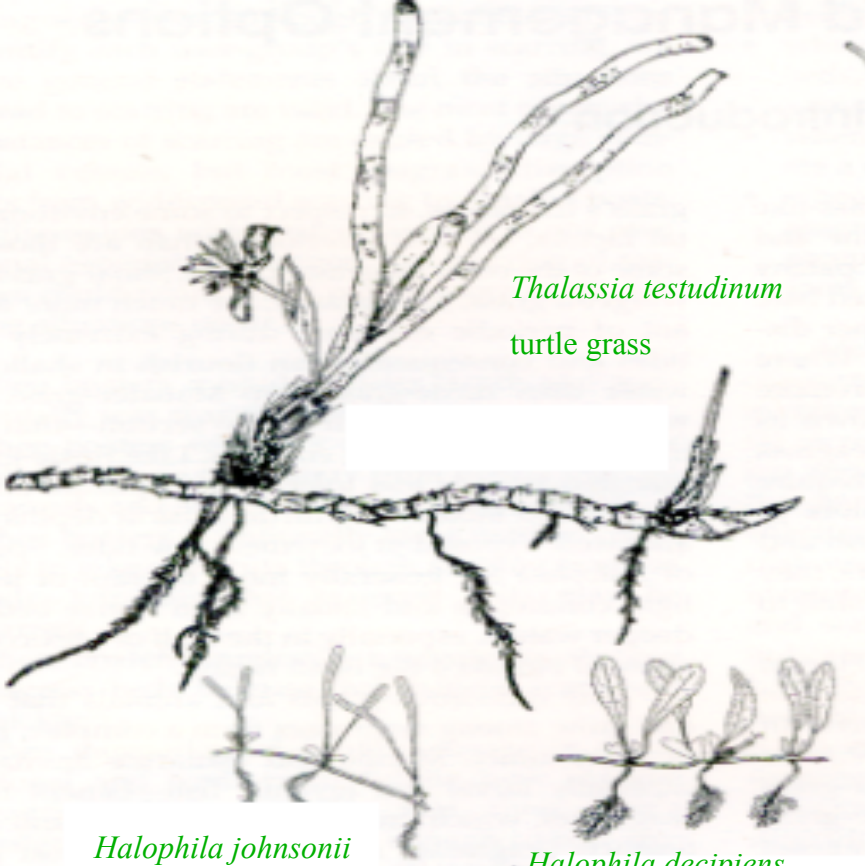
William F. Precht
Dial Cordy & Assoc., Inc.

“Seagrasses”

Are NOT grasses!

What do they have on common with grasses?

They are monocots…
…many species have thin wafty leaves…
…and occur in meadows…
…otherwise not much!



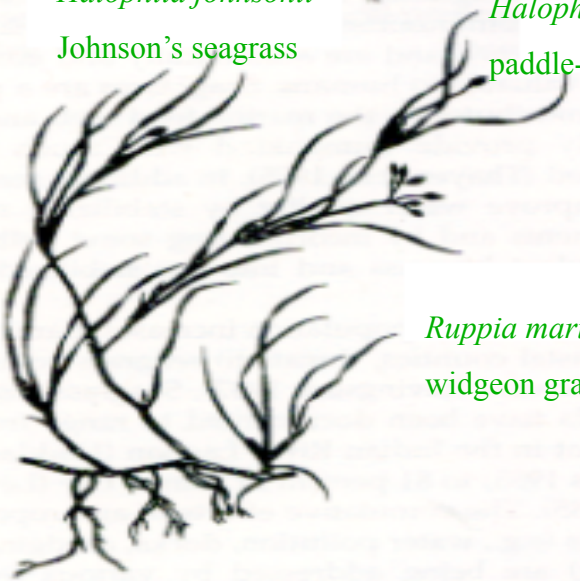
Thalassia testudinum
turtle grass

Halodule wrightii
shoal grass

Halophila englemannii
star-grass

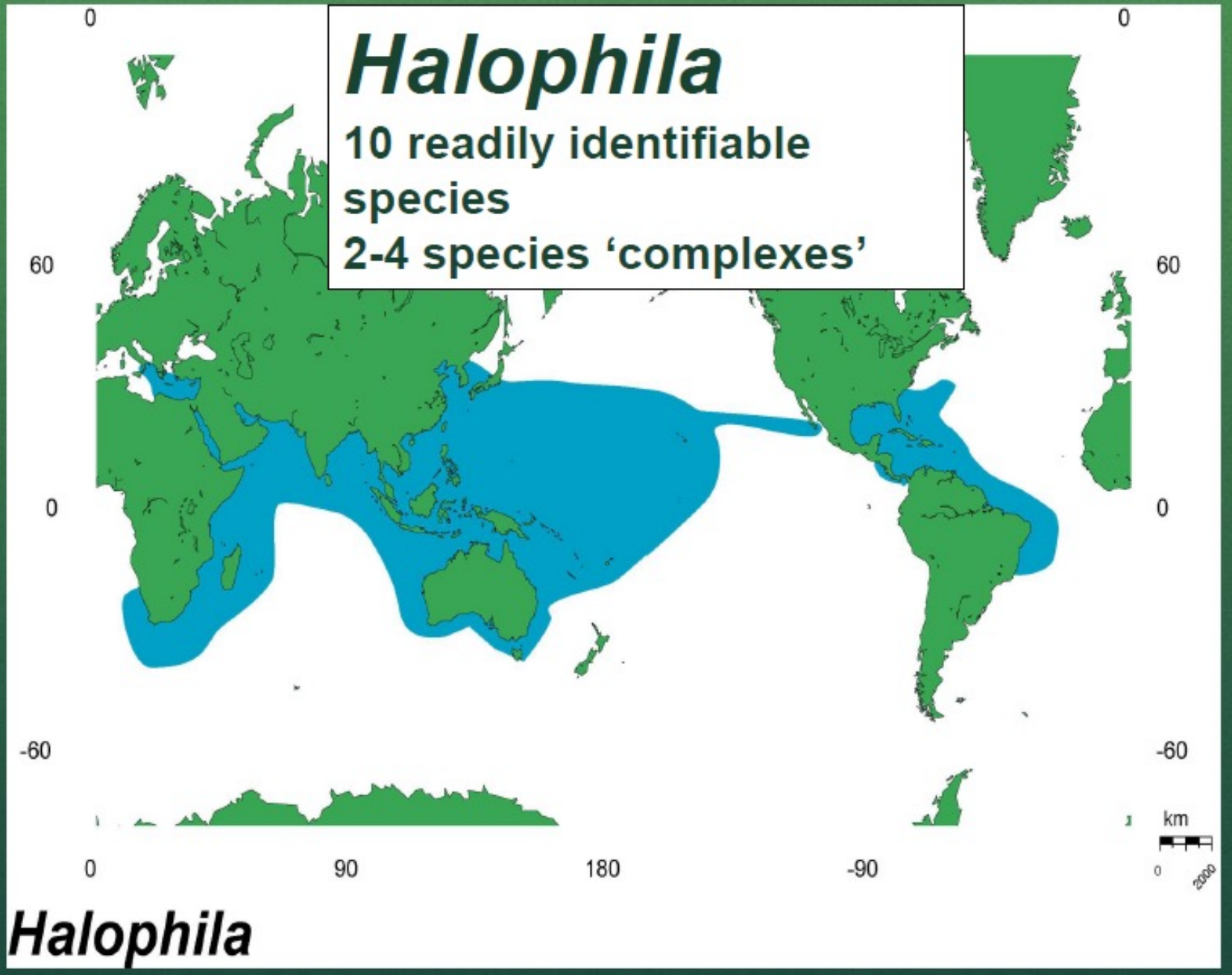
Halophila johnsonii
Johnson's seagrass

Halophila decipiens
paddle-grass



Ruppia maritima
widgeon grass

Syringodium filiforme
manatee grass


Halophila
10 readily identifiable species
2-4 species 'complexes'
0
0
60
60
0
0
-60
-60
0
90
180
-90
km
0
2000
Halophila

Halophila decipiens
paddle grass

- wide pan-tropical distribution
- grows in shallow and deep water in depths greater than 100 ft
- monoecious with both flowering parts identified
- serrated, saw-toothed leaf edges
- tolerates a wide range of salinity

Halophila englemannii

star grass

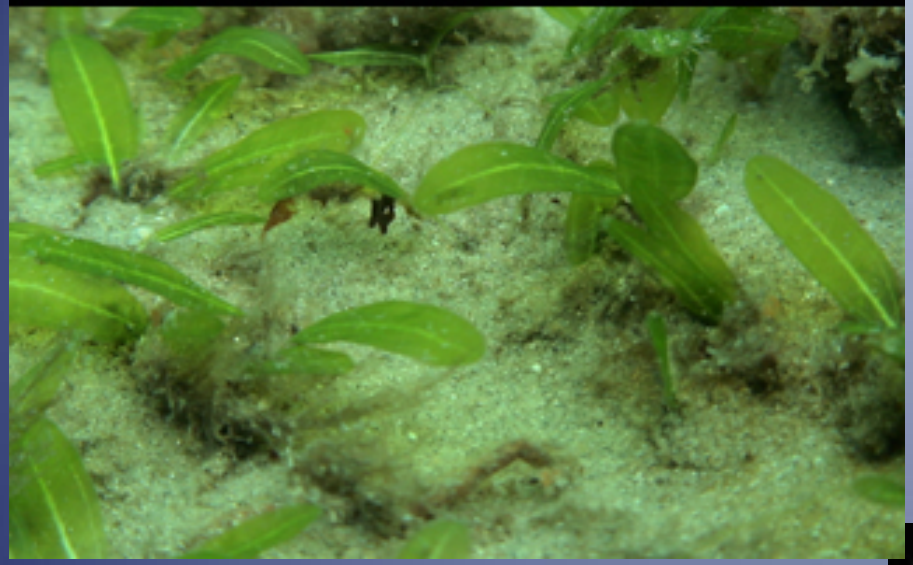
- **four to eight leaves in a whorl at the top of the stem**
- **grows in lagoonal environments and offshore in deep water**

Halophila johnsonii

Johnson's seagrass

- First described in 1980
- Erroneously named previously
- Recently given threatened species status
- Limited distribution - southeast Florida
- Shallow water
- High light intensity
- Probably dioecious, all flowering parts have not been found

Paddle Grass - *Halophila decipiens*



Johnson's Grass - *Halophila johnsonii*

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A NEW SPECIES OF SEAGRASS, *HALOPHILA JOHNSONII*, FROM THE ATLANTIC COAST OF FLORIDA

N.J. EISEMAN

Harbor Branch Foundation, Fort Pierce, FL 33450 (U.S.A.)

CALVIN MCMILLAN

Department of Botany and Plant Ecology Research Laboratory, University of Texas at Austin, Austin, TX 78712 (U.S.A.)

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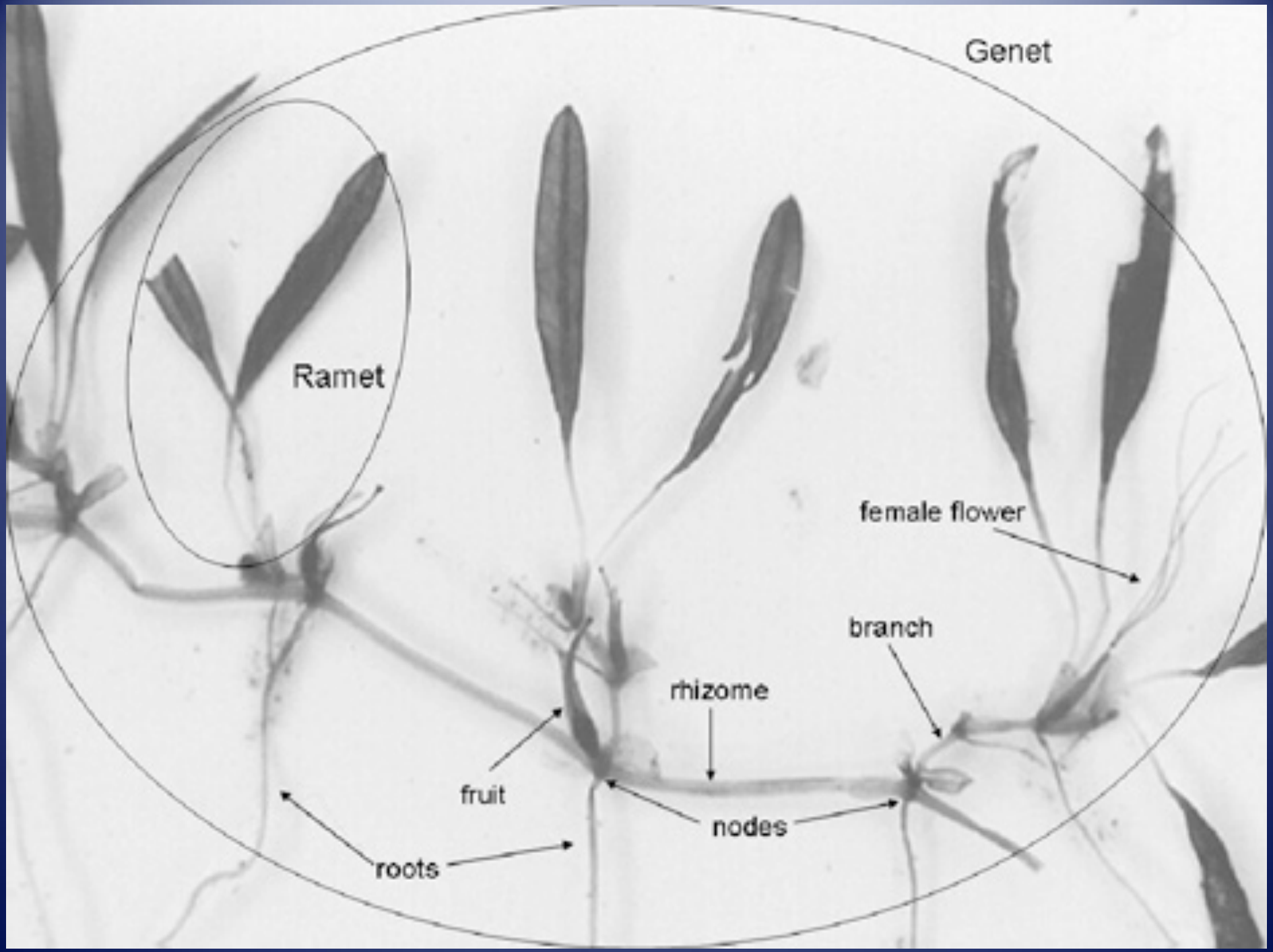
Fig. 1. Holotype of *Halophila johnsonii*. Lower right, leafy branch showing relative size and shapes of female flower, rhizome, roots and leaves. Bracts are shown around the flower. Lower left, leaf showing venation pattern. Top, a fertile leaf axil showing a rhizome supporting two stipular bracts, two petioles and a flower surrounded by a bract (position of the ovary and style shown within the bracts).


Geographic Range
Sebastian Inlet
Virginia Key


Genet
Ramet
female flower
branch
rhizome
fruit
nodes
roots

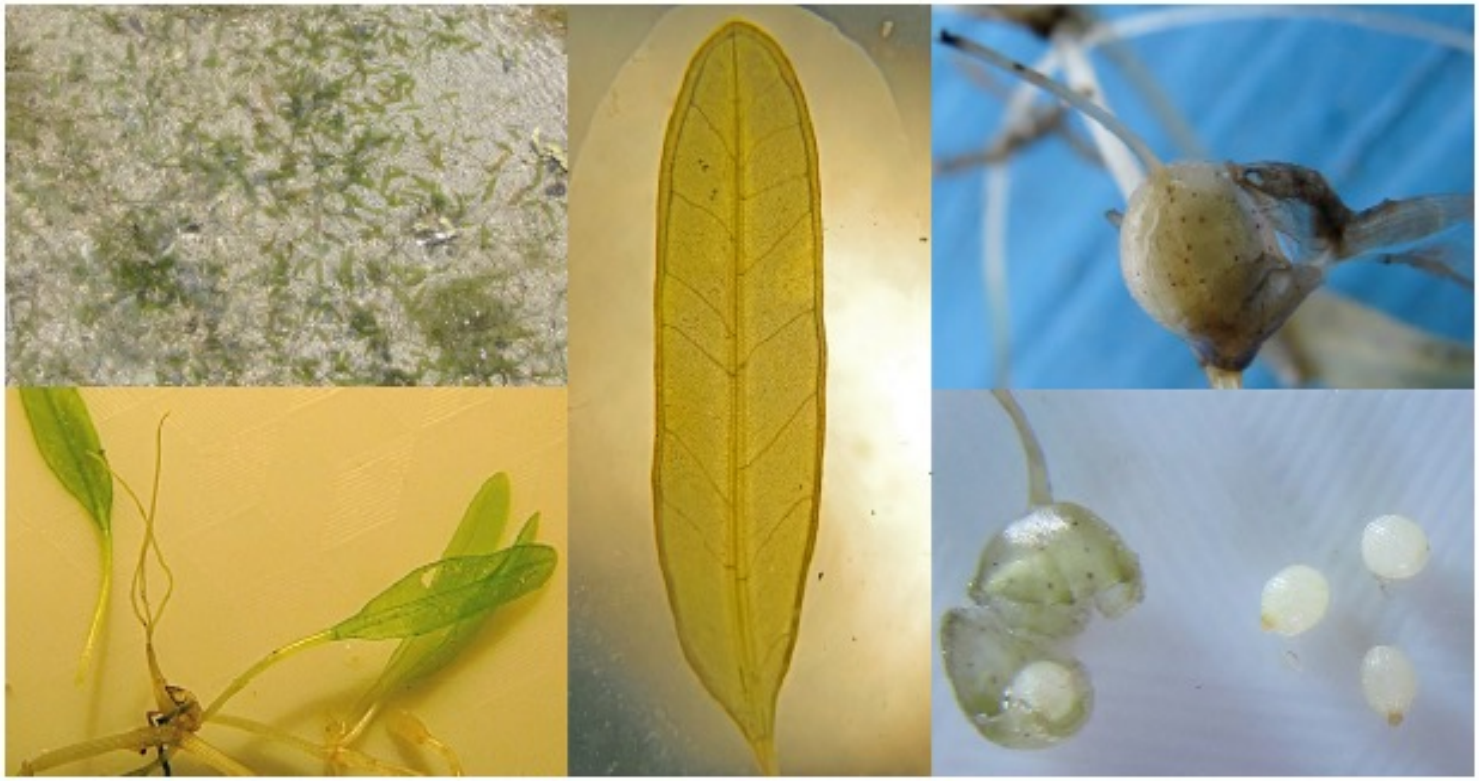


Fig. 1. *Halophila ovalis* from Antigua. Clockwise from upper left; intertidal population growing with *Halodule wrightii*; typical asymmetric leaf; fruit attached to rhizome; ovules released from fruit; ovary and styles of the female flower.

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Megagametogenesis in *Halophila johnsonii*, a threatened seagrass with no known seeds, and the seed-producing *Halophila decipiens* (Hydrocharitaceae)

Robert A. York [a], Michael J. Durako [a,*], W. Judson Kenworthy [b], D. Wilson Freshwater [c]

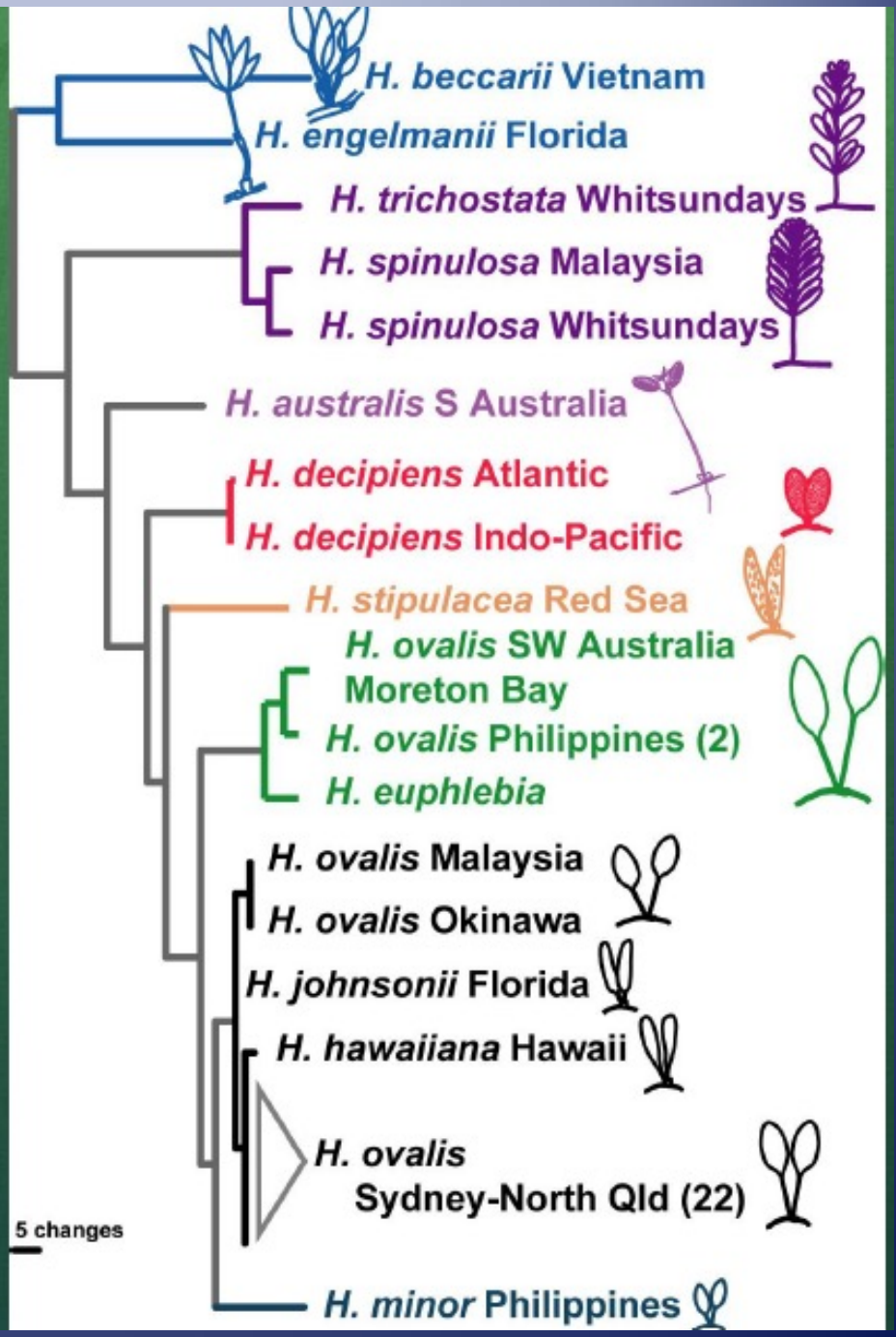
The discovery of a previously unreported seagrass species in a certain geographic area has been interpreted in various ways, including as a new record in a poorly cataloged marine flora (McDermid et al., 2002; Tsuda et al., 1977; Short et al., 2006; McMahon and Waycott, 2009), a range extension as a result of global climate change (Kim et al., 2009) or an exotic species (den Hartog, 1972; Lipkin, 1975; Lipkin et al., 2003; Ruiz and Ballantine, 2004; Willette and Ambrose, 2009). How we interpret seagrass distribution can have far-reaching implications in our perception of biogeography, biodiversity, and natural resource management. For example, certain species such as *H. johnsonii* are considered rare because of their limited distribution; hence the species is afforded protection (Notice for Critical Habitat of *H. johnsonii*, Federal Register 65(66): 17786). In contrast, a species with a history of invasion in one location (i.e., *H. stipulacea* in the Mediterranean, den Hartog, 1972; Lipkin, 1975) can receive a very different label; one that apparently constrains any explanation for its presence in a new biogeographic region to introduction via anthropogenic means, as recently suggested for *H. stipulacea* in the Caribbean (Ruiz and Ballantine, 2004; Willette and Ambrose, 2009). With the discovery of *H. ovalis* in the West Indies, we suggest two hypotheses to explain its presence in the Atlantic flora with the understanding that additional hypotheses may emerge.

Halophila

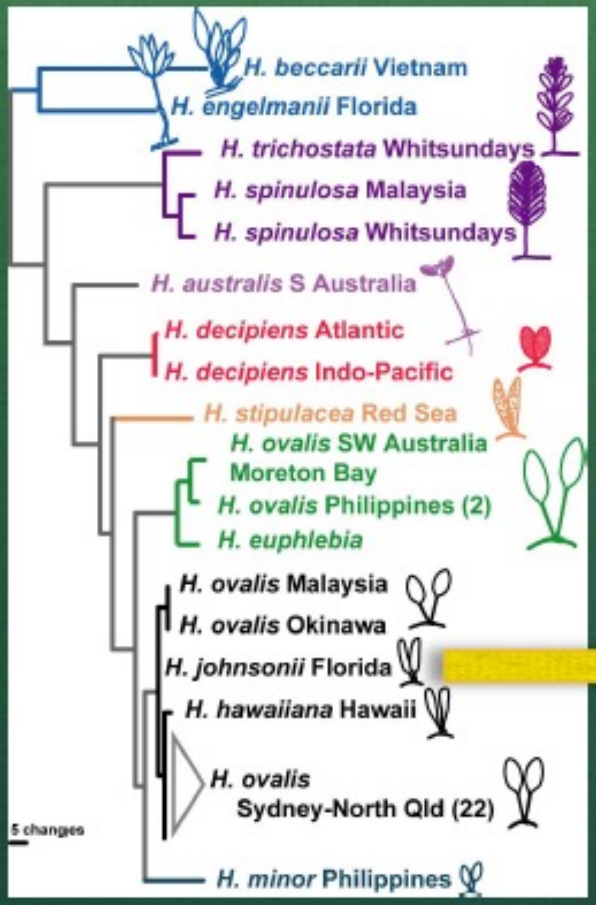
Most species clearly defined with most markers

The *Halophila ovalis* 'complex' remains problematic with between 7 and 20 species being recognised

Summary ITS analysis showing gross morphology



Resolving the *Halophila ovalis* 'complex'



The significant issue of *Halophila johnsonii*

Only Atlantic representative of the *H.'ovalis'* group

Halophila johnsonii? or invasive *H. ovalis*

- *Halophila johnsonii* appears to be a single large clone in the IRL
- The is other evidence…
  - RAPD data (Wilson Freshwater previous results) very low genetic variability
  - AFLP data (Freshwater and Waycott data) low genetic diversity for ~ 950 loci
  - Only female flowers that were found to be 'healthy' (Bob York and long term survey data)
  - …and DNA barcoding data…

Location	Ho2
SB	129/133
HiW	129/133
Joh	129/133
FP	129/133
BB	129/133
BR	129/133

This species was first observed in the1950s by Phillips (1960) when he misidentified this species as *H. baillonis*. It was then collected in 1980 and described as a new species (Eiseman and McMillan 1980). There is some controversy with this species in that genetic analysis showed that *H. johnsonii* is genetically very similar to *H. ovalis*, which is an Indo-Pacific species (Waycott et al. 2006, Short et al. 2010), suggesting that *H. johnsonii* may be an introduced representative of *H. ovalis*, a concept strengthened by the fact that only female plants have been found.

The population of *Halophila johnsonii* has been fluctuating in abundance from 1994-2007 in the portion of its range where surveys have been conducted. There has been a recent report of an 18.5 km extension north of its known geographic range (Virnstein and Hall 2009).

All members of the known population are female and ovules but no seeds have been found. An estuarine species, it is found in intertidal to shallow subtidal areas, mostly on sandy intertidal flats. The distribution of this species is often discontinuous and patchy. This species is highly transient and plants are quick growing, reaching mature size in about two weeks with beds only persisting for a few months. (Zieman 1982, UNESCO 1998, Hemminga and Duarte 2000, Green and Short 2003, Larkum et al. 2006).

Research shows high fragment viability suggesting high dependence on fragmentation as a means of dispersal. Data show that fragment viability is dependent on seasons with fragments being viable for up to four days during the spring months and up to eight days during the fall months. As only female plants have been observed, reproduction is

most likely through fragmentation (Hall et al. 2006).

Halophila johnsonii is limited to the east coast of Florida. There are localized threats due to human activities, but none that cause an overall decline of population. The population is fluctuating and has been increasing in some parts of its range. There is some controversy concerning the taxonomy of this species, with evidence suggesting that it is an introduced representative of *H. ovalis*. However, it is currently a good species under published documentation. This species is listed as Least Concern.

- Recently discovered
- Limited range
- Range is currently expanding
- Reproduces only by asexual fragmentation
- No male flowers – no pollination – no viable seeds!
- Genetically identical with *H. ovalis* from Indo-Pacific
- Recent first arrivals in other parts of Caribbean
- Antigua population identical to Florida population

These studies highlight the major problems of resolving taxonomy when taxonomic concepts are in conflict with available data.
Seagrasses represent groups where barcoding is demonstrating there are ‘fewer’ taxa than currently recognised.
Consider that in reality the burden of ‘proof’ for removing taxa is greater than creating them…

From Waycott