# A Simulation Model of the Florida Bay Seagrass Community to Support Ecosystem Restoration


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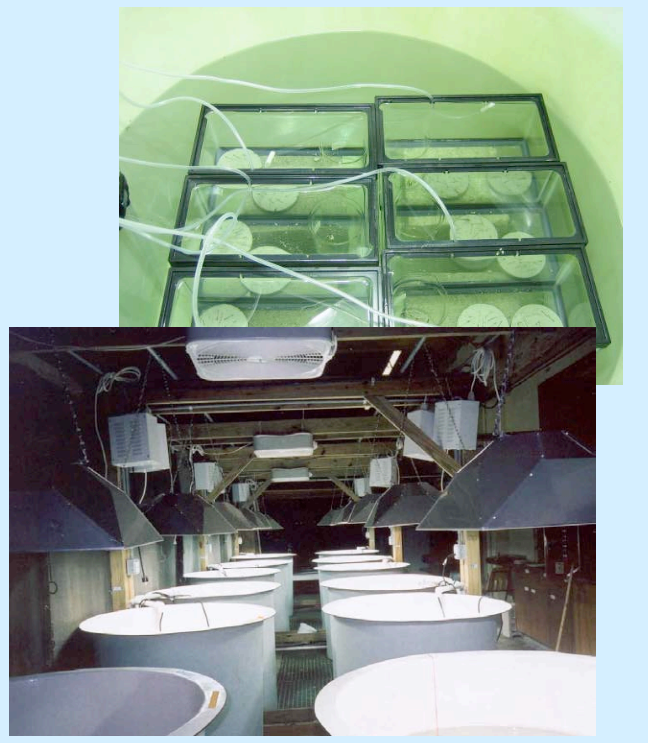
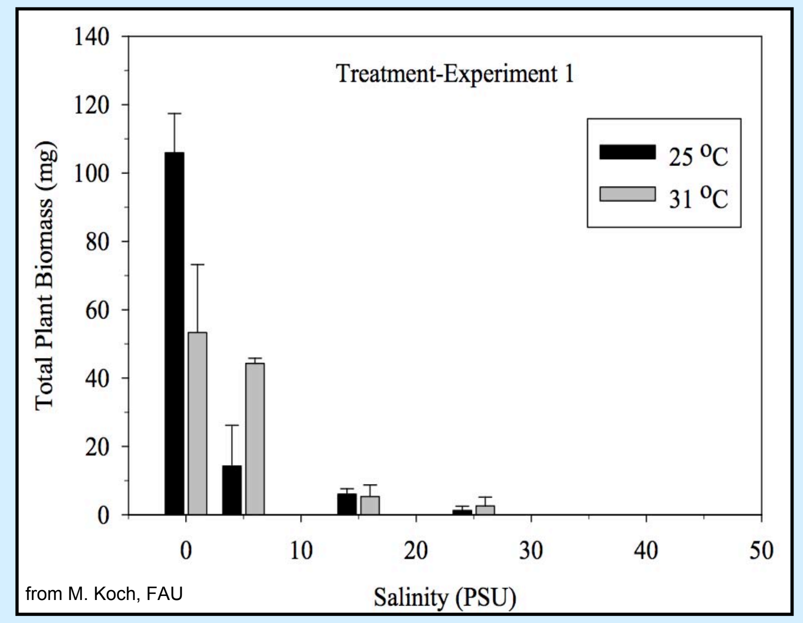
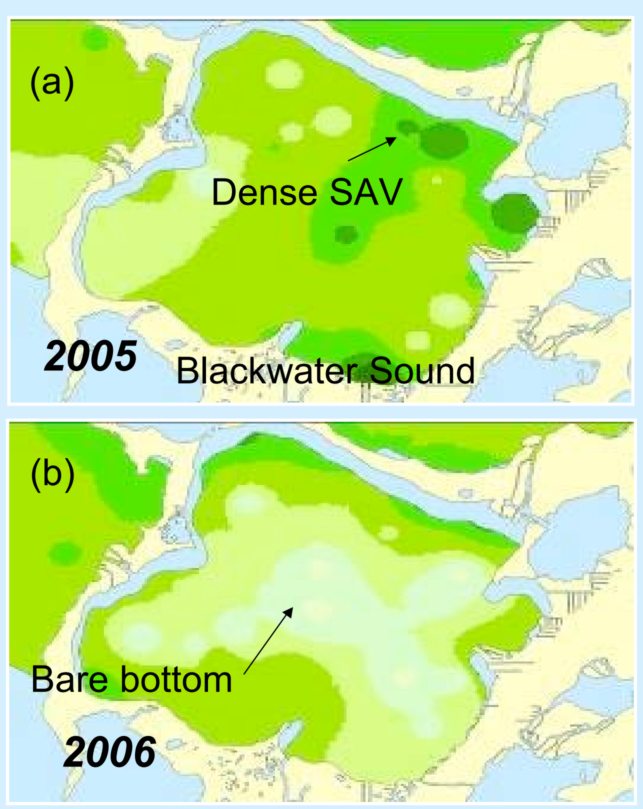
## RESEARCH



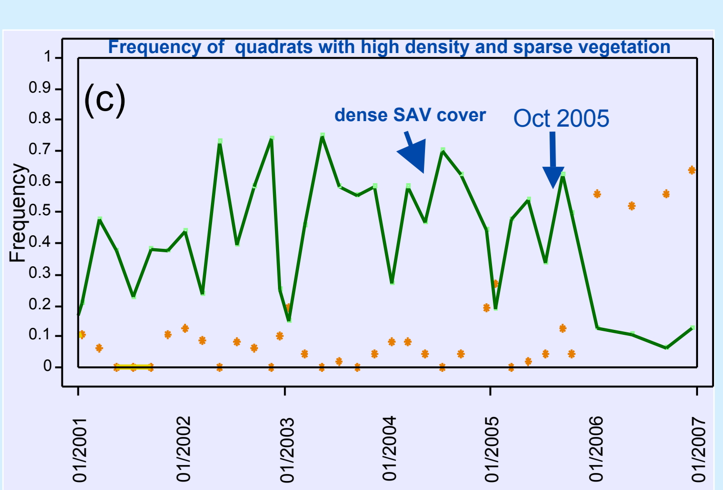
- Seagrass research provides the basis for understanding the effects of water management on seagrass habitat and supports model development. Work is focused on adding *Ruppia* (widgeon grass) to a seagrass community model that simulates *Thalassia* and *Halodule*. *Ruppia* grows in Florida Bay's coastal ponds and bays (in generally oligohaline conditions) and is a key indicator for Minimum Flows and Levels and is a restoration target for CERP. Research shows that:
- Mature plants survive at marine or hyperhaline salinities.
- Salinity and temperature affect seed germination of *Ruppia* (widgeon grass).
- Seedlings require salinity below 30 psu to establish.
- Cooler temperatures promote seedling growth.
- These effects on reproduction have been incorporated into a simulation model of plant growth, survival and distribution in Florida Bay.



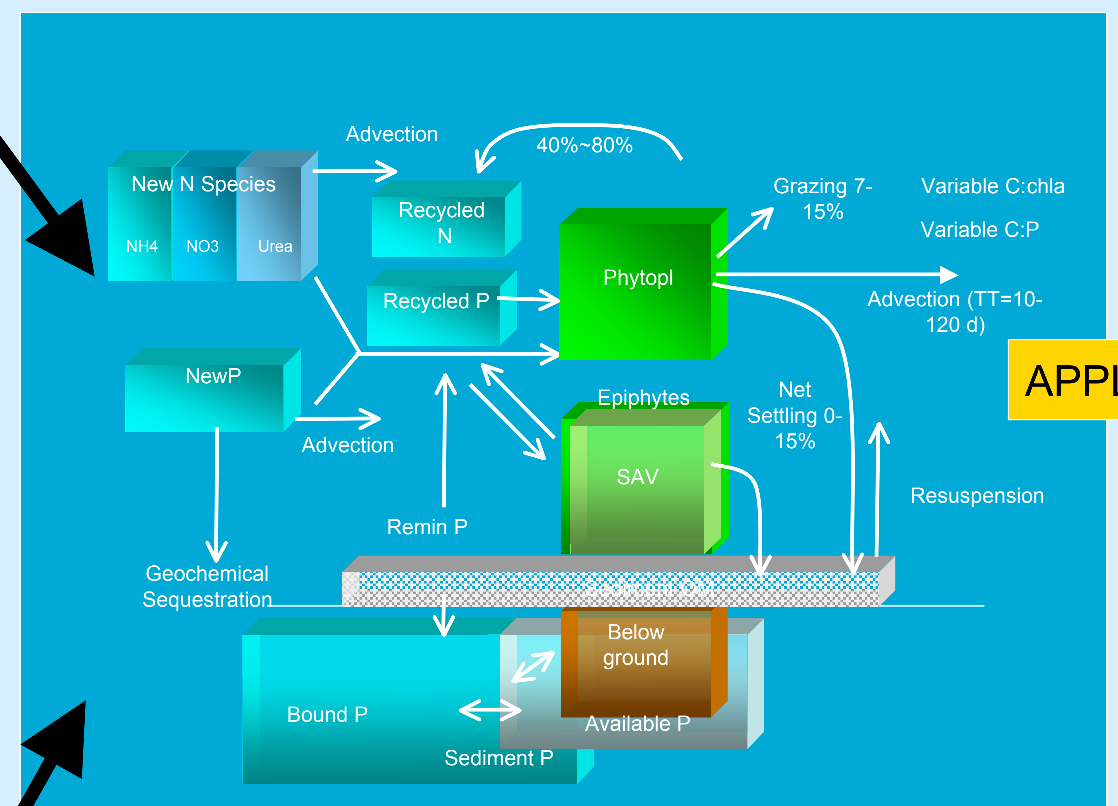

## MONITORING



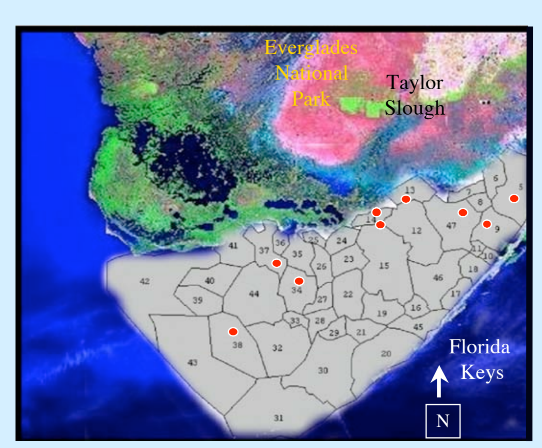

- In 2005 a persistent algal bloom formed in Northeastern Florida Bay, Barnes Sound (FATHOM Basin #5) and Southern Biscayne Bay. Substantial losses in SAV occurred in the following year (e.g. Blackwater Sound- Basin #9- upper figure, a, b).
- The green line in the lower figure (c) depicts observations where 75% or more of the bay bottom in Blackwater Sound (9) was covered by seagrass. Orange dots show observations where the bottom was essentially denuded following the 2005 bloom.
- Data produced by cooperative agreement between SFWMD and Miami-Dade Department of Environmental Resources Management (DERM) and from the South Florida Fish Habitat Assessment Program (FHAP) and the National Audubon Society are used to calibrate and verify District ecological simulation models.



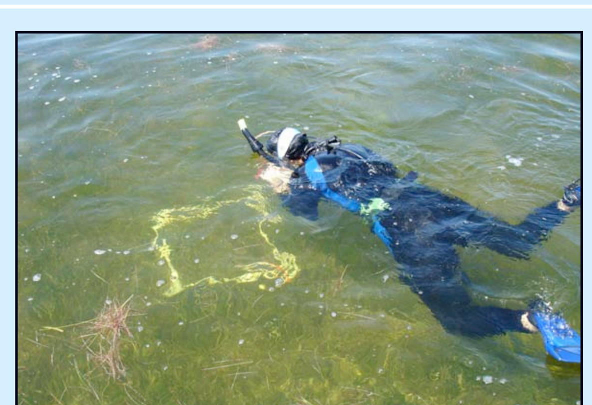

## MODELING




- Experimental and field data are synthesized in a simulation model used to assess restoration strategies, identify targets, and determine performance measures for restoration success.
- Simulation models also identify knowledge gaps to be targeted for additional research.
- Currently, submersed aquatic vegetation (SAV) components in the model include *Thalassia testudinum* (turtle grass), *Halodule wrightii* (shoal grass), and *Ruppia maritima* (widgeon grass).



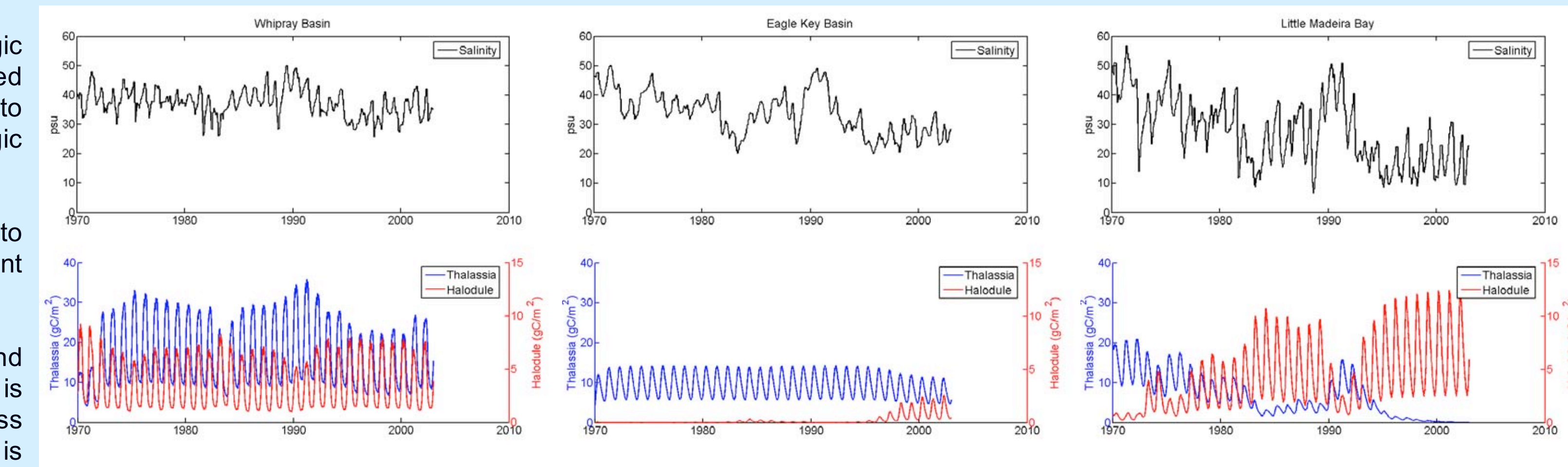

Locations in Florida Bay for which the Florida Bay Seagrass Community model has been calibrated. FATHOM model Basin #s identified in text, described above right.



APPLICATIONS

## Minimum Flows and Levels (MFLs)

- Output from a SFWMD-funded hydrologic model of Florida Bay called FATHOM is used to hindcast Florida Bay salinity from 1970 to 2002. FATHOM output is based on hydrologic basin, identified by #s on map, lower left.
- The District seagrass model uses this input to predict seagrass biomass under different salinity regimes.
- Model results for Little Madeira Bay (14) and Eagle Key Basin (15) show that *Halodule* is survives with variable salinities generally less than 40 psu and dominates when salinity is below 30 psu.

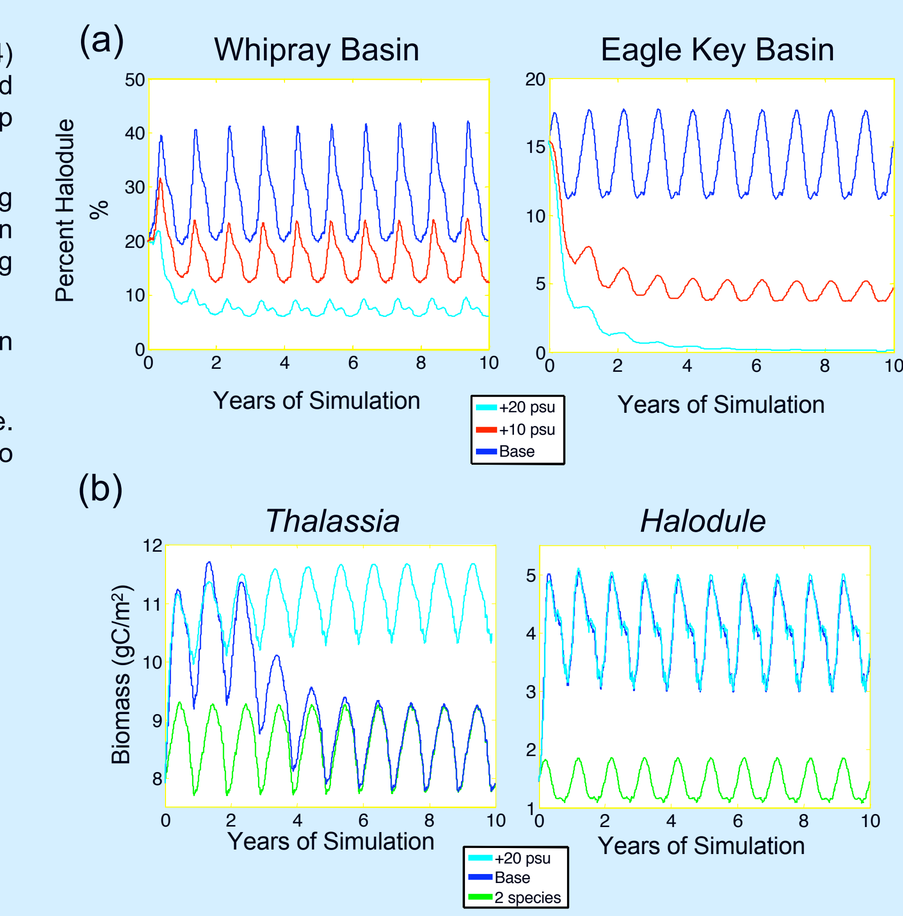


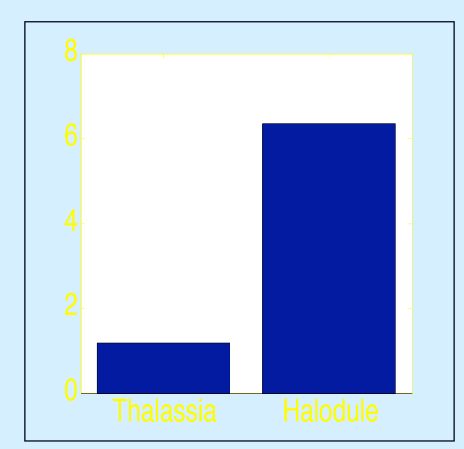

- Increased *Halodule* cover is a restoration target, promoting diversity and stability of the ecosystem. The model shows that salinity greater than 40 psu favors establishment of dense *Thalassia* at Eagle Key (15), excluding *Halodule*. In Whipray Basin (34), mixed-species beds persist throughout the 33 yr simulation despite high salinity.
- These results contributed to the establishment of the Florida Bay MFL in 2006. The Florida Bay MFL is scheduled for review in 2010.

Application: MFLs, C-111 Design, CSOP, Performance Measures

## Competition and Species Zonation

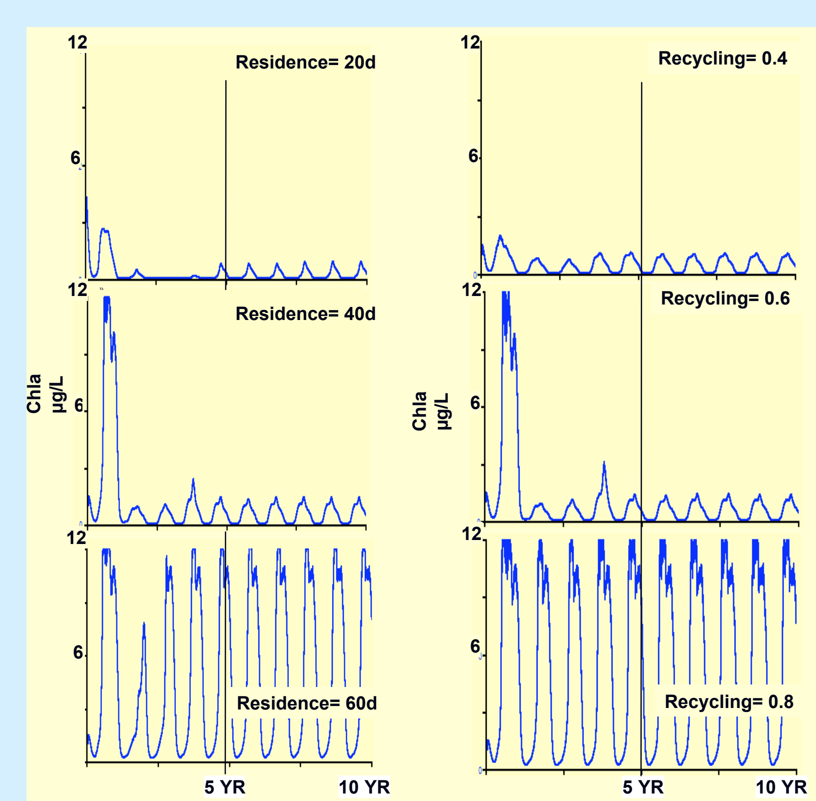
- Model runs were done to investigate why *Halodule* thrives in high salinity in Whipray (34) but not at Eagle Key (15) using the same salinity simulation at both basins. Increased salinity severely impacts *Halodule* negatively in Eagle Key Basin, but not in Whipray (top panels- a).
- In runs for each species individually (light and dark blue lines, lower panels- b), increasing salinity was favorable to *Thalassia* growth but had no direct effect on *Halodule*. When run with both species together, *Thalassia* increased while *Halodule* declined, indicating *Thalassia* was out-competing *Halodule*.
- This competition effect operates everywhere but is more pronounced in Eagle Key Basin (15) where nutrient resources are more limiting than in Whipray Basin.
- *Halodule* is at a competitive disadvantage because of higher metabolism and lower storage. The figure below shows the relative amount of production each species requires to maintain its biomass at equilibrium.
- Restoration will affect different regions of Florida Bay depending on nutrient availability.



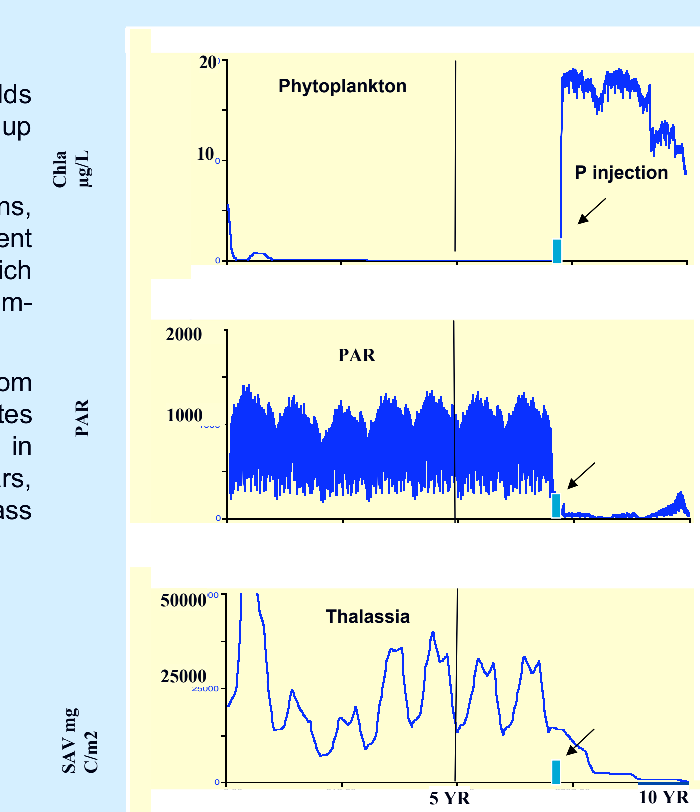




Application : CERP targets, C111 Design, Performance Measures, MFLs

## Algal Blooms Effect on Seagrass Response




- The water column algal module adds capability to predict conditions that can set up algal blooms
- Simulation of different basin conditions, freshwater discharge rates and nutrient species shows thresholds at which Blackwater Sound (9) converts to a bloom-dominated system, with loss of SAV (left)
- Addition of a pulse of phosphorus, as from runoff during a hurricane, rapidly generates an intense algal bloom that persists in simulated Florida Bay for three years, reducing light (PAR) and eliminating seagrass (right)




Application: RECOVER indicators, FBFKFS, C111 Operations


Madden, C. J. and A. A. McDonald. 2007. Development of a dynamic seagrass community model for Florida Bay. SFWMD. 72 pp.



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