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

Christopher J. Madden and Amanda A. McDonald
Everglades Division, South Florida Water Management District, West Palm Beach, FL, USA

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 (white 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 hypersaline salinities.
  - Salinity and temperature affect seed germination of Ruppia (white 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.

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, submerged aquatic vegetation (SAV) components in the model include Thalassia testudinum (turtle grass), Halodule wrightii (shoal grass), and Ruppia maritima (white grass).

APPLICATIONS

MONITORING
• In 2005 a persistent algal bloom formed in Northeastern Florida Bay, Biscayne Sound (FATHOM Basin 4F) and Southern Biscayne Bay. Substantial losses in SAV occurred in the following year (e.g. Blackwater Sound-Basin W-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 data show observations where the bottom was essentially denuded following the 2005 bloom.
• Data produced by cooperative agreement between SFWM 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
• Output from a SFWM-funded hydrodynamic model of Florida Bay called FATHOM is used to forecast Florida Bay salinity from 1970 to 2002. FATHOM output is based on hydrologic inputs (modelled by us on top-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 successful in seagrass beds generally less than 40 psu and dominates when salinity is below 30 psu.

APPLICATIONS

MINIMUM FLOWS AND LEVELS
• 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.

ALGAL BLOOMS EFFECT ON SEAGRASS RESPONSE
• 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 at Eagle Key Basin, but not in Whipray (top panel a).

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VI. CONCLUSIONS
• This competition effect operates everywhere but is more pronounced in Eagle Key Basin (15) where nutrient reoccurrences are more limiting than in Whipray Basin.
• Halodule is at a competitive disadvantage because of higher mortality 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.