

1.0 Performance Measure Title

Wetland Trophic Relationships – Periphyton

Last Date Revised: December 2006

2.0 Justification

Periphyton is a ubiquitous feature of Everglades marshes and has been shown to respond strongly in structure and function to alterations in both hydrologic conditions and water quality. Through interactions with the physiochemical environment and other biota, periphyton influences many features of the Everglades ecosystem including soil quality, secondary production, and concentrations of nutrients and dissolved gasses. Therefore, it is not only a sensitive indicator of environmental change but can serve as an early warning signal of impending change in other components of the ecosystem. Periphyton mats are considered to be regional indicators of the structural and functional bases of food webs of the freshwater wetlands of the Greater Everglades Wetlands. The primary production of periphyton mats supports the aquatic fauna that ultimately sustain reproduction by higher vertebrates.

Floating periphyton mat provides both food (algae and detritus) and habitat structure (hiding places) for macroinvertebrates, including midge larvae, nematodes, amphipods, and juvenile snails. The floating mat complex harbors much higher density of macroinvertebrates than epiphyton and benthic substrates; the daytime water column of oligotrophic Everglades wetlands is remarkably devoid of plankton, and relatively low densities of invertebrates emerge into the water column at night, compared to other North American ecosystems. These small invertebrates serve as a critical food source for Everglades consumers, including small fish, crayfish, and grass shrimp. Lengthened hydroperiods expand the aerial coverage of habitats where these food-rich mats are abundant. Shortened hydroperiod reduces the area of extensive floating mats and decreases the length of the season when habitat is available for aquatic organisms. These losses decrease standing crops available for consumption by higher trophic levels.

Current conditions of reduced hydroperiod and eutrophication appear to have reduced the spatial coverage and nutritional value of periphyton mats throughout much of the freshwater wetlands. Higher nutrient levels stimulate invertebrate productivity, but change community composition to favor pollution-tolerant taxa. Short-lived low-level phosphorus enrichment leads to higher periphyton TP, which stimulates increased biomass and density of floating mat macroinvertebrate infauna. Macroinvertebrate community composition (relative abundance) changes with low-level nutrient enrichment, well below amounts favoring loss of the periphyton mat. The relative abundance of oligochaetes increases with enrichment, while amphipods and chironomids decline. However, sustained TP enrichment leads to dissolution of the floating mat, and loss of that habitat. Hydrologic impacts on periphyton are not well known and require further research.

3.0 Relationship to CEMs and Adaptive Assessment Hypotheses

Everglades Ridge and Slough, and Southern Marl Prairies Conceptual Ecological Models attribute (RECOVER 2004b).

Ecological Premise: Reproduction of higher vertebrates that are dependent on aquatic food webs is food limited due to altered hydrologic and water quality conditions in the Greater Everglades Wetlands. As a result, the foraging distributions and nesting patterns of wading birds have been altered due to the redistribution of high concentrations of prey organisms.

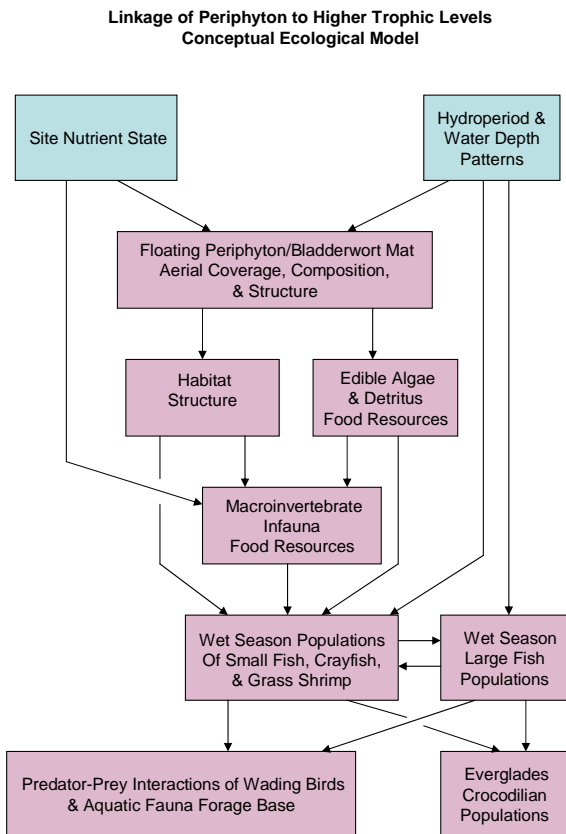
Greater Everglades Wetlands Module Predator-Prey Interactions of Wading Birds and Aquatic Fauna Forage Base hypotheses:

Hypothesis 5:

The floating mat comprised of a periphyton complex and various bladderworts provides critical support of the oligohaline Everglades food web, both as a food source and a refuge for aquatic invertebrates that are consumed by small fish, crayfish, and grass shrimp.

Rationale. The floating mat provides both food and habitat structure for macroinvertebrates, including midge larvae, nematodes, amphipods, and juvenile snails. The floating mat complex harbors much higher density of macroinvertebrates than epiphyton and benthic substrates. These small invertebrates serve as a critical food source for Everglades consumers, including small fish, crayfish, and grass shrimp. Hydroperiods affect the aerial coverage of habitats where these food-rich mats are abundant and shortened hydroperiods reduce the area of extensive floating mats and decrease the length of the season when habitat is available for aquatic organisms. Additionally, higher nutrient levels stimulate invertebrate productivity, but change the community composition to favor pollution-tolerant taxa increasing the relative abundance of oligochaetes, while amphipods and chironomids decline. Also, sustained phosphorus enrichment leads to dissolution of the floating mat and loss of that habitat. Therefore, this hypothesis not only links the Everglades floating mat complex, and particularly the periphyton primary productivity and detrital production to higher trophic levels, but also to hydroperiod and site nutrient state (concentration), both which may be directly affected by management action (RECOVER 2005b).

Periphyton-trophic level conceptual model:



4.0 Restoration Expectation

Restoration of natural hydrologic conditions will generally result in increased hydroperiods and low phosphorus nutrient regimes that benefit the floating mat complex thus aiding to re-establish distributions of prey densities and concentrations across the landscape that in turn will support the return of large, successful wading bird nesting

colonies to the southern Everglades.

4.1 Predictive Metric and Target

Increase in aerial coverage of habitats suitable for periphyton and that reflect NSM-based targets for all areas except the Arthur R. Marshall Loxahatchee National Wildlife Refuge where the applicable targets are the existing condition (2000 Base) was originally proposed, but RECOVER currently does not advocate use of this metric. Efforts to refine and update a predictive model are in development with an expected completion date beyond 2008.

4.2 Assessment Parameter and Target

The assessment parameters are regional assessments of periphyton mat cover, biovolume, organic content, percent noncalcareous algae and diatom compositions. For soft-water systems, this would consist of desmid dominated assemblages with tissue total phosphorus (TP), total nitrogen (TN), total carbon and total calcium concentrations that are analogous to the interior (i.e., unimpacted area) of Arthur R. Marshall Loxahatchee National Wildlife Refuge. For hard water systems, this would consist of calcareous periphyton with tissue TP, TN, total carbon and total calcium concentrations indicative of Shark River Slough, Taylor Slough and the interior (i.e., unimpacted area) of Water Conservation Area 2. However, The specific targets will be set once a Natural System Model [NSM] is updated and supporting research is conducted. This parameter is assess along with the complete hypothesis cluster 9.2.6 (RECOVER 2006)

5.0 Evaluation Application

5.1 Evaluation Protocol

Predictive models to evaluate this performance measure are still under development and refinement. At this time, this performance measure should not be used to conduct evaluations.

5.2 Normalized Performance Output

5.3 Model Output (example attached)

5.4 Uncertainty

Recognition of model uncertainty is needed when interpreting the ecological significance of model output. The Model Uncertainty Workshop Report provides guidance on the potential implications of uncertainty on model output interpretation (RECOVER 2002).

6.0 Monitoring and Assessment Approach

See *CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research* - Greater Everglades Wetlands Module section 3.1.3.8 (RECOVER 2004a)

See *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* – Interim Goal 3.6 Periphyton Mat Cover, Structure, and Composition (RECOVER 2005)

See RECOVER Team's 2006 Assessment Strategy for the Monitoring and Assessment Plan. Final Draft (RECOVER 2006)

7.0 Future Tool Development Needed to Support Performance Measure

7.1 Evaluation Tools Needed

Predictive models to evaluate this performance measure are still under development and refinement.

7.2 Assessment Tools Needed

Accessibility to the various data sources through an integrated database is needed for the complete evaluation of these hypotheses and for parameter refinement.

8.0 Notes

This Performance Measure supersedes and addresses GE-17 Wetland Trophic Relationships – Periphyton (Last Date Revised: November 22, 2005).

9.0 Working Group Members

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10.0 Acceptance Status

GE Working Group November 22, 2005

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Public Review

Final Acceptance Date

11.0 References

- Gaiser, E., Childers, J., Browder, J., Davis, S.M., Tarboton, K.C. 2003. Periphyton habitat suitability index. In: SFWMD, Draft Habitat Suitability Indices, South Florida Water Management District, West Palm Beach, Florida. Chapter 5.
- RECOVER 2002. Model Uncertainty Workshop Report: Quantifying and Communicating Model Uncertainty for Decision Making in the Everglades, Restoration Coordination and Verification Program (RECOVER), United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.
- RECOVER. 2004a. CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research. Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.
- RECOVER. 2004b. Draft Conceptual Ecological Models. In: RECOVER. CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research, Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida, Appendix A.
- RECOVER. 2005a. The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.
- RECOVER. 2006. 2006 Assessment Strategy for the Monitoring and Assessment Plan. Final Draft. c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.
- SFWMD. 2003. 2003 Everglades Consolidated Report. South Florida Water Management District, West Palm Beach, Florida. Appendix 6.

