Indicator 3.6 - Periphyton Mat Cover, Structure, and Composition

What is the desired restoration condition?

The desired restoration condition for periphyton mat cover, structure, and composition is to restore periphyton communities that were characteristic of the spatially distinct hydroperiods (short and long hydroperiod) and low nutrient conditions in the greater Everglades wetland communities.

Why is this indicator important and why this is a good indicator of CERP restoration?

Periphyton represents an important food resource that supports the intermediate trophic level marsh fishes and macroinvertebrates upon which wading birds and other larger vertebrates feed. It also is responsible, in part, for the formation of marl sediments (Browder et al. 1994). Moreover, periphyton composition, structure, and function are significantly affected by alterations in the local environment, especially due to nutrient enrichment (McCormick et al. 2001, Gaiser et al. 2004) and hydrology (Browder et al. 1994). Therefore, periphyton is considered to be a regional indicator of the functional base of the Everglades food web and of water quality. Historically, three types of periphyton communities occurred in the Everglades: 1) benthic mats or "sweaters" associated with short hydroperiods and marl prairies, 2) metaphyton (floating mats) associated with long hydroperiods and sloughs and 3) acid-loving epiphyton (growing on plants) associated with long hydroperiods. The restoration of hydrology associated with the CERP is expected to enhance the cover, structure, and composition of periphyton.

How will the interim goal for this indicator be predicted?

Limited data are available to accurately predict compositional and biomass performance in periphyton responses to hydrologic alterations. Although the relationships between periphyton and water quality are well established, a spatial explicit model has not yet been developed. Thus, current assessment and prediction is limited to broad periphyton community types associated with hydroperiod. Predictions will be based on a periphyton habitat suitability index where benthic mats dominate short hydroperiod marshes (inundated 0-6 months), metaphyton (floating mats) dominate long hydroperiod marshes (inundated 6-30 months), and epiphyton dominate long hydroperiod soft-water marshes (e.g., the Arthur R. Marshall Loxahatchee National Wildlife Refuge).

The periphyton habitat suitability index (Gaiser et al. 2003) is a time-averaged, spatially-variable index that is a function of the average hydroperiod for the simulation period and is partitioned into three models that represent the structurally different Everglades periphyton communities (benthic, metaphytic, and epiphytic). The suitability functions for each index are shown in Figure 3.6.1. Each function is applied only to a specific region (Figure 3.6.2). The benthic function is applied only to the marl prairie in the southern Everglades. The metaphytic function is applied only to the Water Conservation Areas 2 and 3 and Shark River Slough. The epiphytic function is applied only to the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Habitat suitability index values range between 0 and 1, with 0 representing regions not suitable for periphyton and 1 representing suitable regions. Since each grid cell is assigned

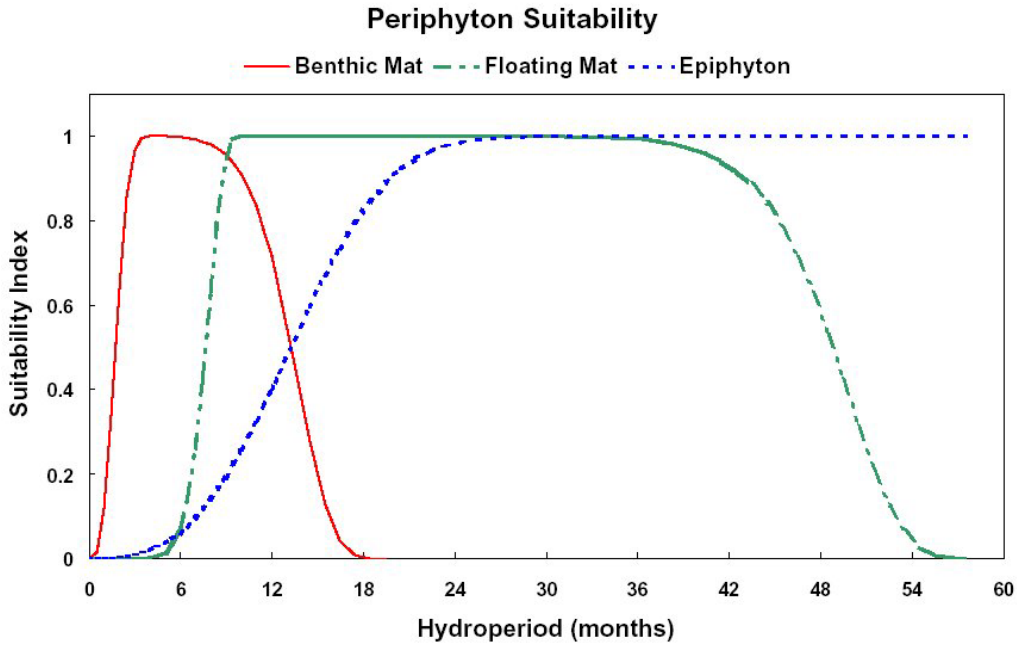

Figure 3.6.1. Habitat suitability functions for Everglades periphyton. Benthic mats dominate in short hydroperiod marshes (flooded 0-6 months), floating mats dominate in long hydroperiod marshes (flooded 6-30+ months), and epiphyton dominates in peat based long hydroperiod marshes (flooded 24-42 months).

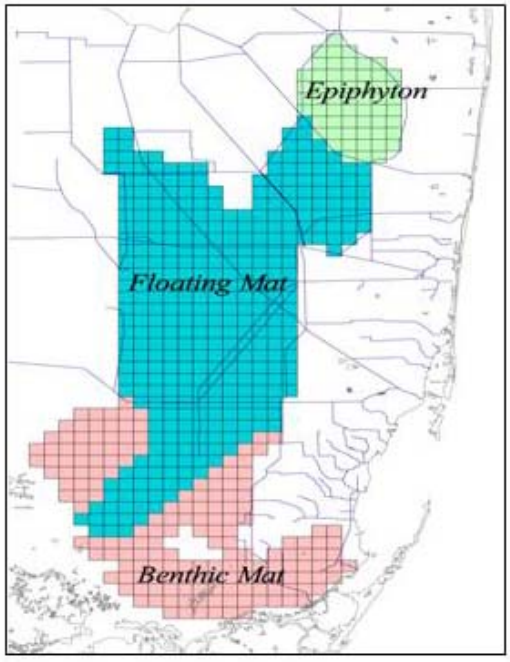

Figure 3.6.2. Regions where each benthic, metaphytic (floating mat), and epiphytic habitat suitability index functions are applied. Only one function is applied per cell. Regions were determined using best scientific judgment.

only one periphyton type, any change in the suitability index for a cell is relative to that specific periphyton type. This means that the periphyton type within a cell cannot change (i.e., a cell that has been assigned benthic cannot change to metaphytic). Model output includes spatial maps of mean annual periphyton habitat suitability values and summary tables. Figure 3.6.3 illustrates the habitat suitability index spatial distribution for the natural system determined using the Natural System Model (NSM). Currently, spatially explicit difference maps are being developed to assess the change for a given cell between the selected base condition and desired model. These maps will improve the interpretation of how periphyton respond to alternative hyrdrologic models by providing a visual representation of the net effects of a specific model run to relative base condition.

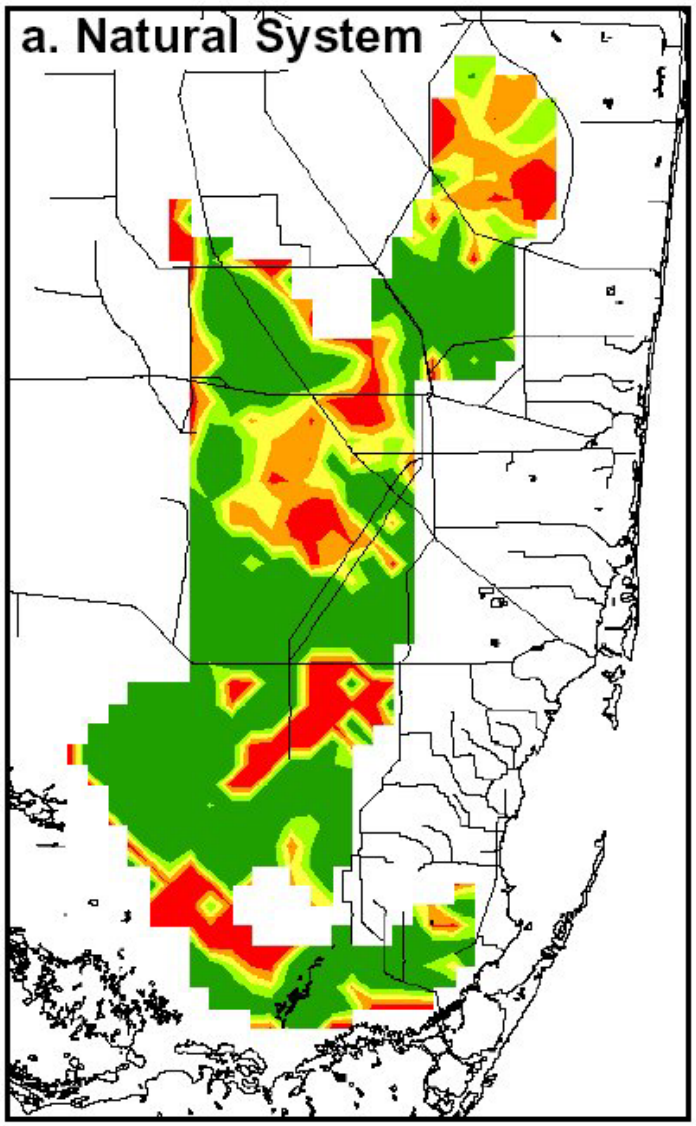

Figure 3.6.3. Distribution of suitable periphyton habitat determined for the natural system using the NSM. Colors indicate habitat suitability: red (0-0.2), orange (0.2-0.4), yellow (0.4-0.6), light green (0.6-0.8), and green (0.8-1.0).

What are the predictions for five-year increments?

Predictions are not yet available.

How will we track whether the interim goals established for this indicator have been achieved?

This interim goal will be assessed by measuring periphyton indicators such as biomass, tissue phosphorus, species composition, and vegetation patterns in appropriate wetland communities. Monitoring protocols are detailed in the *CERP Monitoring and Assessment Plan: Part 1, Monitoring and Supporting Research* (RECOVER 2004).

What additional work is needed to improve this interim goal?

The difference maps need to become standard output for each model run relative to a base condition. These will be available by December 2004. In order to include species composition and biomass as a goal or target and to ensure that the restored community reflects low nutrient conditions, further information derived from monitoring and experimentation is required. Monitoring is currently being done at several sites within the central and southern Everglades and this data provides an excellent baseline dataset. Much more rigorous information will be gathered as the *CERP Monitoring and Assessment Plan* (RECOVER 2004) is implemented. Experiments are needed to validate the assumptions or refine the data used to establish the periphyton HSI. This includes a better understanding of how water depth and flood duration affects periphyton community structure and how water quality and hydrology influence food web dynamics. Specific species composition and biomass responses under different hydrologic and water quality regimes are current being developed and are expected to be available by 2008.

References

Browder, J.A., P.J. Gleason, and D.R. Swift. 1994. Periphyton in the everglades: spatial variation, environmental correlates, and ecological implications. Pages 379-418 in Davis, S.M. and J.C. Ogden (eds). Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, FL.

Gaiser, E., D. Childers, J. Browder, S. Newman, L. Blum, R. Sharitz, S. Davis, and K. Tarboton. 2003. Chapter 5: Periphyton Habitat Suitability Index. In: Tarboton, K.C., M.M. Irizarry-Ortiz, D.P. Loucks, S.M. Davis, and J.T. Obeysekera. Draft Habitat Suitability Indices for Evaluating Water Management Alternatives. Office of Modeling Technical Report, South Florida Water Management District, West Palm Beach, FL, December 2003.

Gaiser, E.E., L.J. Scinto, J.H. Richards, K. Jayachandran, D.L. Childers, J.C. Trexler, and R.D. Jones. 2004. Phosphorus in periphyton mats provides the best metric for detecting low-level P enrichment in an oligotrophic wetland. Water Research 28:507-516.

McCormick, P.V., S. Newman, S. Miao, D.E. Gawlik, D. Marley, K.R. Reddy, and T.D. Fontaine. 2002. Effects of anthropogenic phosphorus inputs on the Everglades. Pages 83-

126 in Porter, J.W. and K.G. Porter (eds). The Everglades, Florida Bay, and Coral Reefs of the Florida Keys: An Ecosystem Sourcebook. CRC Press, Boca Raton, FL.

RECOVER. 2004. CERP Monitoring and Assessment Plan: Part 1, Monitoring and Supporting Research. Restoration Coordination and Verification, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.