1.0 Performance Measure Title

Wetland Landscape Patterns - Ridge and Slough Community Sustainability

Last Date Revised: March 2, 2007

2.0 Justification

A sustainable mosaic of coexisting sloughs and tree islands in the present ridge and slough landscape will require the restoration of the physical and biological processes that maintain them, including plant succession, sediment dynamics and peat accretion, subsidence and combustion.

Water has played an important role in creating and maintaining the characteristic continuous, directional and patterned peatland called the ridge and slough landscape that prevailed over most of the remaining Everglades. The key hypothesis is that water flow, unimpeded by anthropogenic obstructions, was one of the primary mechanisms responsible for the ridge and slough landscape. The resulting vegetation pattern was the direct result of water depth differences, with micro-topographic variations in the peat surface maintained by directional flow-related process. Where directionality of flow has nearly disappeared, the historical topographic and vegetational patterns of the ridge and slough landscape have become degraded.

Prolonged low and high water conditions in the ridge and slough have damaged tree island vegetation and soils and caused a reduction in island spatial extent during the past century (Loveless 1959, McPherson 1973, Dineen 1974, Guerra 1996, Patterson and Finck 1999). Currently, tree islands in the central Everglades exhibit reduced forest canopy cover, loss of characteristic hammock species and reduced spatial extent. These impacts are most pronounced in regions that have experienced prolonged high or low water conditions, such as extreme northern and southern Water Conservation Area 3A (Patterson and Finck 1999, Heisler et al. 2002).

Proposed restoration plans under the CERP forecast large changes in depth patterns over portions of the ridge and slough landscape; hence, performance measures for tree islands are required.

3.0 Relationship to CEMs and Adaptive Assessment Hypotheses

Everglades Ridge and Slough Conceptual Ecological Model attribute (Ogden 2005)

Ecological Premise: The loss of pattern and directionality in Everglades wetland landscapes has been caused by altered hydrologic conditions in combination with eutrophication. : The loss of pattern and directionality in Everglades wetland landscapes has been caused by altered hydrologic conditions in combination with eutrophication. Sheet flow interacts with hydroperiod, water depth, fire, and nutrient dynamics to maintain organic soil accretion and loss in a state of dynamic equilibrium. The dynamic equilibrium involves a balance of particulate organic matter transport, and the accumulation, oxidation, and combustion of organic soil. Altered magnitude, duration, and direction of sheet flow causes disequilibrium of accretion and loss processes. The disequilibrium is exacerbated by eutrophication. Disequilibrium of accretion and loss processes causes a degradation in the ridge, slough, and tree island micro-topography toward a flattening of the landscape.

Degradation of micro-topography interacts with hydroperiod, water depth, eutrophication, fire, and exotic plants to reduce the diversity and stability of habitats which were previously long-term, large-scale features of the ridge and slough landscape. Decline in ridge and slough habitat diversity and stability includes expansion of sawgrass into sloughs and wet prairies, tree island drowning, tree island burn-out, conversion to cattail under eutrophic conditions, and takeover by exotic species, such as, Melaleuca quinquenervia and Lygodium microphyllum.

The composition and distribution of plant communities along elevation gradients are determined by patterns of hydroperiod, water depth, nutrient dynamics, and fire patterns throughout freshwater wetlands of the Greater Everglades. The dynamic equilibrium of the vegetation mosaic in relation to elevation gradients is maintained if biogeochemical processes in the soil support the physiological requirements of the vegetation. The dynamic equilibrium is altered if water depths or hydroperiods decrease or increase. Anthropogenic disturbances (i.e., past 100+ years) of hydroperiods, water depths, eutrophication, fire patterns, land use change, and the spread of exotic

plants and animals have shifted the vegetation mosaic away from the historic dynamic equilibrium. These hypotheses are designed to focus monitoring and modeling at the ecotone boundaries between vegetation types which may be an early location of change.

In most of the greater Everglades wetlands where hydroperiods and water depths have decreased, the hydrologic tolerances of the surviving plant communities are adapted to greater hydroperiods and water depths than are currently maintained. For example, with regional drainage and altered fire regimes in the Big Cypress region there has been a gradual shift in landscape patterns, resulting in an increase in mesic rather than hydric-dominated communities. (RECOVER 2004)

9.2.5 Wetland Landscape and Plant Community Dynamics (RECOVER 2006)

Hypothesis 1: Everglades Ridge and Slough Micro-topography in Relation to Organic Soil Accretion and Loss

(See diagram to the right.)

Sheet flow interacts with hydroperiod, water depth, fire, and nutrient dynamics to maintain organic soil accretion and loss in a state of dynamic equilibrium.

Rationale: The dynamic equilibrium involves a balance of particulate organic matter transport, and the accumulation, oxidation, and combustion of organic soil. Altered magnitude, duration, and direction of sheet flow causes disequilibrium of accretion and loss processes. The disequilibrium is exacerbated by eutrophication. Disequilibrium of accretion and loss processes causes degradation in the ridge, slough, and tree island micro-topography toward a flattening of the landscape.

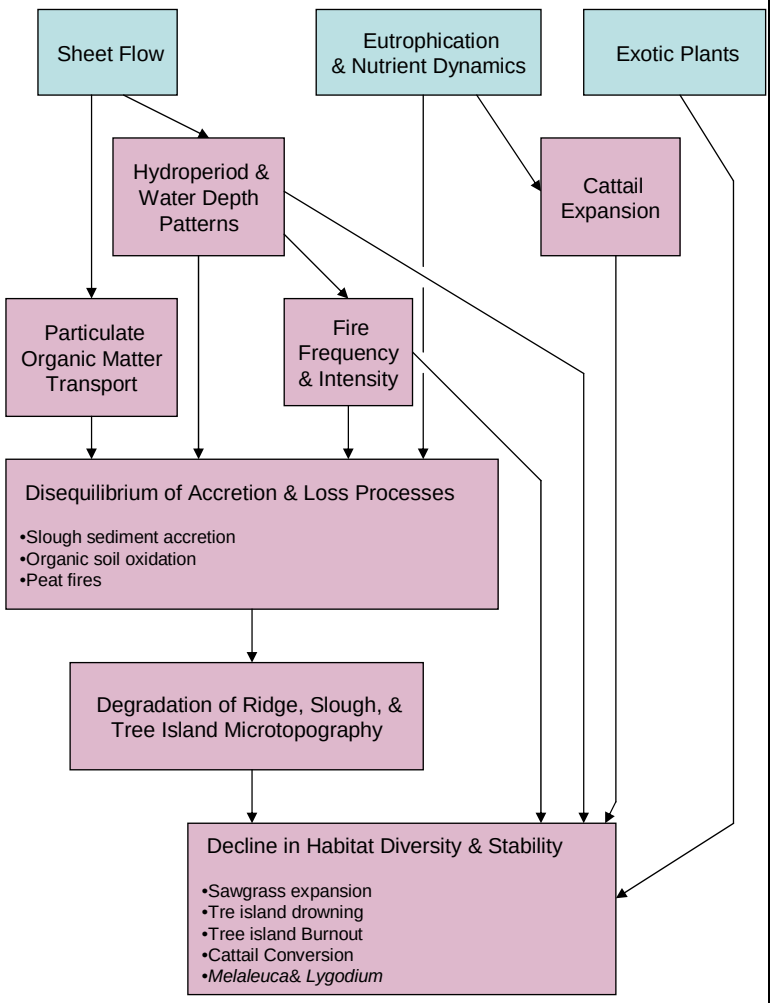
Restoration of sheet flow in combination with related hydrology, water quality, and fire patterns will re-establish the feedback conditions that sustain the micro-topography of ridges, sloughs, and tree islands.

Hypothesis 2: Everglades Ridge and Slough Landscape Pattern in Relation to Micro-topography

(See diagram to the right.)

Degradation of micro-topography, changes in hydroperiod, water depth, eutrophication, fire, and vegetation, especially nonnative and invasive species, can reduce the diversity and stability of habitats which were previously long-term, large-scale features of the ridge and slough landscape.

Ridge & Slough Landscape Dynamics
Conceptual Ecological Model



Rationale: Decline in ridge and slough habitat diversity and stability includes expansion of sawgrass into sloughs and wet prairies, tree island drowning, tree island burn-out, conversion to cattail under eutrophic conditions, and takeover by exotic species, such as, *Melaleuca quinquenervia* and *Lygodium microphyllum*.

Resumption of sheet flow and related patterns of hydroperiod, water depth, water quality, and fire will significantly restore and sustain the microtopography, directionality, and spatial extent of ridges and sloughs and improve the health of tree islands in the ridge and slough landscape.

4.0 Restoration Expectation

Resumption of sheet flow and related patterns of hydroperiod, water depth, water quality, and fire will significantly restore and sustain the micro-topography, directionality, and spatial extent of ridges and sloughs and improve the health of tree islands in the ridge and slough landscape, without significantly infringing on adjacent marl prairies, where short-hydroperiod, tussock growth habitats will persist.

4.1 Predictive Metric and Target

Predictive metric and target are not available at this time. Development of targets based on empirical values or ranges, rather than model based targets, are needed that would support:

Tree Island Species Richness: The general CERP target can be defined as the restoration of historic hydrologic patterns throughout the Everglades ridge and slough ecosystem such that vegetation communities on intact tree islands are protected and those on degraded islands are restored

Ridge and Slough Habitat Suitability: Conceptually, the general CERP target can be defined as restoration of the pre-drainage hydrologic patterns that originally maintained the Everglades ridge and slough landscape.

4.2 Assessment Parameter and Target

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.

5.0 Evaluation Application

5.1 Evaluation Protocol

This performance measure does not attempt to predict optimal depth conditions for tree island restoration, nor is it applicable as a performance measure for lower-elevation islands. In the future, it should be possible to develop more precise tree island performance measures based on the results of ongoing research on the mechanisms of vegetation change on tree islands. At this time, this performance measure should not be used to conduct evaluations.

5.2 Normalized Performance Output

5.3 Model Output

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 3.1.3.6 (RECOVER 2004)

See The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan – Interim Goal 3.7 Ridge and Slough Patterns and Interim Goal 3.8 Everglades Tree Islands (RECOVER 2005)

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

Discussion on the characteristics and variation among tree island groups is needed to refine this performance measure. Extensive research is being conducted by various groups and discussion is needed to develop consensus.

This performance measure supersedes and addresses GE-15 Wetland Landscape Patterns - Ridge and Slough Community Sustainability (Last Date Revised: November 15, 2005).

9.0 Working Group Members

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10.0 Acceptance Status

GE Working Group	November 15, 2005
ET	
AT	
Public Review	
Final Acceptance Date	

11.0 References

Dineen, J.W. 1974. Examination of Water Management Alternatives in Conservation Area 2A. Central and Southern Florida Control District in depth report 2(3), West Palm Beach, Florida.

Guerra, R.E. 1996. Impacts of the high water period of 1994-1995 on tree islands in water conservation areas. In: Armentano, T. (ed), Proceedings of the Conference: Ecological Assessment of the 1994-1995 High Water Conditions in the Southern Everglades, August 22-23, 1996. Everglades National Park, Homestead, Florida, pp. 47-58.

Heisler, I.L., D.T. Towles, L.A. Brandt, and R.A. Pace. 2002. Chapter 9: Tree island vegetation and water management in the central Everglades. In: van der Valk, A., and F.H. Sklar (eds), Tree Islands of the Everglades, Kluwer Academic Publishing, Dordrecht, The Netherlands.

Loveless, C.M. 1959. A study of the vegetation in the Florida Everglades. Ecology 40:109.

McPherson, B.F. 1973. Vegetation in Relation to Water Depth in Conservation Area 3, Florida. Open File Report 73025, United States Geological Survey, Tallahassee, Florida.

Ogden, J.C. 2005. Everglades ridge and slough conceptual ecological model. Wetlands 25(4):810-831.

Patterson, K., and R. Finck. 1999. Tree Islands of WCA3 Aerial Photointerpretation and Trend Analysis Project Summary Report. Produced for the South Florida Water Management District, West Palm Beach, Florida, by Geonex Corporation, St. Petersburg, Florida.

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. 2004. 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. 2005. 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.