Greater Everglades Performance Measure

Wetland Landscape Patterns – Tidal Creek Sustainability

Last Date Revised: March 1, 2007

Acceptance Status: Accepted

1.0 Desired Restoration Condition

Maintain and restore processes that recover and sustain tidal creeks. These processes will be determined by the supporting research project.

1.1 Predictive Metric and Target

Predictive metric and target are not available at this time.

1.2 Assessment Parameter and Target

With the projected future increase in the rate of rise in sea level over the coming century, dramatic changes in coastal landscapes of the Everglades are inevitable. It is critical to predict the resulting landscape changes in the lower Everglades because ecosystem restoration will succeed only by working in harmony with those inevitable changes. Ecological performance measures and project design features may require substantial modification given the projected changes resulting from this evaluation (RECOVER 2006).

2.0 Justification

Tidal creeks throughout coastal wetlands of the Everglades have filled in with sediments and with the vegetation of surrounding landscapes so that many have disappeared entirely during the past century. Reduced freshwater flow volume and rising sea level are probable contributing factors. Determining CERP's success in maintaining and restoring tidal creeks through the mangrove estuary requires monitoring their status and evolution, which are functions of their hydrodynamics and bathometry as affected by flow volume and distribution. Current conditions of tidal creeks will be determined through geomorphic surveys of tidal rivers and creeks along the coastal ecotone of the southern Everglades (RECOVER 2004).

3.0 Scientific Basis

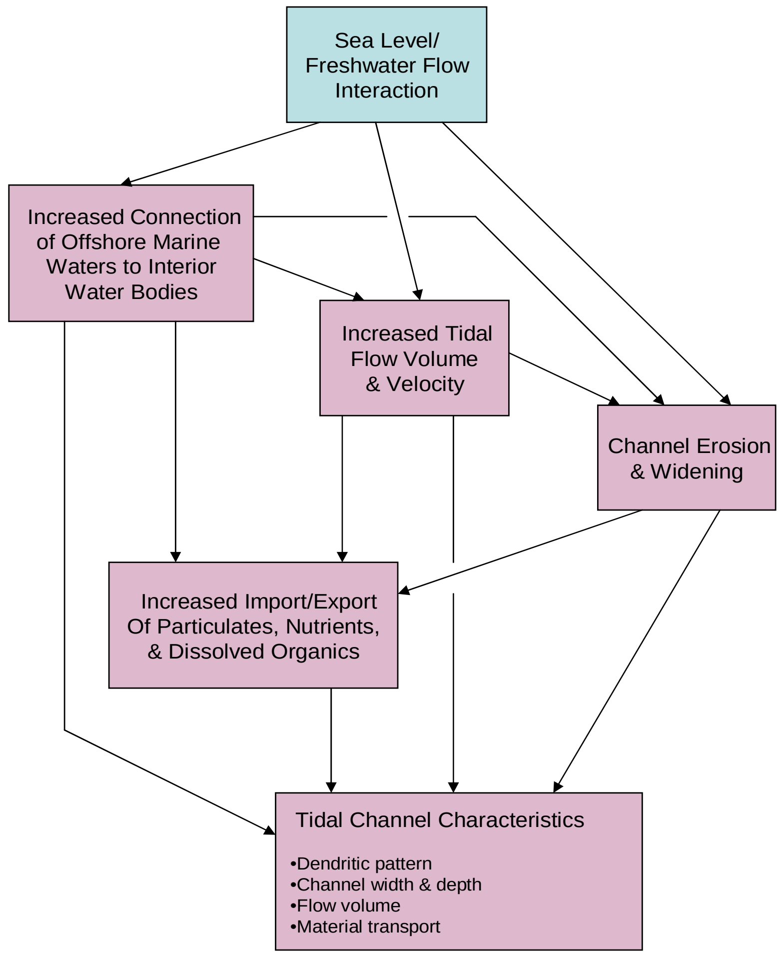
3.1 Relationship to Conceptual Ecological Models

The indicator for this performance measure is an ecological attribute in the following Conceptual Ecological Models:

<u>Regional Models</u>
Everglades Mangrove Estuaires (Davis et al. 2005)

<u>Conceptual Ecological Models</u>
Tidal Channel Characteristics (RECOVER 2006)

3.2 Relationship to Adaptive Assessment Hypothesis Clusters



Ecological Premise: River and tidal creeks through coastal wetlands of the Everglades have filled with sediments and the vegetation of surrounding landscapes to the point that many have greatly diminished or disappeared entirely during the past century. The dendritic pattern of tidal creeks and adjacent salt marshes within mangrove forests is being lost due to mangrove encroachment and siltation resulting from reduced freshwater flow volume and duration in combination with sea level rise. Siltation and mangrove encroachment of tidal creeks has progressed to the extent that open water courses that were described earlier this century are no longer recognizable (G. Simmons, gladesman, pers. comm.). Causal factors, including the relative contributions of reduced freshwater flow and sea level rise, remain unclear.

Populations of small marsh fishes in gulf estuaries may respond to hydroperiod and water recession patterns very differently than Everglades marsh fish communities because of more complex topography created by a dendritic pattern of tidal creeks. Tidal creeks may further influence the resident mangrove fish community as corridors for immigration of juveniles of more marine species

Restoration plans under consideration are to redirect additional freshwater inflow from the Everglades to open and sustain these waterways to a level that closely resembles historic patterns. (RECOVER 2004)

Coastal Transgression, Tidal Channel Characteristics, Salinity Gradients, and Mangrove Forest Productivity (RECOVER 2006)

Ecological processes and attributes in the mangrove coastlines of the southern Everglades are hydrologically controlled by interactions between overland sheet flow from freshwater wetlands and the waters of the Gulf of Mexico and Florida Bay. Changes in freshwater flow from the implementation of CERP projects are relatively short-term in comparison to the longer-term, progressively increasing changes in salinity and coastal hydrologic budgets resulting from relative sea level rise.

The rate of relative sea-level rise in south Florida increased began increasing in about 1930. Since that time, relative sea-level in south Florida has increased about 23 centimeters (9 inches), or 30 cm (one foot) per century. Anticipated response of sea level rise to global warming is projected to result in a global increase in sea level of about 60 centimeters (two feet) in the coming century

Hypothesis 1: Sea Level and Freshwater Flow as Determinants of Coastal Transgression. Sustained substrate buildup by physical and biological processes in many coastal marl and mangrove environments of South Florida may not be capable of keeping up with rates of sea-level rise during the twenty-first century.

Where rates of peat or marl elevation buildup do not keep up with rates of sea level rise, shoreline transgression and landward salinity intrusion into mangrove and freshwater wetlands will occur.

Rationale: Red mangrove forests in south Florida can potentially accrete organic peat substrate at 2-6 mm/year. Disturbances (major hurricanes, fire, freeze, and changing flushing) disrupt these peat accretion rates and commonly result in alternating phases of substrate subsidence and decay. Salinity stress may also reduce accretion rates. In this time of rapidly rising sea level, most mangrove communities are presently losing area of coverage. In the coming century the coastal mangrove community may be expected to become increasingly dissected. Sustained rates of accretion of coastal marl shorelines of Florida Bay may also be incapable of keeping up with the rate of sea level rise, and over-topping and breaching of embankments during storm events are likely under future scenarios of rising sea level.

Where rates of peat or marl elevation buildup do not keep up with rates of sea level rise, shoreline transgression and landward salinity intrusion will lead to mangrove erosion along shorelines and mangrove movement into interior landscapes. Saline intrusion into freshwater wetlands underlain by peat substrate may lead to wetland community collapse and transformation to open, saline ponds and estuaries. Saline intrusion into marl substrate wetlands results in an advancing zone of diminished productivity (this is often called the “white zone”). Restoration of freshwater flow volume, timing, and distribution may slow the inland movement but it is not expected to change the rate of erosion along the shoreline.

Hypothesis 2: Sea Level and Freshwater Flow as Determinants of Tidal Channel Characteristics

The dendritic pattern, channel width and depth, flow volume, and material transport of tidal watercourses and channels through the coastal mangrove estuaries are controlled by sea level interacting with the volume, timing, and distribution of sheet flow and channel flow from the southern Everglades.

Rationale: Restored freshwater inflow from the Everglades is expected to help sustain open watercourses through the estuary that will more closely resemble historic patterns, and re-open some channels that have partly filled because of reduced flow. Sea-level rise is expected to modify the patterns of connectivity and channel patterns through the coastal wetlands and create increased sediment loads.

With rising sea level, offshore marine waters become connected to interior depressions (interior lakes and collapsed freshwater marsh areas) by a combination of connecting channels, sheet flow through wetlands, and/or flow across inundated ridges, such as the buttonwood embankment. These connections increase the flood tidal prism (area and volume of flood tidal water) and result in enhanced flood and especially ebb tidal flow. This process is expected to result in stronger tidal currents through channels resulting in enhanced erosion and widening of those channels. Such conditions are expected to result in an increased import and/or export (depending on setting) of particulates, nutrients and dissolved organics. Sea-level rise is expected to destabilize many coastal and nearshore marine sedimentary environments resulting in increased movement of fine-grained sediment in the coastal zone. Significant portions of this sediment probably will be moved inwards through tidal channels into interior coastal bays and wetlands.

4.0 Evaluation Application

4.1 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.

4.2 Normalized Performance Output

4.3 Model Output

4.4 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).

5.0 Monitoring and Assessment Approach

5.1 MAP Module and Section

See CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research - Greater Everglades Wetlands Module section 3.1.3.7 (RECOVER 2004a).

5.2 Assessment Approach

6.0 Future Tool Development Needed to Support Performance Measure

6.1 Evaluation Tools Needed

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

6.2 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

7.0 Notes

This performance measure supersedes and addresses GE-16 Wetland Landscape Patterns - Tidal Creek Sustainability (Last Date Revised: October 20, 2005).

8.0 Working Group Members

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References

Davis, S.M., D.L. Childers, J.J. Lorenz, and T.E. Hopkins. 2005b. A conceptual model of ecological interactions in the mangrove estuaries of the Florida Everglades. Wetlands 25(4):832-842.

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.

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