Greater Everglades Performance Measure

Wet Prairie

Last Date Revised: May 29, 2007

Acceptance Status: Under Review

1.0 Desired Restoration Condition

1.1 Predictive Metric and Target

The restoration target is the recovery of marl prairies at their indicator sites and indicator areas. An indicator site is a location in the systematic field survey where the vegetation was wet prairie in the quantitative vegetation survey between 2003 and 2007 (Ross et al 2004, 2006). The indicator areas are locations where wet prairie vegetation communities were observed in the predrainage period. The indicator areas need to be identified in the future, due to current inadequate data.

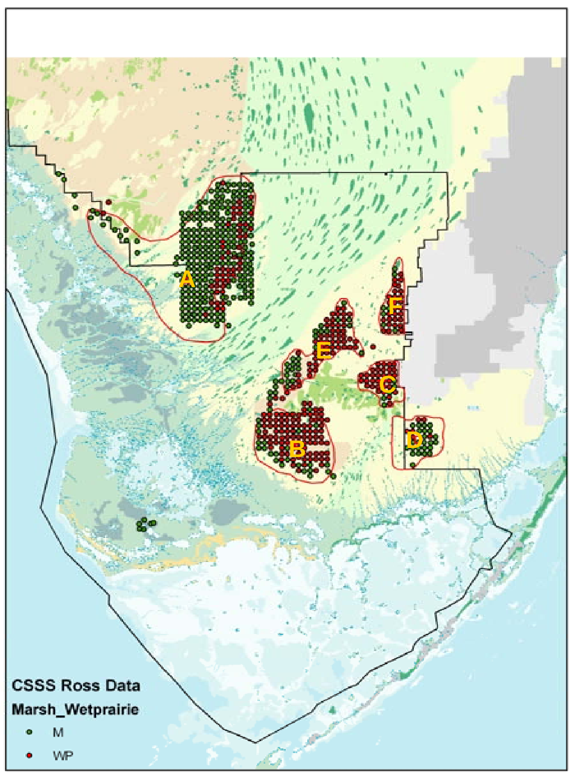

Figure 1. Distribution of two different vegetation types based on the quantitative field survey. The red dots are indicator sites of wet prairies.

Immediate restoration target: Maintenance of current distribution of wet prairie (Ross et al. 2006). Figure 1 shows the locations of the indicator sites for the immediate restoration target.

1.2 Assessment Parameter and Target

A monitoring and assessment plan need to be developed or enhanced through RECOVER monitoring and assessment plan (MAP), or Everglades National Park (ENP) monitoring.

2.0 Justification

Wet prairies are conspicuous and major landscape features in southern Everglades. They occur in broad transitional wetlands between sloughs and uplands, on both sides of Shark Slough and Taylor Slough, the main natural flow ways within the ENP. They also occur in shallow depressions on the inland side of coastal embankments. To the east, they extend outside the park, to the southeast of the southern end of the Atlantic Coastal Ridge and the mangrove zone that borders Barnes Sound and Card Sound. To the west, they extend into Big Cypress National Preserve and stretch southward to the interior side of the Gulf of Mexico mangrove forests.

Wet prairies contains four types of vegetation named after their dominant species: *Schizachyrium, Muhlenbergia, Schoenus, and Cladium,* (Ross et al. 2004, 2006). They support a high diversity of plant species, provide habitats for a variety of native invertebrate and vertebrate species, including the endangered species, Cape Sable seaside sparrow (*Ammodramus maritimus* mirabilis), and provide seasonal aquatic habitats, where the small aquatic animals boom and bust, constituting an important prey base for the more conspicuous predatory species, such as wading birds (Davis et al. 2005).

Hydrology is a determinant environmental factor for wet prairies. Wet prairie vegetation typically occurs in locations and at elevations that subject it to seasonal surface inundation, hydroperiods intermediate between sloughs and uplands. Relatively short hydroperiods and annual dry downs provide pulsing conditions for aquatic fauna, affecting trophic and competitive interactions and thereafter the survival and coexistence of species (Ross et al. 2004, 2006, Davis et al. 2005).

In the last century, the wet prairie ecosystems have deteriorated and the main contributors to the ecosystem deterioration are water management practices and land uses, including agriculture and urban development (Davis et al. 2005). These human activities lead to the loss of spatial extent and connectivity, shortened or extended hydroperiod, increased drought severity, altered wetting and drying patterns, introduction and spread of non-native species (Armentano et al. 1995, Jones and Doren 1997), fire regime shifts (Gunderson and Snyder 1994), and thereafter vegetation shifts (Hilsenbeck et al. 1979, Hofstetter and Hilsenbeck 1980, Loope and Urban 1980, Armentano et al. 2006) and population declines in the Cape Sable seaside sparrow, marsh fishes and associated aquatic fauna (Pimm et al. 2002, Davis et al. 2005).

3.0 Scientific Basis

3.1 Relationship to Conceptual Ecological Models

The indicator for this performance measure is an ecological attribute (prairie vegetation) in the following conceptual ecological models:

<u>Regional Models (RECOVER 2004)</u>

Southern Marl Prairies

Ecological Model for Hypothesis Clusters (RECOVER 2006)

Plant Communities and Elevation Gradients Conceptual Ecological Model

3.2 Relationship to Adaptive Assessment Hypothesis Clusters

Hypothesis 3: Plant Community Dynamics along Elevation Gradients. 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.

Rationale: 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.

Vegetation gradients between higher elevation marl prairies and lower elevation ridge and slough communities are of particular concern in the southern Everglades. Although a potential trade-off exists between ridge and slough habitat restoration and the extent and quality of habitat in adjacent marl prairies. It is thought that longer hydroperiods, greater water depths, and appropriate flow regimes will re-establish and sustain ridge and slough landscape patterns without significantly infringing on adjacent marl prairies, where short hydroperiod, tussock growth habitats will persist.

4.0 Evaluation Application

4.1 Evaluation Protocol

Projection Metrics

i) The Ross-Sah frequency distribution of hydroperiod of wet prairie. Figure 2 shows the frequency distribution of wet prairie hydroperiods. The data were collected during vegetation surveys and analyses of wet prairies between 2003 to 2005 (Ross et al. 2004, 2006).

ii) Deviation from the Ross-Sah frequency distribution.
Target: minimize the deviation. Alternatives that deviate less from the Ross-Sah frequency

distribution are preferred over those with larger deviations (Figure 2). Alternatives that more closely approach the historical spatial distribution of wet prairie are preferred over those with substantial spatial skewness. We used the sum of squared differences (*SSD*) as a measure of this deviation,

$$\boldsymbol{SSD} = \sum (\, \boldsymbol{fs}_{\mathbf{i}} - \boldsymbol{fd}_{\mathbf{i}} \,)^2$$

where, fs_i is the relative frequency of the hydroperiod in the i[th] hydroperiod interval of a hydrological scenario and fd_i is that of the field survey, i = 0-15, 16-30, 31-45, 46-60, 61-75, 76-90, 91-105, 106-120, 121-135, 136-150, 151-165, 166-180, 181-195, 196-210, 211-225, 226-240, 241-255, 256-270, 271-285, 286-300, 301-315, 316-330, 331-345, 346-360, 361-366.

Bottomline: The scenario should not produce a spatial distribution that is worse than the current spatial distribution.

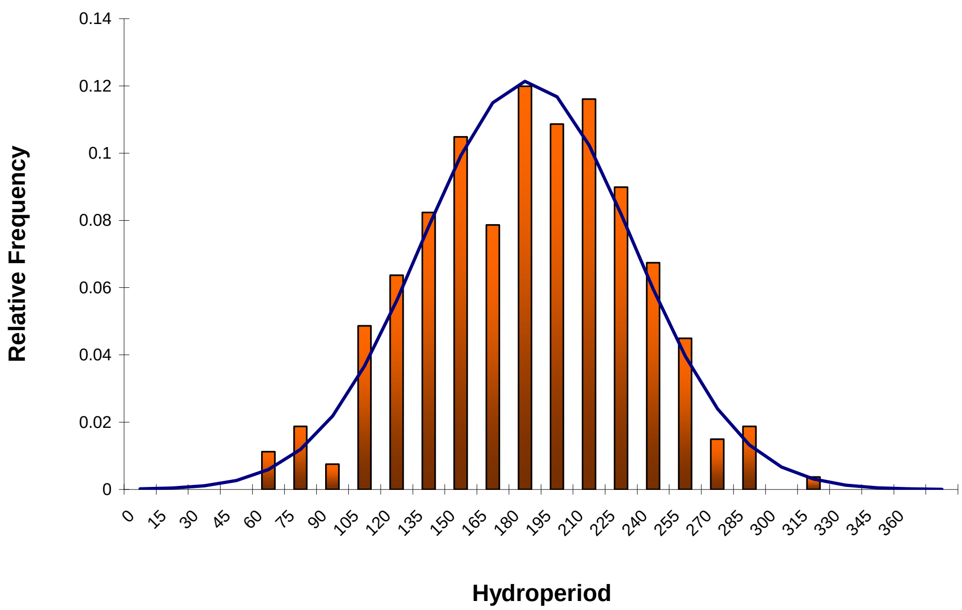

Figure 2. The Ross-Sah frequency distribution of hydroperiod of wet prairies. The blue line indicates the normalized frequency distribution.

4.2 Normalized Performance Output

4.3 Model Output

Models: HIE-hydroperiod (Donalson et al. 2005), ATLSS High Resolution hydrology model (HRT) (online, URL: www.ATLSS.org), and SFWMM (URL: www.sfwmd.gov/org/pld/hsm/models/sfwmm/index.html).

Model Output:

i. the hydroperiods between 1965-2000 for each indicator site,

ii. the spatial distribution of the average hydroperiod.

iii. iii. the frequency distribution of hydroperiods for all indicator sites through all 36 years

4.4 Uncertainty

Uncertainty and Caveat. The performance measure is based on spatially-explicit, quantitative data from field surveys. This performance measure is mostly based on the information published in technical reports and peer-reviewed literature. Despite this level of confidence, a significant amount of uncertainty exists. The projection metrics of this performance measure are based on the number of days when water elevation is above or below a certain reference elevation. In calculation, the number of days could be extremely sensitive to the errors in both the water elevation and the reference elevation. There is a level of error associated with the reference elevations at each survey site. The error analysis is documented in (Donalson et al. 2006). Water elevation from the HRT and SFWMM are affected by various sources of uncertainty. For each site, this uncertainty can be significant. This uncertainty is reduced and the performance measures are still useful for relative comparisons between different scenarios, especially when model data are aggregated and when we focus on general spatial patterns. For more details about the uncertainty of HRT and SFWMM, please see their documentation.

5.0 Monitoring and Assessment Approach

5.1 MAP Module and Section

A monitoring and assessment plan need to be developed or enhanced through RECOVER monitoring and assessment plan (MAP), or ENP monitoring.

5.2 Assessment Approach

6.0 Future Tool Development Needed to Support Performance Measure

6.1 Evaluation Tools Needed

Predrainage indicator sites and areas of wet prairies need to be identified. A combination of the field survey of current prairie vegetation in more areas, historical vegetation data, and paleoecological analyses of sediment cores will help the identification. Spatial metrics that characterize the historical spatial distribution needs to be developed.

It is desirable to develop specific targets for sub-regions, more sampling, including historical transects, and, hopefully, monitoring and assessment of wet prairie will provide information for this purpose.

6.2 Assessment Tools Needed

7.0 Notes

HIE-hydroperiod can be replaced by other hydrologic models that have a spatial resolution between 100m and 1000m and that can run simulations at a time scale of decades.

8.0 Working Group Members

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