Indicator 2.4 - Lake Okeechobee Aquatic Vegetation

What is the desired restoration condition?

The desired restoration condition for Lake Okeechobee aquatic vegetation is to restore and maintain healthy communities of submerged aquatic vegetation, littoral zone vegetation, and shoreline bulrush. Specifically, the Comprehensive Everglades Restoration Plan (CERP) will attempt to do the following:

- Maintain at least 40,000 acres of total submerged aquatic vegetation, and at least 20,000 acres of vascular submerged aquatic vegetation (eelgrass, peppergrass, and southern naiad).

- Maintain a substantially increased spatial extent of native, and noninvasive plants (e.g., spikerush, beak rush, willow, sawgrass, button bush, and pond apple) in the littoral zone.

- Maintain at least 5,000 acres of healthy bulrush along the lake's west and north based on a five-year rolling average of yearly data.

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

The submerged aquatic vegetation in Lake Okeechobee provides critical habitat for fish and wildlife, stabilizes shoreline sediments, and supports attached algae that help to remove phosphorus from the water (Havens et al. 2001, Havens 2004). The spatial extent of submerged aquatic vegetation varies in response to changing water levels. Because submerged aquatic vegetation is a keystone component of the ecosystem, affecting both fauna and water quality, it is one of the priority performance measures for evaluating CERP's success, as documented in Havens (2002). Because submerged aquatic vegetation responds to water clarity, which is affected by the amount of nutrients and algae present in the water, it also is an important performance measure for evaluating success of the Lake Okeechobee Protection Plan.

Construction of the Herbert Hoover Dike in the early to mid-1900s reduced the size of the lake's open water zone by nearly 30 percent. This resulted in a considerable reduction in average water levels and produced a new littoral zone within the dike. Variations in rainfall, evopotranspiration (loss of water to the atmosphere), water supply deliveries from the lake, operation of the lake's water schedule, and supply-side management have the potential to affect water levels or stage in the lake. This becomes stressful to the ecosystem when there are prolonged or extreme high or low lake levels. For example, between 1994 and 2000, high water levels in Lake Okeechobee resulted in a number of adverse impacts on the lake's plant communities, including water quality. Submerged beds of eelgrass (*Vallisneria americana*) and peppergrass (*Potamogeton illinoensis*) along the south and west lake shore were nearly eliminated. On the other hand, extremely low lake levels have allowed expansion of exotic vegetation. Due to low levels, torpedo grass (*Panicum repens*) and melaleuca (*Melaleuca* *quinquenervia*) species have expanded their range in Lake Okeechobee, displacing in some areas spikerush (*Eleocharis* spp.) and beakrush (*Rhynchospora* spp.) flats. Lake regulation schedules also presented problems in the Caloosahatchee Estuary, San Carlos Bay, and St. Lucie Estuary caused by excessive pulse releases of freshwater flow from Lake Okeechobee.

When the spatial extent of the submerged aquatic vegetation was measured in Lake Okeechobee just after a period of low water levels in 1989 to 1991, between 43,000 and 51,000 total acres were found. Between 13,000 and 22,000 acres were due to vascular plants (eelgrass, peppergrass, and southern naiad), with the remainder due to shrimpgrass (*Chara zeylanica*), a macro-alga that serves to stabilize sediments, but is not as useful for wildlife. Submerged vegetation was not sampled between 1991 and 1997. In 1998, after many years of high lake stage, a rough estimate by the Florida Fish and Wildlife Conservation Commission indicated that only 3,000 acres of total submerged vegetation remained in the lake. A detailed survey by the South Florida Water Management District in August 2000, after a managed lake recession (lowering lake levels), indicated that the community had recovered to 44,000 total acres, with 16,000 acres due to vascular plants. In September 2001, after a severe drought and record low lake stage, there were 37,000 total acres of submerged plants and 10,000 acres of vascular plants. In July 2002, the spatial extent of submerged vegetation was 43,000 acres, with 23,000 acres of vascular plants (primarily hydrilla, eelgrass, coontail, southern naiad, and peppergrass). In the most recent sampling, conducted in August 2004, the total acres had increased to nearly 55,000.

CERP's goals include lowering average water levels in the lake, reducing frequency of extreme high water levels, and decreasing phosphorus inputs. Under those conditions, the distribution and abundance of bulrush and submerged plants are expected to increase.

We expect that by providing a reduction in the frequency of extreme high water levels and low water levels and an increase in the frequency of spring recessions (see Indicator 2.1) will result in the following changes (Havens 2002): a) increase in spatial extent of bulrush along the western lakeshore and increased spatial extent of spikerush, beakrush, willow, and other native plants in the littoral zone; b) a reduction in the rate of expansion of exotic and nuisance plants; c) increase in spatial extent of vascular submerged plants, in particular eelgrass, peppergrass, and southern naiad; and d) reduction in the occurrence of harmful shoreline organic berms.

We expect that by reducing phosphorus loads from agricultural and urban activities to 40 parts per billion, in the pelagic zone (open-water area) will result in the following changes: a) a decrease in algal blooms; b) an increase in water clarity; c) an increase in the spatial extent and biomass of native submerged vegetation; and d) a decrease in the rate of nuisance and exotic plant species expansion along the edge of the littoral zone.

How is the interim goal for this indicator predicted?

At the present time, it is not possible to predict interim performance for this indicator. However, the South Florida Water Management District recently has completed development of a submerged vegetation model that links with an existing hydrodynamic model of the lake. This coupled hydrodynamic-water quality-vegetation model, the Lake Okeechobee

Environment Model (LOEM), is undergoing calibration and verification and should be ready for use in CERP applications in late 2005. It then will be possible to display predicted maps showing the spatial distribution of submerged plants under different water level management/ nutrient loading scenarios.

At this time the South Florida Water Management District has no plans to develop mechanistic models for emergent plant communities or the animals that they support. However, using existing information on emergent plant distribution in the lake's littoral zone and associated data on hydrology, it should be possible to develop simple geographic information system (GIS)-based empirical models of emergent plant distribution. Empirical relationships also might be developed between certain types of plants and the lake's faunal community, but this will require new research (see below).

What are the predictions for five-year increments?

Because the modeling tool still is under development, we cannot provide predictions at this time. When the modeling can be performed, it will be possible to compare the predicted spatial extent and composition (vascular plants versus shrimp grass) at different time intervals, and then make comparisons with the long-term desired restoration conditions of the CERP. As indicated, this will only be done for submerged plants.

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

A systematic sampling program for tracking actual changes in the submerged and emergent plant communities is 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?

Based on preliminary results from the LOEM, it appears that more information will be needed regarding how submerged and emergent plants, along with their associated periphyton, sequester nutrients from the water column. Information also is needed regarding the amount of shearing stress that is needed to break and/or uproot plants during high wind events (e.g., tropical storms, hurricanes, strong frontal systems).

We also recommend that research be done to quantify linkages between particular types of submerged and emergent vegetation and the fish and wildlife populations that they potentially can support. This will allow us to make inferences about those populations based on model predictions of plant distribution. Some of the key issues that should be considered are how changes in plant community structure affect spawning, juvenile survival, and foraging success of fish, as well as similar information for wading birds and migratory water fowl. We also need to better understand how changes in water level within a given plant community type influence its ability to function as habitat for aquatic animal populations. These recommendations are consistent with those provide in the *CERP Monitoring and Assessment Plan: Part1 Monitoring and Supporting Research* (RECOVER 2004).

References

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