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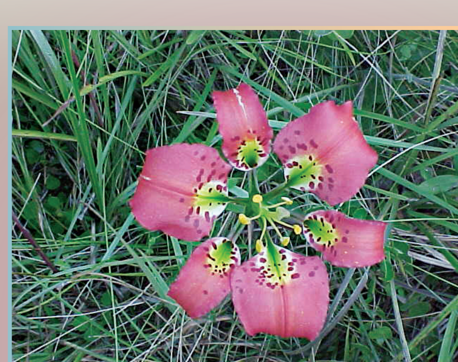
**Prepared in cooperation with**

**Pinellas County, Southwest Florida Water Management District, and Tampa Bay Water**

# Flooding Frequency Alters Vegetation in Isolated Wetlands

Saw palmetto



Pine lily

Flooded-area frequency data combined with vegetation assessments improve our ability to assess the ecological status of wetlands

## Introduction

Many **isolated wetlands**[1] in central Florida occur as small, shallow depressions scattered throughout the **karst topography** of the region. In these wetlands, the water table approaches land surface seasonally, and water levels and **flooding frequency** are largely determined by differences between precipitation and **evapotranspiration**. Because much of the region is flat with little topographic relief, small changes in wetland water levels can cause large changes in wetland surface area. Persistent changes in wetland flooding frequencies, as a result of changes in rainfall or human activity, can cause a substantial change in the vegetation of thousands of acres of land. Understanding the effect that flooding frequency has on wetland vegetation is important to assessing the overall ecological status of wetlands. Wetland **bathymetric mapping**, when combined with water-level data and vegetation assessments, can enable scientists to determine the frequency of flooding at different elevations in a wetland and describe the effects of flooding frequency on wetland vegetation at those elevations.

Five **cypress swamps** and five **marshes** were studied by the U.S. Geological Survey (USGS) during 2000-2004, as part of an interdisciplinary study of isolated wetlands in central Florida (Haag and others, 2005). Partial results from two of these marshes are described in this fact sheet.

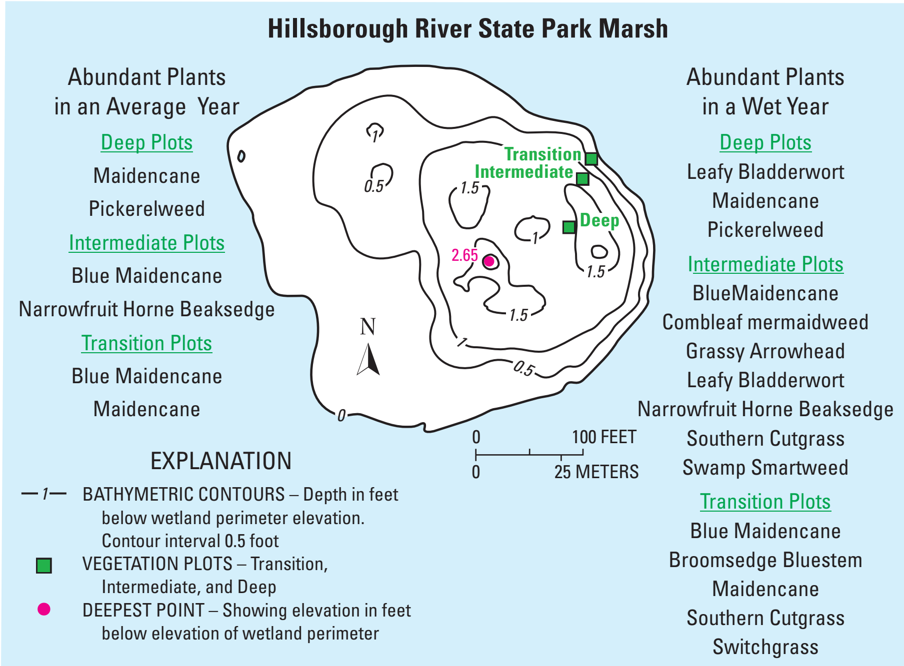
## Methods

Hillsborough River State Park (HRSP) Marsh has a maximum size of about 2 acres and a maximum depth of about 2.6 feet (fig. 1). This natural marsh is largely unaffected by human activities. W-29 Marsh has a maximum size of about 6.5 acres and a maximum depth of about 2.8 feet (fig. 1). This impaired marsh is located on a municipal **well field**. The effects of ground-water withdrawal in the well field and prolonged periods of less than average rainfall have lowered wetland water levels and reduced the frequency of flooding in this wetland.

The wetland perimeter was delineated at both marshes, and the perimeter elevation was determined (see Haag and others, 2005). Wetland stage (water level) was measured at staff gages, and bathymetric data were collected at many points throughout the interior of each wetland. Bathymetric contour maps were drawn, and wetland area and stored water volume were calculated.

Vegetation was assessed semiannually. At each wetland, a transect line was established from the perimeter to the deepest point in the wetland. Three vegetation zones were established along the transect line and were defined as **Transition**, **Intermediate**, or **Deep** based on their elevation relative to the elevation at the wetland perimeter. Vegetation was identified to species in fixed plots in each of the vegetation zones.

[1]Terms defined in the glossary are in **bold print** where first used in this fact sheet.



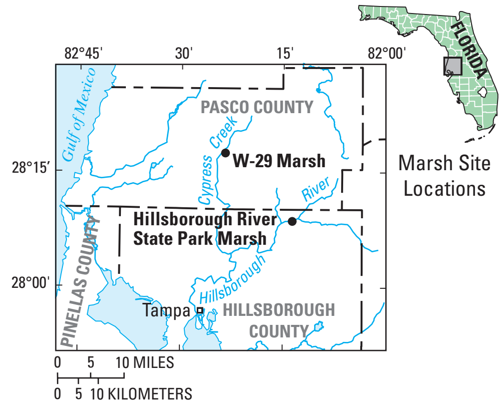
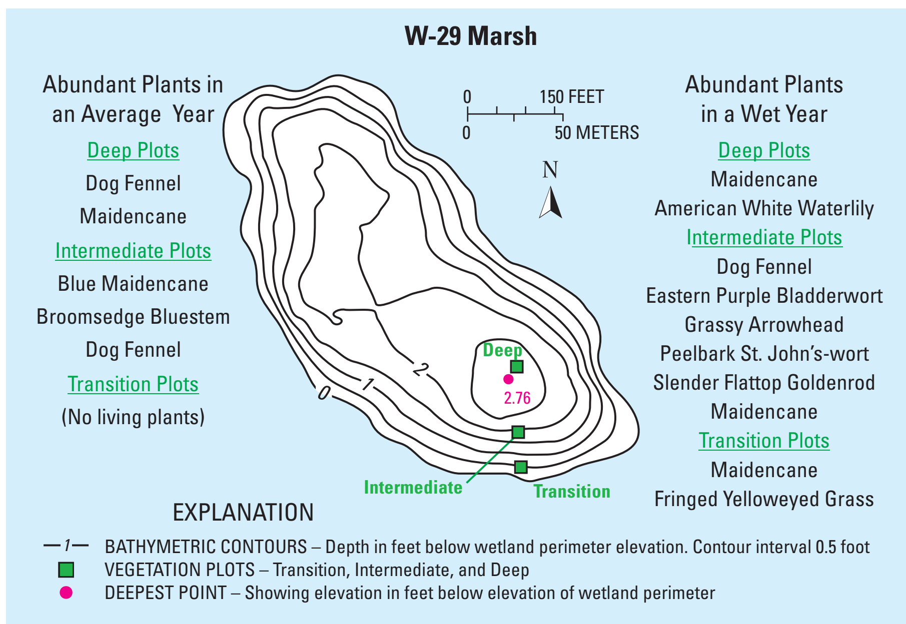




**Figure 1.** Bathymetric maps of Hillsborough River State Park (HRSP) Marsh (at left) and W-29 Marsh (below).

## Results

Establishing vegetation plots at distinctly different elevations allowed vegetation assessments to be directly related to wetland stage. Bathymetric data were used to further describe the relation between vegetation, stage data, and changes in flooded area in each wetland.

The percent of wetland area flooded and the percent of time flooded at HRSP Marsh (natural) and W-29 Marsh (impaired) were compared during 2 consecutive years. The first year (July 17, 2001 - July 16, 2002) was a period of average rainfall and average ground-water withdrawal in the well field, and is referred to in this fact sheet as an "Average Year". The second year (July 17, 2002 - July 16, 2003) was a period of greater than average rainfall and less than average ground-water withdrawal, and is referred to as a "Wet Year"




During the Average Year, 20 percent or less of the surface area at W-29 Marsh was flooded about 85 percent of the time (fig. 2), and for most of that time, the marsh was almost completely dry (less than 5 percent flooded). For the remaining 15 percent of the year only 21-60 percent of the total surface area of the wetland was flooded. In contrast, more than 40 percent of the surface area at HRSP Marsh was flooded about 75 percent of the time during the Average Year (fig. 3).

Rainfall amounts were almost identical at the two wetlands during the Average Year. Ground-water withdrawals in the well field were probably responsible for the low flooding frequency and small flooded area observed at W-29 Marsh compared to HRSP Marsh.

During the Wet Year, more than 60 percent of the surface areas at both W-29 Marsh and HRSP Marsh were flooded about 60-65 percent of the year (figs. 2, 3). The similarity in flooded areas between the natural wetland and the impaired wetland during the Wet Year reflected the substantially reduced quantities of ground-water withdrawals in the vicinity of W-29 Marsh, and the increased rainfall throughout the region during the year. W-29 Marsh received about 50 percent more rainfall and HRSP Marsh received about 25 percent more rainfall during the Wet Year than during the Average Year. Upper Floridan aquifer water levels beneath W-29 Marsh averaged about 14 ft higher during the Wet Year than during the Average Year. This change is likely the combined result of increased rainfall and reduced ground-water withdrawal.

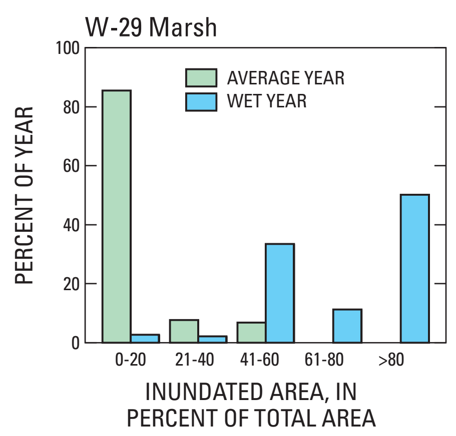



**Figure 2.** Inundated area at W-29 Marsh.

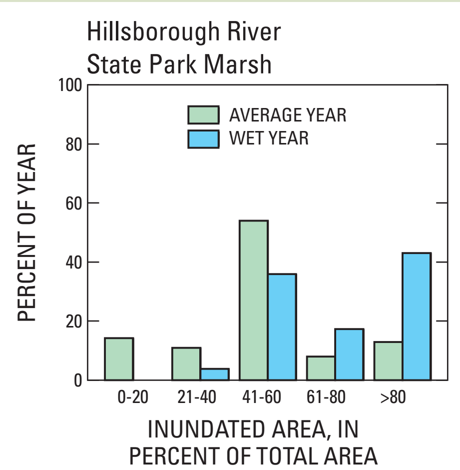



**Figure 3.** Inundated area at Hillsborough River State Park Marsh.

The frequency of flooding at the elevations of the Deep, Intermediate, and Transition vegetation plots also was compared at HRSP Marsh and W-29 Marsh during the same 2 consecutive years. During the Average Year, Deep plots at HRSP Marsh were flooded about 80 percent of the time (fig. 4). Intermediate plots were flooded for more than 70 percent of the time, and Transition plots had water at the surface more than 40 percent of the time. In contrast, Deep plots at W-29 Marsh were flooded only 30 percent of the time (fig. 5), Intermediate plots were flooded less than 10 percent of the time, and water was not present in the Transition plots at W-29 Marsh during the Average Year.

During the Wet Year, the flooded-area frequencies of these two marshes were more similar (figs. 4, 5). Deep and Intermediate plots were flooded 90-100 percent of the year in both wetlands. The greatest difference occurred at the elevation of the transition plots. At W-29 Marsh, transition plots were flooded about 50 percent of the year, whereas those at HRSP Marsh had water at the surface almost 90 percent of the year.

Vegetative surveys alone can be an ambiguous indicator of the frequency of flooding in different areas of some wetlands. Many marsh plants display broad tolerances for flooding and desiccation. In this study, several species were observed across a gradient of elevation in both of the wetlands (see plant lists in fig. 1). For example, at HRSP Marsh, maidencane (a wetland grass) was abundant in Deep and Transition plots in May 2002 when the ground was saturated, with no standing water. The species was again found at this site in Deep and

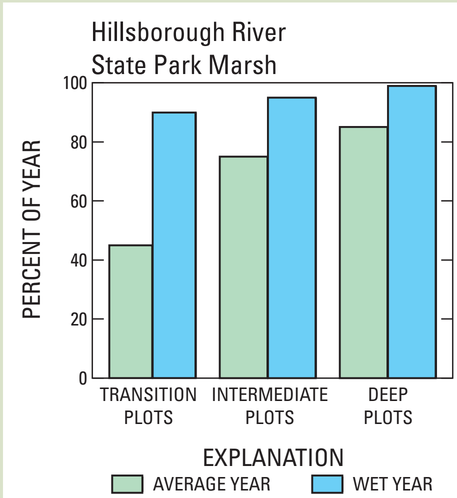



**Figure 4.** Duration of inundation at Hillsborough River State Park (HRSP) Marsh.

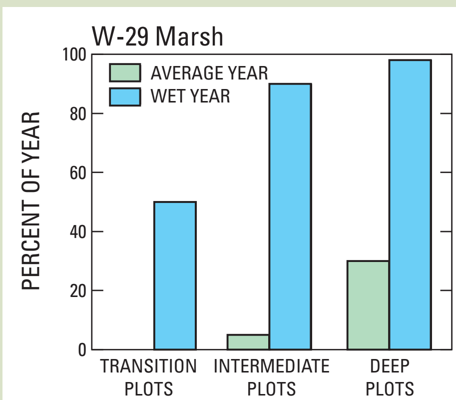



**Figure 5.** Duration of inundation at W-29 Marsh.

Transition plots in October 2003 when water depths were 10-15 inches. Dead maidencane was present in Deep and Intermediate plots at W-29 Marsh in May 2002 when those plots were dry. At W-29 Marsh in October 2003, maidencane was found in plots in all three zones where water depths ranged from 8-36 inches.

The occurrence of floating and submersed aquatic plants is a less ambiguous indicator of prior flooding in a particular wetland zone, although the duration of that flooding cannot be inferred reliably without access to bathymetric and stage data. For example, at HRSP Marsh (fig. 1) during the Wet Year, leafy bladderwort (a submersed plant) was found in Deep plots where water depths were 8-12 inches, but it was not present in the wetland during the Average Year. The Intermediate plots also contained leafy bladderwort and several other **obligate wetland plants** that were not present during the Average Year. At W-29 Marsh (fig. 1), the occurrence of American white water lily (a floating plant) in Deep plots coincided with water depths of 24-36 inches during the Wet Year. Intermediate plots also sustained much more flooding during the Wet Year, as indicated by the occurrence of eastern purple bladderwort (a submersed plant) and several other obligate wetland plants. During the Average Year, the diversity and density of wetland plants were much lower in both marshes.

Spatial and temporal patterns of flooding sustained over a period of years determine the distribution of long-lived wetland plants (trees and shrubs), and facilitate the long-term maintenance of viable habitat for wetland wildlife. Determining flooded-area frequencies for natural wetlands based on long-term stage records would provide a more representative indication of long-term average conditions compared to sporadic vegetation assessments with little or no associated stage data. The utility and robustness of estimates of long-term average conditions would be enhanced if a large number of natural wetlands representing a range of hydrologic conditions could be included.

## Conclusions

Wetland water-level changes can be related to changes in rainfall, and can indicate a connection between groundwater levels and the depth and frequency of flooding in isolated wetlands in central Florida. Vegetation assessments in wetlands were enhanced as a quantitative management tool when they were coupled with data on the elevation of vegetation plots and the location of transects, and when vegetation results were combined with information on wetland bathymetry. When the elevation of vegetation plots is determined, the composition of the vegetation community in those plots can be extrapolated to areas of similar elevation and flooding frequency throughout the entire wetland. In this way, bathymetric data can be used to expand wetland vegetation community assessment into the landscape scale, and the extent and duration of wetland flooding over time can be interpreted in terms of a loss or gain of functional wetland area.

## Reference


Haag, K.H., Lee, T.M., and Herndon, D.C., 2005, Bathymetry and Vegetation in Isolated Marsh and Cypress Wetlands in the Northern Tampa Bay Area, 2000-2004: U.S. Geological Survey *Scientific Investigations Report 2005-5109*, 49 p.


Spikerush

## Glossary of Terms

**Bathymetric mapping**—mapping the water depth of the wetland

**Cypress swamp**—a wetland with pond cypress (*Taxodium ascendens*) and other trees, shrubs, and vines

**Deep plot**—vegetation plot located near the deepest part of the wetland

**Evapotranspiration**—water that vaporizes from water or soil in a wetland, together with moisture that passes through plants to the atmosphere

**Flooding frequency**—the percent of the year when water covers some part of the wetland bottom

**Intermediate plot**—vegetation plot located halfway between the elevation of the deep plot and the elevation of the transition plot

**Isolated wetland**—a wetland with no apparent surface-water connections to streams, rivers, estuaries, or the ocean

**Karst topography**—a region underlain by limestone that contains solution cavities and where the physical features of the land surface (topography) include large and small depressions

**Marsh**—a wetland with rooted and/or floating aquatic plants but without trees

**Obligate wetland plant**—plant found in wetlands 99 percent of the time

**Transition plot**—vegetation plot located 3-6 inches below the elevation of the wetland perimeter, at the transition to upland vegetation

**Well field**—an area developed by a local or regional water authority where ground water is withdrawn and sent to a treatment and distribution system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