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Effects of desiccation duration on the community structure and nutrient retention of short and long-hydroperiod Everglades periphyton mats

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Abstract

Responses of periphyton communities to different relevant durations of dry down were assessed. Long-hydroperiod sites within Everglades National Park remain wet for greater than 8 months of the year while short-hydroperiod mats are wet for fewer than 4 months of the year. Dry down duration of long and short-hydroperiod Everglades periphyton was manipulated from 0 to 1, 3, or 8 months after which periphyton was rewetted 1 month and examined for algal species composition. The effects of desiccation and rewetting on periphyton nutrient retention were also assessed. Relative abundance of diatoms declined from an average of 47% in the long-hydroperiod community at the start of the experiment to 24% after 1 month of desiccation and only 12% after 8 months of desiccation. Short-hydroperiod periphyton contained a lower proportion of diatoms at the outset (3%), which declined to less than 1% after the 8-month desiccation treatment. A significant increase in the filamentous cyanobacteria *Schizothrix calcicola* occurred in long-hydroperiod periphyton mats during this same period, but not in short-hydroperiod mats. Long-hydroperiod periphyton communities had a greater response to desiccation overall, but short-hydroperiod community structure responded to desiccation more rapidly. Because short-hydroperiod communities dry frequently, they appear to cope better to desiccating conditions than long-hydroperiod periphyton communities. This is indicated by the dominance of desiccation resistant algal taxa such as the cyanobacterial filaments *S. calcicola* and *Scytonema hofmanni*. Long-hydroperiod periphyton mat communities converge compositionally to

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short-hydroperiod periphyton communities after prolonged desiccation. Desiccation and rewetting caused long-hydroperiod periphyton to flux greater concentrations of nutrients than short-hydroperiod periphyton. Significant increases in efflux occurred from 1 to 8 months for total phosphorus (TP) and from 1 to 3 and 8 months for total nitrogen (TN) and total organic carbon (TOC). Thus, changes in periphyton mat community structure and function with altered hydroperiod may have long-term ecosystem effects.

Keywords: Algal assemblages; Nutrient fluxes; Drying; Diatoms; *Schizothrix*; *Scytonema*

1. Introduction

In the shallow, hardwater wetland systems of the Everglades, periphyton communities are a prominent feature in the landscape and can be found as epiphytic mats, epipelic mats, epiphytes on the submersed stems of emergent macrophytes and metaphyton floating in the water column (Browder et al., 1981; McCormick et al., 1996; McCormick et al., 1998). These mats contribute more than half of the primary production in some Everglades environments (Childers et al., 2002) and have the capacity to sequester substantial quantities of phosphorus (Noe et al., 2003; Gaiser et al., 2004). Periphyton communities differ between long and short-hydroperiods and show contrasting patterns of seasonal variation in community structure. These differences, however, are primarily in species relative abundances (Gottlieb, 2003).

The Everglades has been characterized as a broad, slowly flowing river that varies seasonally in width and depth and has an array of combinations of geomorphology and hydrological regime (Douglas, 1947; Fennema et al., 1994). Because the Florida Everglades is currently undergoing a restoration effort, and a more natural hydroperiod regimen is one of the restoration targets, we need a greater understanding of the ecological effects of hydroperiod manipulation (Davis and Ogden, 1994). Hydroperiod refers to the spatial distribution, timing and duration of flooding (Townsend, 2001). Some Everglades marshes remain wet throughout the year, while others may only be inundated a few months of the year. Hydroperiod is one of the major drivers of plant and animal community structure in wetlands, and presumably hydroperiod also structures algal communities (Browder et al., 1981; Flora et al., 1988; Gunderson, 1994; Bruno et al., 2001).

Changes in hydroperiod will lead to changes in desiccation stress, which affects algal community structure and productivity (Fritsch, 1922; Browder et al., 1981). Until recently, few studies investigated these effects on algal communities. Fritsch (1922) performed early studies of soil algae and determined that desiccation resistant taxa often had large mucilage sheaths. Fritsch (1922) also speculated that there was no true distinction between aquatic and terrestrial algae. Evans (1959) studied effects of desiccation on litter and mud from pond margins. He discovered no initial decreases in algal frequency or number of species upon drying. As moisture levels decreased below 50%, however, species richness and cell abundance rapidly declined. The majority of studies on algal desiccation have been conducted in tidal marine settings (Stephenson and Stephenson, 1949; Lubchenco, 1980; Neto, 1992). More recently, the effects of desiccation on algal community structure and