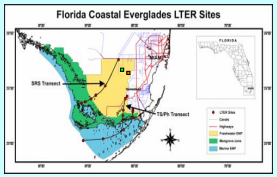
The Effects of Desiccation Duration on Periphyton Mat Structure and Function after Rewetting



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Abstract:

The Everglades wetlands are a mosaic of short and long hydroperiod marshes. Periphyton mats, a complex of diatoms, green algae, cyanobacteria, and bacteria, are a prominent feature of these marshes (Loveless, C.M. 1959). Preliminary results suggest there is significant variation in mat structure and function between long and short hydroperiod communities. I performed an experimental manipulation to determine the effects of hydroperiod on periphyton structure and function. I predicted: 1) hydroperiod, or the duration of dry down, will affect periphyton community structure and function after rewetting; 2) the greater the duration of dry down, the more similar long hydroperiod periphyton mat communities become to short hydroperiod periphyton communities and conversely the longer short hydroperiod mats are submerged, the more similar they become to long hydroperiod periphyton mat communities. I sampled floating periphyton mats associated with *Utricularia purpurea* from three long hydroperiod sites and benthic periphyton mats from three short hydroperiod sites. Each mat sample was sectioned into four mat fractions and dried for varying durations. At each of the sample intervals replicate water samples were collected for water TN, TC and TP analysis. Results indicate a significant change in periphyton community structure in the directions hypothesized, a significant increase in the release of TOC and TP from periphyton mats, and no significant change in the organic content of the mats with increasing duration of desiccation. The results of this study provide experimental evidence of the response of periphyton communities to future hydroperiod manipulation during the Everglades restoration activities.

Introduction: Why study hydroperiod effects on periphyton communities?

- Early indicators of community changes in aquatic ecosystems (McCormick and Cairns 1996).
- Preliminary results indicate significant variation in mat structure and function between short and long hydroperiod communities.
- Restoration activities will alter current hydroperiod regimes in ENP.

Figure 1A
Shark River Slough
(Long Hydroperiod)

Figure 2A
Representative Long Hydroperiod Diatoms

Mastogolia smithii

Fragilaria synegrotesca

Figure 1B
Chekika
(Short Hydroperiod)

Figure 2B
Representative Short Hydroperiod Algae

Brachysira neoexilis

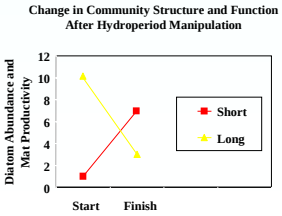
Scytonema hofmanii

Encyonema microcephala

Chroococcus sp.2

Hypothesis:

- Hydroperiod, or the duration of dry down, will affect periphyton mat structure and function after rewetting.
- The greater the duration of dry down, the more similar long hydroperiod periphyton mat communities become to short hydroperiod periphyton mat communities.



Experimental Design:

Three short and three long hydroperiod sites (with three replicates/site) were sampled.

Samples were divided into four mat fractions and dried for 0,1,3, and 8 months respectively and then rewet for one month.

Sample collection and analysis:

Water sampled before rewetting and after 48 hours of rehydration for TN, TC, TP and nutrient analysis

Five periphyton cores/sample collected and frozen.

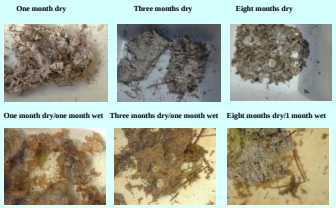
Subsample of periphyton removed to determine organic content and periphyton community structure.

All algal counts performed on wet mounts

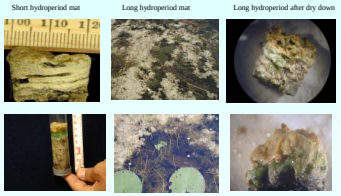
Results: Physical, Chemical, and Community

Physical Results: Effects of Dry Down on Short Hydroperiod Mat Structure

Physical Results: Effects of Dry Down on Long Hydroperiod Mat Structure

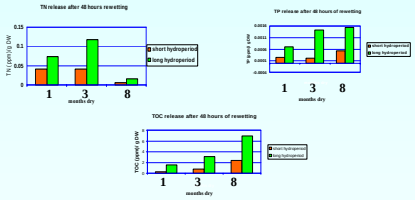


Comparison of Mat Structure After Desiccation

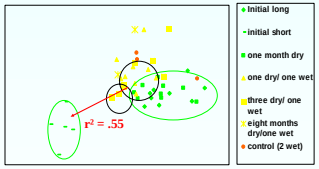


Note that after the dry down treatment long hydroperiod mats become laminated. This structure is similar to that of benthic short hydroperiod mats which occur in Everglades National Park.

Chemical Results: TN, TP, and TOC Fluxes from Periphyton into Water

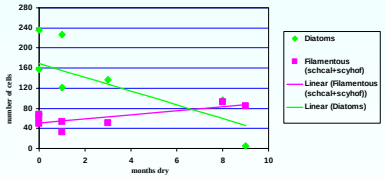


Community Results: Soft Algae Community Structure Related to Dry Down Duration



NMDS biplot vector is shown in the direction of increasing desiccation

Effects of Desiccation Duration on Diatom and Blue Green Filament Abundance



Conclusions/Discussion:

- Increasing desiccation duration leads to lamination in long hydroperiod periphyton mats.
- There is a significant increase in the flux of TP and TOC from periphyton mats with increasing desiccation duration.
- The greater the duration of dry down, the more similar long hydroperiod periphyton mat communities become to short hydroperiod periphyton mat communities.
- Increasing desiccation duration leads to significant increases in the filamentous, blue-green algae *Scytonema hofmanii* and *Schizothrix calcicola* and a significant decrease in total diatom abundance (i.e. *Fragillaria synegrotesca*).
- In addition to providing specific algal indicators of hydroperiod in Everglades National Park, these results indicate that relatively small changes in hydroperiod cause significant changes in periphyton nutrient content and periphyton physical and community structure.

References:

1) Loveless, C.M. 1959. A study of the vegetation of the Florida Everglades. Ecology 40:1-9.
2) McCormick, P.V. and Cairns, J. Jr. 1996. Plants for Environmental Studies. CRC Press pp. 177-207.

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