# INTERACTIONS BETWEEN PERIPHYTON AND MACROPHYTES IN THE SOUTHERN EVERGLADES MARL PRAIRIES, FLORIDA, USA

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## ABSTRACT

Interactions between plant and periphyton communities have been the focus of many investigations in the past. Those studies revealed that both communities can suppress each other's production, but can also benefit each other. Plant and periphyton communities are strongly influenced by hydrology, but the existing plant- and periphyton-based hydrologic inference models have not considered the potential mediating effect of their interactions. In order to describe how plant and periphyton communities interact in different hydrologic settings, we conducted a harvesting experiment in three areas in the southern Everglades marl prairies with contrasting hydroperiods.

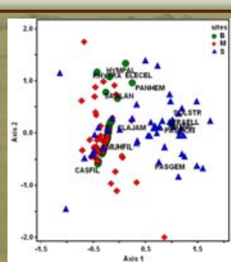
This study revealed that removal of macrophytes increased biomass of periphyton at intermediate- and short-hydroperiod locations, while total plant biomass was negatively affected by periphyton removal at long- and intermediate-hydroperiod sites. Periphyton removal especially negatively affected biomass of *Muhlenbergia filipes* at short-hydroperiod site during wet periods, while the process seemed to benefit *Panicum tenerum* at intermediate-hydroperiod site. Biomass of *Cladium jamaicense* was also reduced in the absence of periphyton, although this trend was not significant across all sites. The same was true for *Schizachyrium scoparium* var. *rhizomatum* and *Rhynchospora tracyi* at intermediate-hydroperiod site. Species richness was negatively affected at site with longest hydroperiod during dry periods.

Enhanced growth of periphyton after plant removal was most likely due to the opening of new areas for algal colonization and increased availability of sedimentary nutrients. Periphyton harvesting negatively affected plants, which probably heavily rely on moisture and nutrients stored in periphyton mats for seed germination, and survival during dry periods. The removal was likely beneficial to the young shoots of plants that have delicate structure, especially in the early stages of their growth, when they are prone to smothering by thick periphyton mats.

## STUDY SITES

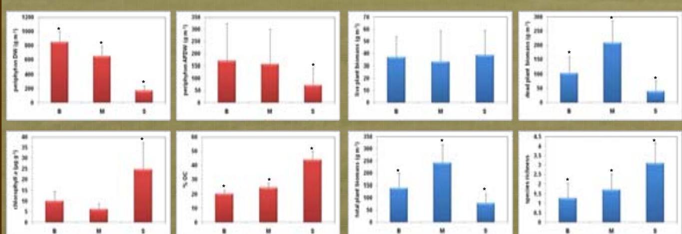


▪ Locations of the study sites in Everglades National Park, FL, USA





▪ Sites had sign. differ. plant communities (p < 0.05)





▪ Differences in periphyton and plant biomass among study sites. Asterisk indicates significant differences at α < 0.05

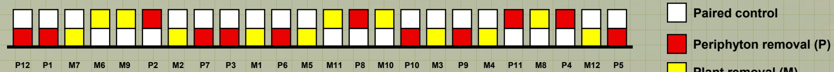
▪ Site B had the longest hydroperiod, followed by sites M and S (~6.6- vs. ~6.5- and ~3.8-months, respectively)

▪ Plant cover was highest at site M, followed by sites B and S (26.4 % vs. 15.7 % and 13.3 %, respectively); differences were not significant between sites B and S (p = 0.712)

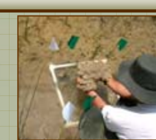
▪ Plants were tallest at site B, followed by sites M and S (66.2 cm vs. 48.2 cm and 44.8 cm, respectively); differences were not significant between sites M and S (p = 0.716)

▪ Site S had the highest percentage of live plant cover, followed by sites B and M (85.5 % vs. 51.7 % and 50.9 %, respectively); differences were not significant between sites B and M (p = 0.744)

## EXPERIMENTAL DESIGN







▪ Four 50-m-long transects established at each site in May/June 2003

▪ 12 periphyton- and 12 macrophyte paired control and treatment plots set-up along each transect with randomly given numbers between 1 and 12

▪ Sparsely vegetated plots chosen for periphyton-removal plots and densely vegetated plots chosen for macrophyte-removal plots

▪ 8 pairs of additional plots established in May 2003 to confirmation that control and treatment pairs have similar plant and periphyton biomass and structure

▪ Periphyton and plants growing in and around the plots were continuously removed on bi-monthly basis for 1 year

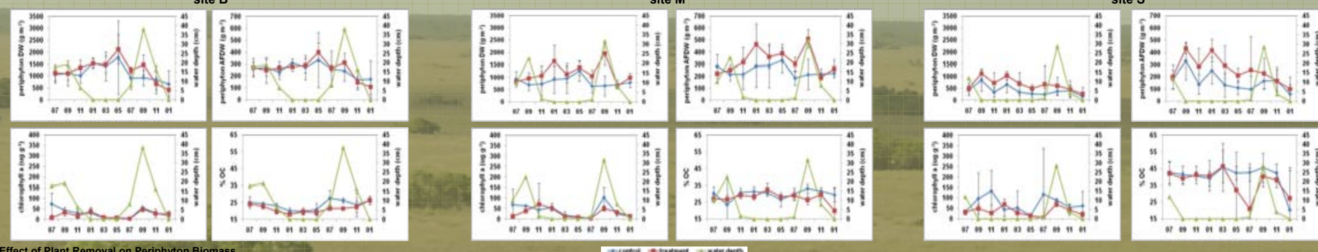
▪ After 1 year, plots began to be harvested every 2 months between 05/2004 and 04/2006 to estimate the effect of periphyton removal on plant biomass and vice versa

▪ Periphyton material was processed in laboratory to determine periphyton dry weight (DW), ash-free dry weight (AFDW), organic carbon (OC) content, and chlorophyll *a* (CHL*a*) concentration

▪ Dead and live plant material were dried and weighed; live plant material was sorted first by species

▪ One-way ANOVA with post hoc Tukey's test was used to test the differences among sites in the initial set-up, *t*-test was used to test the differences between control and treatment plots, repeated measures ANOVA was used to test the effect of plant removal on periphyton biomass and vice versa, PERMANOVA was used to test the differences in plant structure among sites

## RESULTS



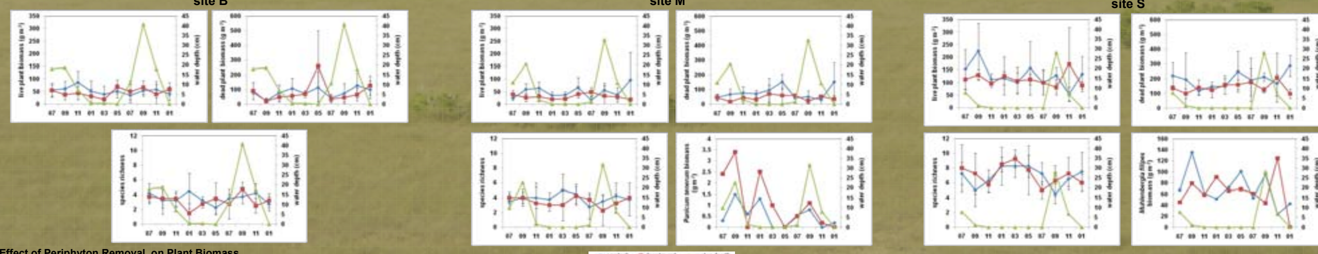


**Effect of Plant Removal on Periphyton Biomass**

▪ DW and AFDW higher at site M during 2005 wet period (p = 0.008 & p = 0.047, respectively) and site S during dry periods (p = 0.048 & p = 0.015, respectively); no change at site B (p = 0.807 & p = 0.604, respectively)

▪ Chlorophyll *a* concentration lower at all sites during several wet period sampling events (p < 0.05)

▪ OC content lower at sites B and S during wet periods (p = 0.045 & p = 0.048, respectively); no change at site M (p = 0.275)





**Effect of Periphyton Removal on Plant Biomass**

▪ Live biomass not affected at site B (p = 0.31), lower at sites M and S during some wet period sampling events (p = 0.008 & p = 0.034, respectively)

▪ Dead biomass lower at site B towards the end of the 2005 wet period (p = 0.02), generally lower at site M (p = 0.031)., and lower during several dry period sampling events at site S (p = 0.03)

▪ Live biomass of *Panicum tenerum* increased at site M , while live biomass of *Muhlenbergia filipes* decreased at site S during some wet period sampling events (p = 0.014)

▪ Species richness lower at site B at the beginning of the 2005 dry period, but higher towards the end of that period (p = 0.032); no difference at sites M and S (p > 0.05)

**Summary**

▪ The largest aver. increase in peri. DW and AFDW due to plant removal occurred at short-hydroperiod site S (62% and 59%, respectively), followed by intermediate-hydroperiod site M (41.1% and 32.7%, respectively), and long-hydroperiod site B (11% and 2.2%, respectively). The largest decline in chlorophyll *a* conc. occurred at site S (47.9%), followed by sites B and M (28.4% and 27.2%, respectively), while %OC dropped the most at site B (9.3%), followed by sites S and M (8.4% and 6.9%, respectively)

▪ The largest decrease in tot., dead and live plant biomass due to peri. removal occurred at site M (aver. 40.2%, 43.9% and 37%, respectively), followed by sites S and B (aver. 20.5%, 26.4% and 11.7% and 4.8%, 0.2% and 11.7%, respectively)

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