Effects of Returning Flow to the Florida Everglades on the Freshwater Macroinvertebrate Community

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Introduction

Macroinvertebrates are vital to moving organic matter up trophic levels. They are a main source of food for fish and many species of birds[1]. Returning flow has been shown to alter macroinvertebrate communities in river systems around the world[2,4], and with restoration efforts in the Florida Everglades focusing on returning flow[5], we have initiated an investigation to determine how flow may effect the macroinvertebrates within freshwater sloughs. Flow could have a direct effect on some small (<3mm) macroinvertebrates (infauna) by physically pushing them downstream. It is also possible that food quality may improve by increasing P, however, this increased P could also diminish periphyton mats that infauna use as cover[3] (Fig. 1) making them more susceptible to predation. Large Rare macroinvertebrates may benefit from enhanced production if they can withstand the flow and altered structure.

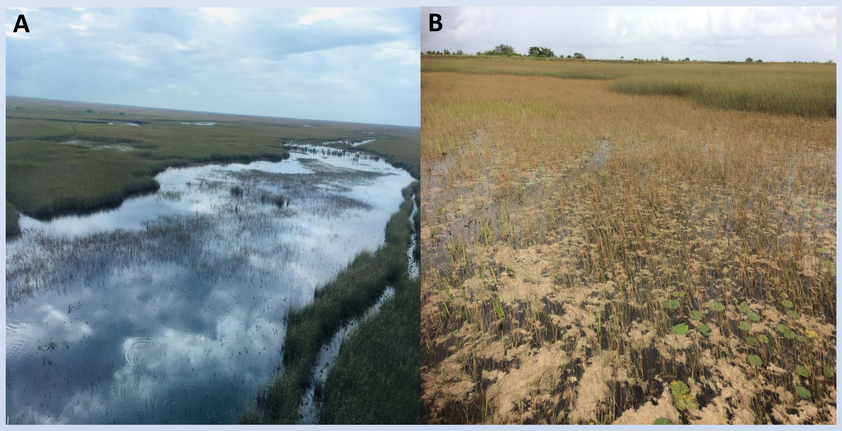

Figure 1: Typical slough vegetative cover within the high flow sloughs (A) and the control sloughs (B) of DPM.

Methods

Field: We sampled three transects (Control 1, Control 2, and Flow) within the Decompartmentalization Physical Model (DPM) footprint (Fig.2) during a flowing period. The Flow transect was positioned between the two Control transects to allow us to control for possible NE to SW gradients (Table 1). We also used transects to account for any possible vegetation or flocculant changes as you get further from the levee. Within each transect we selected six sloughs (total of 18) and randomly generated four 3m x 3m plots within each slough. In the winter of 2018, flow began on January 19th. We began sampling on January 29th allowing the system 10 days to equilibrate. Using D-framed dip nets, two sweeps were conducted at ten stations within each plot collecting the floating vegetation and the benthic flocculant material. Large rare macroinvertebrates (e.g. shrimp, crayfish, adult insects, etc.) were searched for in the field while a 3L subset of material was brought back to the lab and searched for any infauna (Fig.3). The results presented in this poster are for the 9 sloughs nearest the L67A (three per transect).

Stats: The control transects were combined and linear models were conducted to compare macroinvertebrate densities between control versus flow transects. To help explain the slough-level variation of infauna densities we also conducted a multiple linear regression with slough-level environmental parameters (biovolume, floc depth, water depth, and flow) and reported the best single variable model for total infauna. The best 2-parameter models contributed little to the adjusted R^2 values.

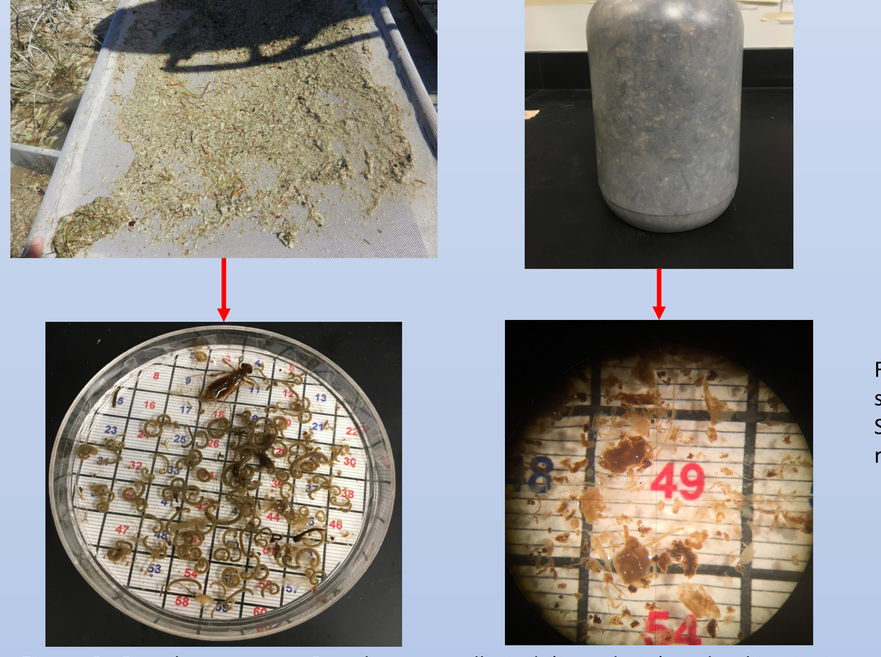

Figure 3: Sampling process. Sample were collected (top photo) and split into two different groups, the LR (left side) and infauna (right side) . The LR sample was placed in a large bin until sampling was completed. The LR sample was then placed on a bar seine and searched in the field. All LR collected were placed into a vial until they were identified and counted in the laboratory. The infauna sample was placed in a 500µm sieve bucket, of which 3L was placed in a 1gal jar and preserved with NOTOXhisto while the remaining infauna sample was put on the bar seine and searched for LR. The preserved infauna sample was taken back to the laboratory where it was searched using a dissection microscope.

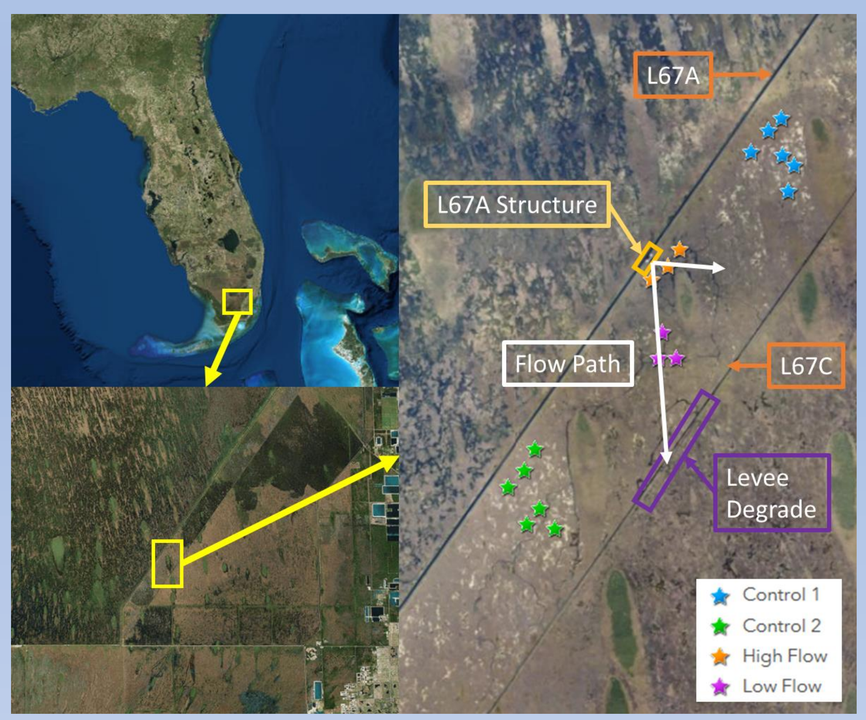

Figure 2: Location of sloughs (stars) and their arrangement along the three transects between the L67A and L67C levees within the DPM. The DPM is a landscape scale field test investigating the impact of flow on numerous environmental parameters within the Everglades.

Transect	Slough	Average Water Depth (cm)	Average floc depth (cm)	Average Biovolume (mL/m²)	Average Velocity (cm/s)
C1	C1-A	48.8	25.3	6460	0.423
C1	C1-B	58.8	10.0	5152	0.536
C1	C1-C	43.6	30.5	7360	0.190
C2	C2-A	24.7	29.8	12080	0.186
C2	C2-B	39.4	18.3	2880	0.158
C2	C2-C	32.8	22.4	3840	0.215
Flow	E300	74.5	8.5	240	3.147
Flow	Hansen	64.8	14.6	3960	2.431
Flow	RS1	63.8	16.2	0	4.045

Table 1: Average water depths (cm), floc depths (cm), biovolume (mL/m²), and water velocity (cm/s) at the nine sloughs closest to the L67A.

Results for Infauna

- Chironomids dominated the macroinvertebrate assemblages; 84% and 69% of the infauna and LR macroinvertebrates, respectively.
- Mean infauna densities (#/m²) were lower in the flowing sloughs, but the variation made the results non-significant at $\alpha = 0.05$ ($F_{1,7} = 4.26$, $p = 0.078$) (Fig. 4A).
- Chironomid densities did not differ significantly between control and flowing sloughs ($F_{1,7} = 2.83$, $p = 0.14$) (Fig. 4B)
- Infauna and chironomids per gram of dry vegetation had no significant difference ($p > 0.6$) when comparing control versus flow (data not shown).
- Variation in infauna densities across sloughs in DPM increase with biovolume of periphyton and submerged aquatic vegetation (SAV) ($R^2 = 0.71$, slope $p < 0.05$, Fig. 4C).

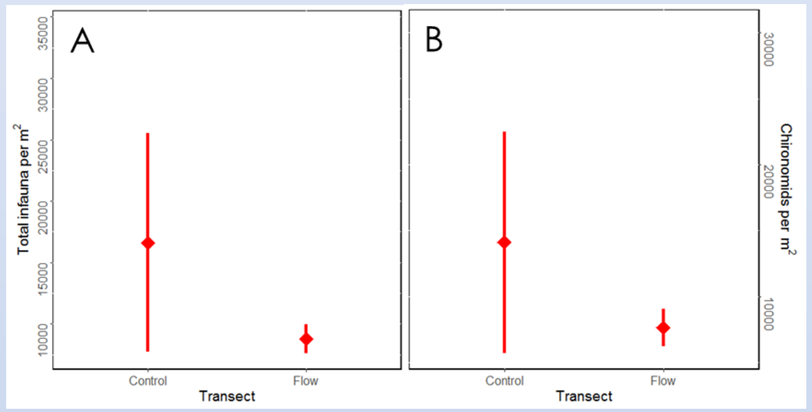

Figure 4: Mean (± 95% CI) infauna (A) and chironomid (B) densities (#/m²) of sloughs nearest the L67A. Infauna densities versus biovolume of periphyton and SAV (C), the filled black circles represent flowing sloughs, the open black circles represent control sloughs, and the dashed blue line is the best fit line.

Results for LR Macroinvertebrates

- There was a significant difference in total LR densities ($F_{2,6} = 8.16$, $p = 0.019$), we ran a pairwise comparison and found that C2 had near significant difference with C1 ($p = 0.089$), C2 had a significant difference with Flow ($p = 0.017$), however C1 had no significant difference with Flow ($p = 0.41$) (Fig. 5A)
- LR chironomid densities did not differ significantly between control and flowing sloughs ($F_{1,7} = 4.12$, $p = 0.082$) (Fig. 5B)

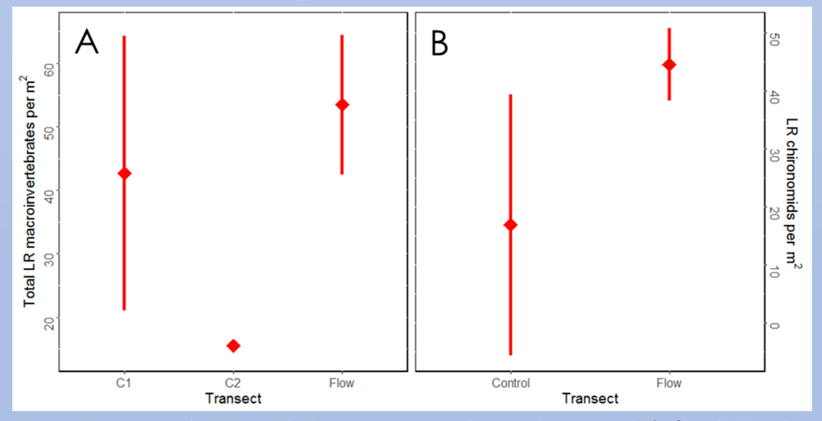

Figure 5: Mean (± 95% CI) LR macroinvertebrate densities (#/m²) of sloughs nearest the L67A. The control transects were combined (n=6) for LR chironomid densities (B), but were not combined for total LR densities (A).due to variations between the two.

Discussion

We did not find any consistent statistical density difference between the control sloughs and the flowing sloughs. The differences observed for the larger macroinvertebrates could be explained by other spatial variable conditions within the pocket. We did observe suggestive trends in the infauna densities; which appear to be explained, at least to some degree, by decreased biovolume of SAV and periphyton in the flowing sloughs . We still have more analysis to look at including changes in community composition, biomass, and summertime densities of macroinvertebrates.

Literature Cited

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