Charles E. Schmidt College of Science

Cascading effects of vegetation on peat soil properties and crayfish survival in the Everglades.

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Altered hydrology and nutrient pollution in the Florida Everglades have resulted in the replacement of native vegetation by invasive cattails (Typha spp.). This change in vegetation may influence the quantity and quality of the underlying organic soils, as well as the faunal populations it supports. Procambarus fallax (slough crayfish) is a mid-trophic omnivore that relies on peat as habitat, food source, and dry season refugia. Our goal is to determine whether shifts in the dominant plant community affect peat characteristics or have cascading impacts on the growth and survival of crayfish. We assessed differences in soils from native and cattail-invaded sloughs with three experiments: 1) comparison of the physical properties of the soils 2) comparison of the nutritional value of detritus for juvenile crayfish using a growth assay experiment, and 3) evaluation of the quality of peat as burrowing substrate for P. fallax under a simulated water table drawdown. Understanding these indirect linkages between vegetation and crayfish populations in the Everglades can provide insight on the consequences of vegetation shifts away from native plant communities for ecosystem trophic dynamics.

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I. INTRODUCTION

The Everglades are peat-forming wetlands, with thick organic soil layers (peat) formed by the accumulation of detrital plant biomass over the past 4000 years. Feedbacks between the physical environment and vegetation govern the process of peat formation and maintenance. Altered hydrology and nutrient pollution have resulted in the replacement of native vegetation by invasive cattails (*Typha* spp.) throughout the Everglades. This change in vegetation may influence the quantity, quality, and physical properties of soil detrital inputs, as well as the faunal populations it supports. *Procambarus fallax (*slough crayfish) is an important mid-trophic omnivore that relies on Everglades peat as habitat, food source, and dry season refugia. The goal of this research is to determine whether differences in the quality and quantity of soil organic matter have cascading impacts on the growth and survival of crayfish populations.

In this study, we evaluated the influence of peat origin (Slough vs Cattail) on 1) crayfish burrowing success and survival with a simulated dry season water table drawdown experiment and 2) crayfish growth response with a juvenile crayfish growth assay.

Figure 1. Crayfish being collected from WCA-3A.

II. BURROWING SUCCESS

Figure 2. Plastic tubs of peat arranged in mesocosm tanks at the UF-IFAS facility in Davie (left). The slough crayfish, *Procambarus fallax* next to tip of index finger (right).

- 20 tubs of cattail and slough peat saturated in mesocosm with four adult crayfish/tub **(Figure 2)**
- Water depth incrementally lowered to a maximum depth of -22cm (i.e., dry season conditions)
- After 10 weeks, the tubs were excavated and survivors' length and mass were recorded

Crayfish survival did not differ between substrates (t_1=2.02, p=0.42), although there were a greater number of burrows after the first week in slough peat (t_1=2.02, p<.01; **Figure 3**). Cattail peat had greater average subsidence with water draw-down (t_1=2.02, p<.01), with a greater rate of subsidence than slough peat during the initial phase of drying (**Figure 4**)**.** These data suggest it is more difficult for crayfish to construct burrows in cattail peat, although survival once burrows are formed is equivalent among peat types.

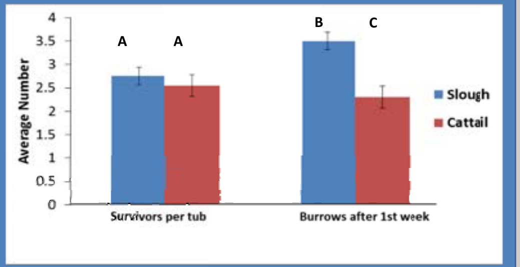

Figure 3. The effects of substrate type on average number of survivors (4 per tub) and number of successful burrows after one week of drydown.

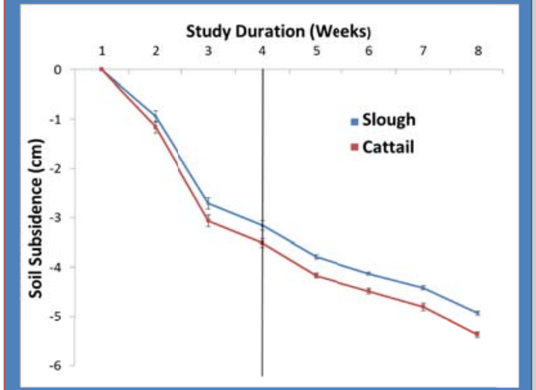

Figure 4. Average soil elevation loss (±SE) due to subsidence during the two month experiment. The black vertical line indicates lowest water point at -22 cm.

III. JUVENILE GROWTH

Figure 5. Peat collected for growth experiment (left) and growth chambers set up in the FAU greenhouse (right).

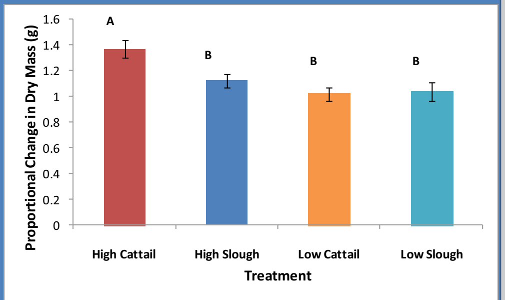

Figure 6. Average change in proportional dry mass (±SE) among four treatments varying in peat origin and peat quantity over eight week growth study.

- 40 juvenile crayfish placed in individual rearing chambers (**Figure 5**)
- Crayfish provided fresh, homogenized peat given of varying peat origin (Slough vs Cattail) and quantity (High vs. Low).
- Wet mass, carapace length, and molting recorded weekly

There was a significant effect of peat origin ($F_{1,7}$=4.54, p=0.04) and peat quantity ($F_{1,7}$=11.76, p<.01) on crayfish growth, as well as a significant interaction ($F_{1,7}$=7.21, p = .021). The high cattail treatment had the greatest increase in proportional dry mass over eight weeks (Figure 6). This suggests an increased nutritional benefit from cattail peat when it is provided in larger quantities.

IV. IMPLICATIONS

- **Crayfish have greater burrowing success in slough derived peat over cattail derived peat.**
- **Extreme drying events coupled with poor burrowing success could pose risks to crayfish populations.**
- **Peat quantity has a greater effect on crayfish growth than peat type.**
- **Habitat homogenization by cattail may increase crayfish growth potential based on the quality of detrital food sources.**

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