Drought and Large Fish Re-Colonization Have Variable Effects on Macroinvertebrates in Experimental Wetlands

Natalie Knor and Nathan J. Dorn

Introduction

Drought leading to local dry-disturbances (no surface water) has the potential to dramatically alter freshwater animal communities.1,2 Drying may kill a fraction of local populations, but upon re-flooding the disturbance can also alter food web interactions as well as resources for re-colonizing animals and plants. The net effects of a drying and re-wetting cycle on aquatic invertebrate populations depends on invertebrate life history and taxon-specific sensitivities to predator reduction and habitat changes generated by the drying.3,4 Some taxa may be enhanced following dry-disturbances while others experience reductions.

In the Florida Everglades, dry-disturbances vary spatially and temporally and can be exacerbated by water management practices. Large-bodied predatory fishes, like sunfish (Centrarchidae) are important top predators in aquatic ecosystems,5,6 and they generally decline in the Everglades following years with low water levels.7

We examined the net effects of drying history and predatory sunfish on population growth (density) of large wetland macroinvertebrates (crayfish and dragonflies) with a 6-month experiment that manipulated drying history and large-bodied fish.

Objectives

To quantify the population responses of crayfish (Procambarus fallax) and dragonflies (Order: Odonata) to drying history and sunfish re-colonization in wetlands

Methods

We altered the hydrologic history and presence of sunfish (Lepomis spp.) in nine 18 m² experimental wetlands with natural sedge vegetation. We simulated a dry-disturbance by drying six of the wetlands in May for 2 weeks. Upon re-flooding, we stocked three of the previously dried wetlands with sunfish (6 fish per tank), which created three different treatments: previously dried without sunfish (low re-colonization), previously dried with sunfish (fast re-colonization), and permanently wet with sunfish. The experimental wetlands were stocked or re-stocked with adult crayfish (P. fallax), grass shrimp, mosquitofish, and Lepomis spp. Dragonflies re-colonized wetlands through natural reproduction. Adult activity was measured twice weekly by recording the number of individuals from each species that landed on or hovered over each tank. Using 1-m² throw traps we quantified the mean densities of invertebrates, fish, stems, and the volume of submerged vegetation in the wetlands six months after re-flooding. Abundances (number or g/m²) were analyzed with ANOVAs using wetlands as replicates (n=3 per treatment).

Results and Conclusions

• Crayfish biomass was higher in the treatment without sunfish than in treatments with sunfish (Figure 1, p=0.0043), and crayfish density showed a similar pattern (p=0.0539).

• When sunfish were present the drying history did not affect crayfish biomass density (Figure 1).

• Crayfish populations in wetlands with sunfish were dominated by small juveniles, suggesting that the direct consumptive effects of the sunfish were preventing recruitment of crayfish to larger juvenile and adult sizes.

• Larval dragonfly densities (all species combined) were higher in the continuously flooded wetlands than in the previously dried wetlands (p=0.0095) and were unaffected by the presence of sunfish in wetlands that had previously dried (Figure 2a).

Results and Conclusions, cont'

• The three most abundant dragonfly species showed approximately the same pattern, with C. eponina found only in all wet treatment replicates, E. simplicollis found in two of the wet treatment replicates, and P. longipennis found in all three treatments but generally less abundant in dried treatments (Figure 2).

• Daily observations of adult activity over the six months did not differ between treatments (Table 1, all p-values > 0.3185), suggesting that differences in larval densities may be due to mortality occurring in the wetland and not adult oviposition choices.

• Mosquitofish densities were highest in the permanently wet treatment, but mosquitofish biomass did not differ between treatments. Densities of other animals also did not differ between treatments (Table 2).

• Sun densities of Eleocharis cellulosa were similar across all treatments, but the volume of submerged vegetation (Utricularia spp.) was higher in the continuously flooded treatment (Table 2).

• The results of this experimental study indicate that crayfish population growth is enhanced by sunfish reductions that can be caused by droughts, while dragonflies are not as sensitive to sunfish and may suffer indirect losses due to other changes caused by dry-disturbances.

Acknowledgements: We are grateful to the University of Florida-IFAS for providing the macroinvertebrates. We would also like to thank Jake Bransky for his assistance in the field.

References


Table 1: Mean total adult individuals (± SE) observed/houring ± 15 min over a week in each treatment over 53 observation days (approximately 3 hours per tank) and their mean larval densities of a) all taxa combined, b) Orthetrum caledonicum, and c) Eastern pondhawk, Erythemis simplicollis. (Figure 1). Mean larval densities (no./m²) for a) all taxa combined, b) Orthetrum caledonicum, and c) Eastern pondhawk, Erythemis simplicollis. (Figure 1).