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Ethan G. Staats
Virginia Commonwealth University, staatseg@vcu.edu

Salvatore J. Agosta
Virginia Commonwealth University, sagosta@vcu.edu

James R. Vonesh
Virginia Commonwealth University, jrvonesh@vcu.edu

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Emergent non-consumptive predator effects alter habitat colonization by mosquitoes

Ethan G. Staats[1], Dr. Salvatore Agosta[2], and Dr. James R. Vonesh[1]
1: *VCU Biology* 2: *VCU Center for Environmental Studies*

Introduction

- Top-down consumptive control (suppression) is an important driver of populations and communities of prey organisms
- Diverse predator assemblages often yield non-linear suppression with respect to constituent species' effects (emergence); most often diversity enhances suppression
- Predators also affect prey organisms non-consumptively through changes in prey physiological, physical, spatial, temporal, and behavioral responses to predators
- Role of predator diversity in non-consumptive response by prey is relatively un-studied
- Role of predator diversity in shaping prey populations and communities through habitat colonization is a novel question

System and Methods

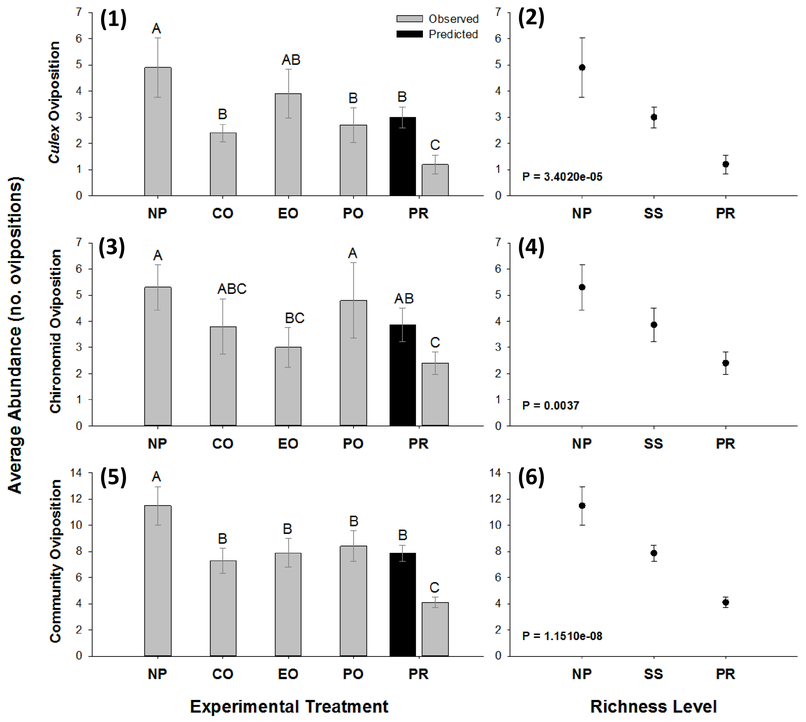
- Containers with water and nutrients (mesocosms) historically used as analogs for small temporary water-bodies, such as rock pools or vernal pools
- Mosquitoes colonize mesocosms by laying eggs/ovipositing **(1)**
- We collected predators for mesocosm treatments (richness; 0, 1, or 3 predator species)
- We established and maintained mesocosm treatments **(2)**
- We quantified colonization by *Culex* mosquitoes (*et al*.) **(3)**
- We used GLM and GLHT to distinguish whether response was linear or emergent

Fig 1. **(1)** 5 x 5 mescosm (12m x 12m) grid with treatments established randomly throughout **(2)** 5 treatments (no-predators, 3 *Celithemis eponina*, 3 *Enallagma sp*., 3 *Procambarus sp*., predator-rich), *n* = 5 each **(3)** Colonization by *Culex* mosquitoes, coincidental colonization by Chironomid midges and *Anopheles* mosquitoes quantified and analyzed

Results

Fig 2.

- Predator treatment significantly affected *Culex* oviposition **(1)**; GLM: df = 5, F = 28.150, P < 0.0001
- Predator treatment significantly affected Chironomid oviposition **(3)**; GLM: df = 5, F = 15.406, P = 0.0088
- Predator treatment significantly affected whole-community oviposition **(5)**; GLM: df = 5, F = 37.336, P < 0.0001
- Notably, observed oviposition responses to predator-rich treatment significantly lower than predicted responses in all analyses (GLHT)
- Significant overall relationship of predator diversity with *Culex* **(2)**, Chironomid **(4)**, and community **(6)** oviposition



Conclusions

- Rich predator assemblages reduced oviposition by *Culex* mosquitoes non-linearly indicating emergent response and suggesting mosquitoes possess capacity to detect and respond to multiple predator species, compensating for possibility that combination of predators may be synergistic
- Chironomid response similar, but does not exclude the possibility of sampling-effect
- Community response also similar, but stronger than *Culex* response suggesting that aquatic macro-invertebrate prey, in-general, may detect and respond to predator diversity
- Results show that non-consumptive, emergent predator effects on colonization can drive aquatic community composition; overall relationships highlight importance of predator diversity in this pattern
- May be useful in informing bio-control programs for disease-vectors and agro-pests

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