



Presence of amplification hosts increases mortality of syntopic amphibians by ranaviral disease

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Introduction

Declines in amphibian populations from disease outbreaks could be mediated by host susceptibility. Thus, changes in community composition could affect the likelihood of an outbreak. Additionally, the outcome of an outbreak might depend on which species in a community is exposed to the pathogen first.

Objective

Our objective was to determine if the outcome of a ranaviral disease outbreak in an amphibian community was dependent on community composition and which species was initially exposed to the virus.

Appalachian Community



Coastal Plain Community



Communities

We created two amphibian assemblages:

- (1) wood frog (*Lithobates sylvaticus*), upland chorus (*Pseudacris feriarum*), and spotted salamander (*Ambystoma maculatum*) larvae, and
- (2) Carolina gopher frog (*L. capito*), upland chorus frog (*P. feriarum*), and southern toad (*Anaxyrus terrestris*) larvae.

These species are known to have different levels of susceptibility (percent mortality; Hoverman et al. 2011, Brenes 2013).

High (>70%) = LISY, LICA

Moderate (30 – 70%) = PSFE, ANTE

Low (<30%) = AMMA

Study Site

Our experiment was conducted outdoors in 320-L mesocosms ($n = 5$ /treatment) located at the University of Tennessee Joe Johnson Animal Research and Teaching Unit (JARTU).



Methods

Treatments consisted of one, all, or none of the species initially exposed to Frog Virus 3 (type species of *Ranavirus*) Initial exposure occurred under laboratory conditions in water baths (10^3 PFU/mL) for 3 days prior to distributing larvae to the mesocosms.



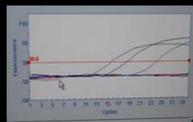
Mesocosms were aged for 7 weeks to produce an aquatic environment emulating natural conditions. Larvae were monitored daily for survival and morbidity. Experiments lasted 8 weeks.

Ranavirus Testing

Necropsy: Larvae were dissected and gross signs were recorded.



Sections of liver and kidney were extracted and frozen at -80C for real-time PCR analysis, and rest of the body was stored in 10% buffered formalin for histopathology.

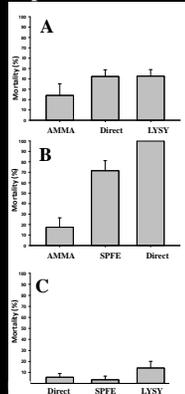


Results

Mortality from ranavirus depended on community composition and which species was initially exposed to the pathogen.

Appalachian Community

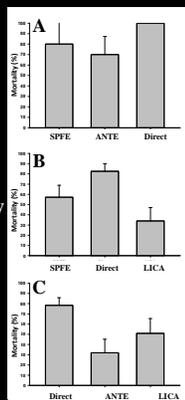
Exposed wood frog tadpoles caused an outbreak of ranaviral disease in unexposed chorus frogs (40% mortality) and amplified mortality of spotted salamander larvae 2X greater than when this species was directly exposed to the virus.



Mortality of individuals (A= Wood frog, B= Chorus frog, C= Spotted salamander) when exposed to the ranavirus directly by inoculation or indirectly by contact with another species; AMMA= Spotted Salamander, SPFE=Chorus frog, LISY=Wood frog. Bars represent standard error.

Coastal Plain Community

All species were able to cause outbreaks of ranaviral disease (>40% mortality) in co-inhabitant unexposed species.



Mortality of individuals (A= Gopher frog, B= Southern toad, C= Chorus frog) when exposed to the ranavirus directly by inoculation or indirectly by contact with another species; SPFE=Chorus frog, ANTE= Southern toad, and LICA= Gopher frog. Bars represent standard error.

Discussion

Our experiment demonstrated that amphibian community composition affected outcome of a ranavirus outbreak.

Community-wide Mortality

- Appalachian = 36%
- Coastal Plain = 64%

Appalachian Community

Wood frog tadpoles may be superspreaders:

- Spotted Salamanders = Amplified Mortality 3X
- Chorus Frog = 40% Mortality

Spotted salamander larvae:

- Wood Frog = 18% Mortality
- Chorus Frog = 24% Mortality

This species likely is insufficient to cause an outbreak.

Coastal Plain Community

High community-level mortality was observed in the Coastal Plains community regardless of which species was initially exposed to the virus .

Implications

The presence of highly susceptible species can create diseases hotspots and sources areas that will promote persistence and dispersion of the pathogen across the environment, possibly resulting in recurrent mortality events that could diminish amphibian populations and entire communities.

- Based on our results, amphibian communities composed of ≥ 3 moderately to highly susceptible species may be hotspots for ranavirus outbreaks.
- Natural resource practitioners can use results from susceptibility studies to identify communities to target ranavirus surveillance efforts.

Acknowledgments

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