

Are Ranaviruses Capable of Contributing to Species Declines?



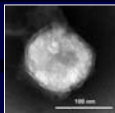
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History of Ranavirus Die-offs

- First Isolated:**
- Dr. Allan Granoff
 - St. Jude Hospital
 - Rana pipiens* (1962)



First Large-scale Die-offs:



A. Duffus

- Dr. Andrew Cunningham
- Institute of Zoology, ZSL
- Rana temporaria* (1992)

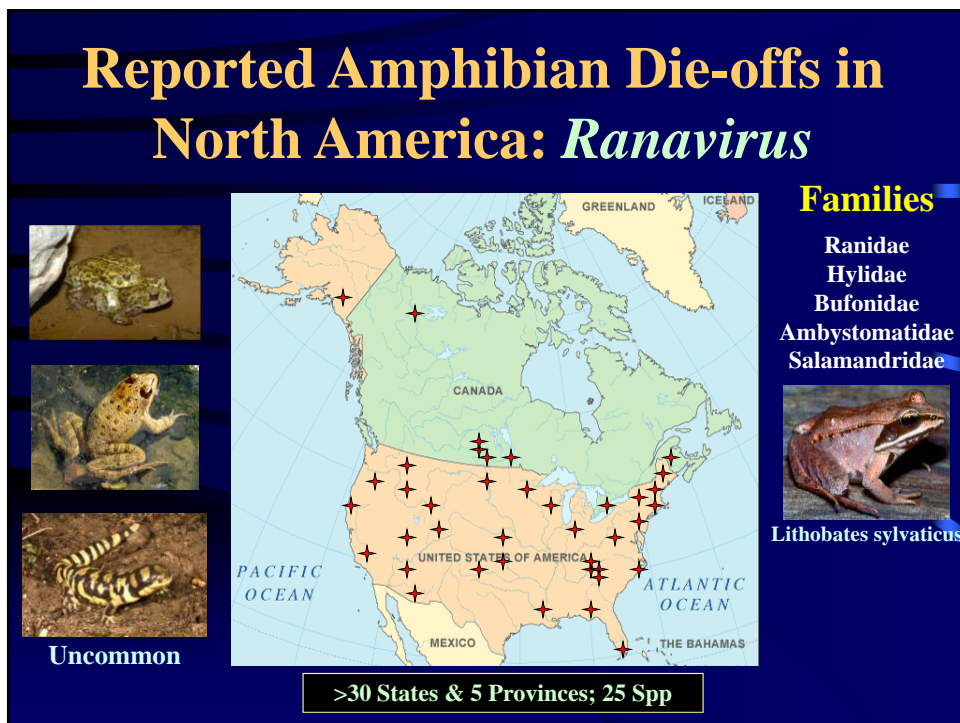
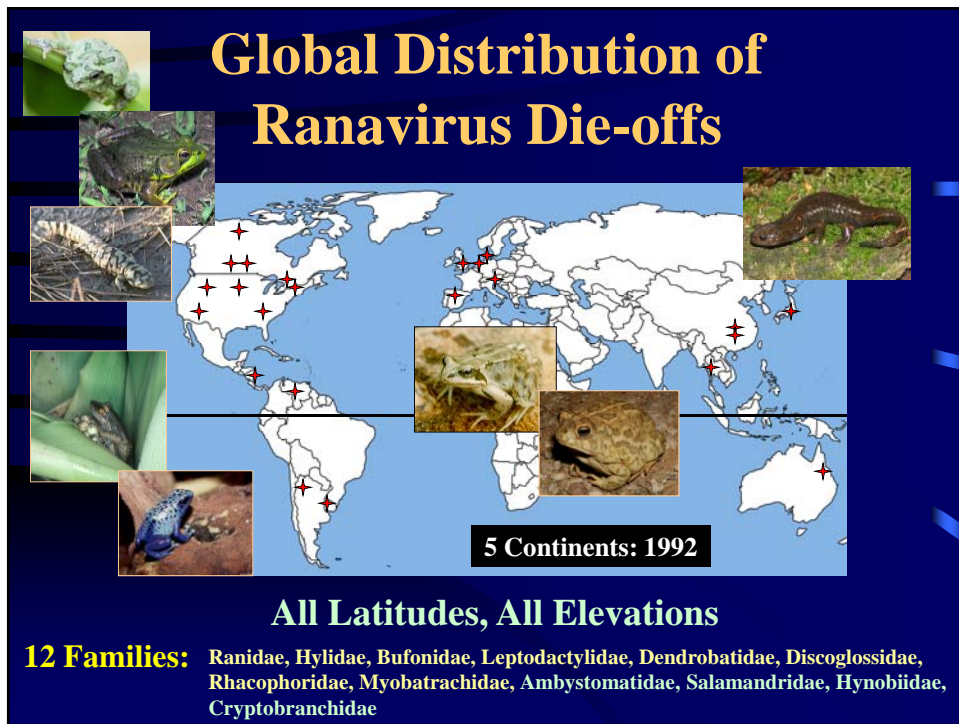


First North American Die-offs:



- Dr. Jim Collins and students
- Arizona State University
- Ambystoma tigrinum stebbinsi* (1985, 1997)

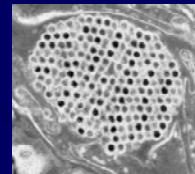
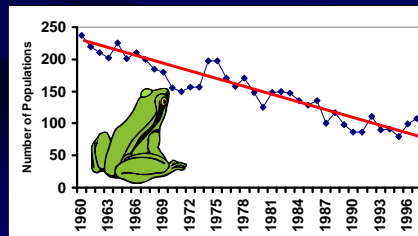




Are Ranaviruses Capable of Causing Local Extirpations and Species Declines?



Muths et al.
(2006)



Collins & Crump
(2009)

Traditional Theory

(Anderson and May 1979)



Extirpation is possible if:

Frequency Dependent

**(1) Multiple Host Pathogens Where
Susceptibility Differs**

- Asymptomatic Carriers

(2) Environmental Reservoir

- Survive Outside Host

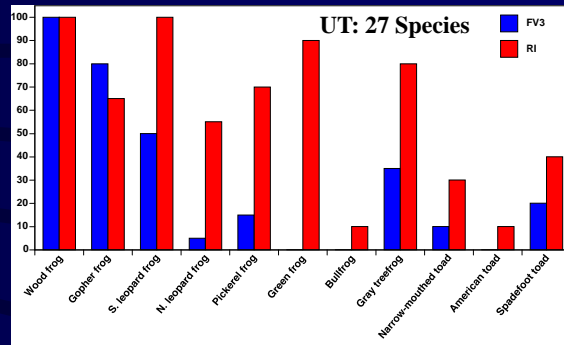
(3) Clustering of Individuals

- Sexually transmitted disease

Evidence of Alternate Hosts

(Moody and Owens 1994, Marschang et al. 1999, 2005; Hyatt et al. 2002; Allender et al. 2006; Duffus et al. 2008, Picco et al. 2010; J. Briggler, J. Hoverman, D. Miller, B. Rothermel, unpubl. data)

(1) Multiple-host Pathogen:



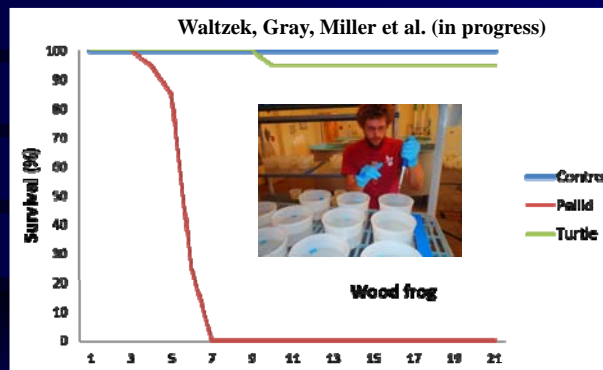
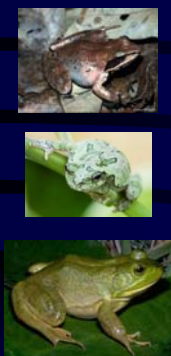
(2) Other Ectothermic Vertebrates



Possibility of Interclass Reservoirs

(Moody and Owens 1994, Ariel 1997, Johnson et al. 2007, Bang Jensen et al. 2009, Picco et al. 2010)

Pallid Sturgeon and Box Turtle Isolates



Ranaviruses can infect multiple host species & some serve as asymptomatic carriers – #1 Met

Evidence of Environmental Persistence

(1) EHNVPersistence (Langdon 1989)



- Distilled Water: **97 d**
- Dry Infected Tissue: **113 d**
- Frozen Infected Tissue: **2 yr**

(2) FV3, FV3-like (Nazir, Spengler, Marschang, in review)

- | | | |
|--------|---------------------------------|-----------------------|
| 20 C = | •PW (unsterile): 22-34 d | •Soil: 13-22 d |
| 4 C = | •PW (unsterile): 58-72 d | •Soil: 30-48 d |

(T-90 Values)

Evidence of Individual Clustering and Transmission

(1) Breeding (Brunner et al. 2004)

- Juvenile/Adult: Sub-lethal Infections
- High Transmission
- Period of Stress (Rollins-Smith 2001)



(2) Larval Clustering

- Increase Infection Rates
- Vegetation Reduction

(Greer et al. 2008)



Local Extirpations and Declines?

YES, all 3 characteristics met in the Ranavirus-Host System

Caveat: Species, Community, and Site Dependent!

Evidence of Declines

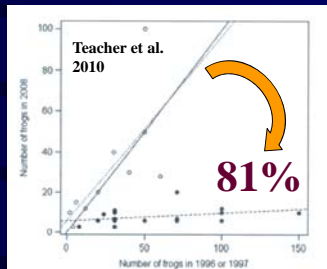


Dr. Amber Teacher
Southeastern England
1996/97 and 2008

**Animal
 Conservation**
 13:514-522



Ranavirus (+)
populations
81% Median
Reduction



A. Teacher



A. Teacher

Evidence of Re-occurring Die-offs



Dr. Jim Petranka
Tulula Wetland Complex, NC
1998-2006

Biological Conservation
 138:371-380

Wetlands
 23:278-290

**Recruitment at most
 wetlands failed due
 to ranavirus**



**Persistence Possible
 from Source
 Populations**

Rescue Effect



**Uncommon
 Species?**



**Should we be concerned with a few
 uncommon species?**

Commonality of Being Uncommon

Southeastern United States

Federally Listed: *Rana capito sevosa*, *Ambystoma cingulatum*,
Phaeognathus hubrichti, *Ambystoma bishopi*

Species of Concern: **113 Species and 25 Genera Total** **50% U.S.**

- 1) Alabama = 14 species (11 genera)
- 2) Arkansas = 25 species (12 genera)
- 3) Florida = 19 species (12 genera)
- 4) Georgia = 22 species (15 genera)
- 5) Kentucky = 22 species (11 genera)
- 6) Louisiana = 15 species (10 genera)
- 7) Mississippi = 18 species (12 genera)
- 8) North Carolina = 41 species (15 genera)
- 9) South Carolina = 19 species (13 genera)
- 10) Tennessee = 26 species (14 genera)

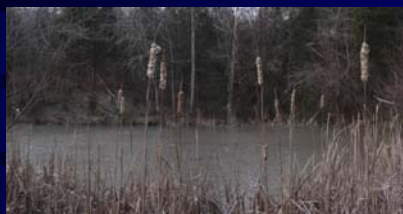


Ranavirus Landscape Prevalence

Tennessee Ponds

Hoverman et al. (in review)

Green Frog, Bullfrog,
Pickerel Frog, Eastern
Newt, Tiger and
Spotted Salamanders



Ranavirus Distribution: **83%** of Ponds Sampled

Hotspots: **≥40%** in 15 out of 40 Ponds Sampled

- 85% Infection
- 100% Infection
(morbid and dead)

Take Home Messages

Should we be Concerned?



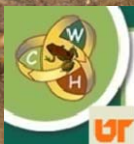
- Ranavirus Die-offs have **Global Distribution**
- Ranavirus **Prevalence** can be **High**
- Ranaviruses **Infect Multiple Amphibian Species** with **Different Susceptibilities**
- Community Composition** may **Matter**
- Interclass Transmission** is **Possible** – **Abundant Reservoirs**
- Ranavirus **Persistence** may be **Long**
- High Transmission: Breeding and for Schooling Spp.**

Epidemiological Theory Supports the Premise that
Ranaviruses Could Cause **Local Population Extirpations**
and Contribute to Species Declines

Uncommon Species with High Susceptibility are at Greatest Risk!

Questions??

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2011 JMIH: Ranavirus Symposium

<http://fwf.ag.utk.edu/mgray/ranavirus/Ranavirus.htm>



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