EFFECTS OF PESTICIDE EXPOSURE ON SUSCEPTIBILITY TO RANAVIRUS IN TIGER SALAMANDERS

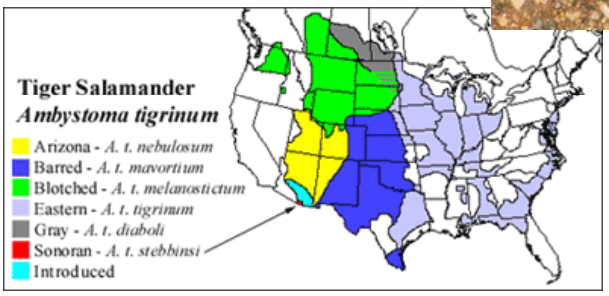
Jake Kerby University of South Dakota

Focus on one Ranavirus- ATV

- *Ambystoma tigrinum* virus
- Infects Tiger Salamanders
- Focus on ATV, but likely applicable to other Ranaviruses and species

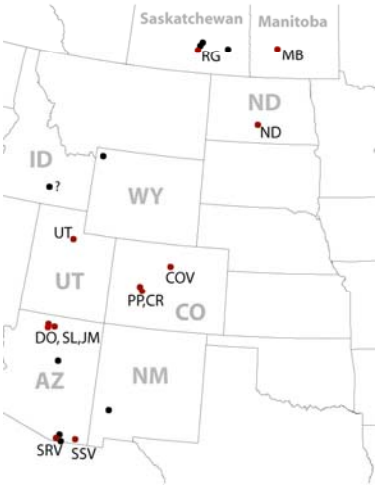
Tiger Salamanders

- Widespread across the US
- Known virus



Disease Emergence

- Virus has co-evolved with salamanders (Jancovich et al. (2005) *Mol. Ecol.*; Storfer et al. (2007) *Ecol Letts.*)
- What is causing rapid die-offs?



Habitat use

- Tiger salamanders typically breed in ponds
- Ephemeral ponds and vernal pools (no fish)

Land Use Change

- Conversion of land to agricultural and pasture
- Loss of native grassland areas
- Draining of wetlands
- Whole host of co-factors
  - Nitrogen, Phosphorus
  - Hormones
  - Pesticides

Impacts of pesticides

- Large host of literature showing negative direct impacts of pesticides on amphibian growth, development, behavior, and survival
- Several pesticides act via several different mechanisms

Pesticides

Alter nervous system function-

Organophosphate insecticide:

Chlorpyrifos

Carbamate insecticide:

Carbaryl (Sevin)

Alter photosynthesis-

Triazine herbicide:

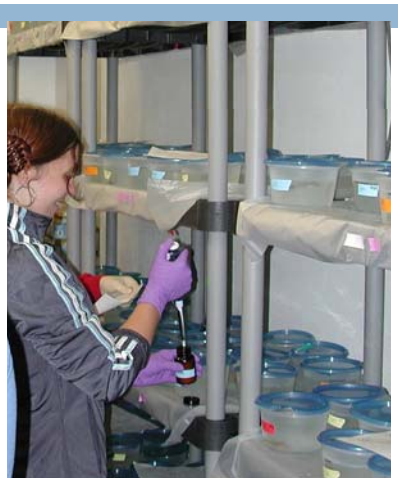
Atrazine

Previous research

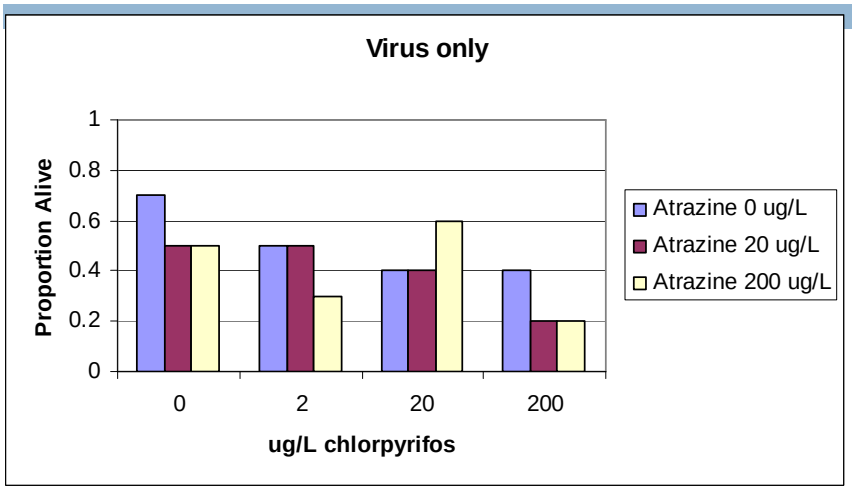
- Forson and Storfer 2006 exhibit atrazine impacts
- Increased susceptibility to RV at 16ug/L atrazine
- Decrease in white blood cell counts at same level

Design

- Virus/ no virus
- Atrazine – 3 levels: 0, 20, 200 µg/L
- Chlorpyrifos – 4 levels: 0, 2, 20, 200 µg/L
- Replicated 10 times



Mortality



Kerby and Storfer 2010, *Ecohealth*

Summary

- Sub-lethal pesticide concentrations magnify number killed by disease
- Combined chlorpyrifos, atrazine, and virus treatments show lowest survival
- Emerging pathogens –pesticides as potential cofactors

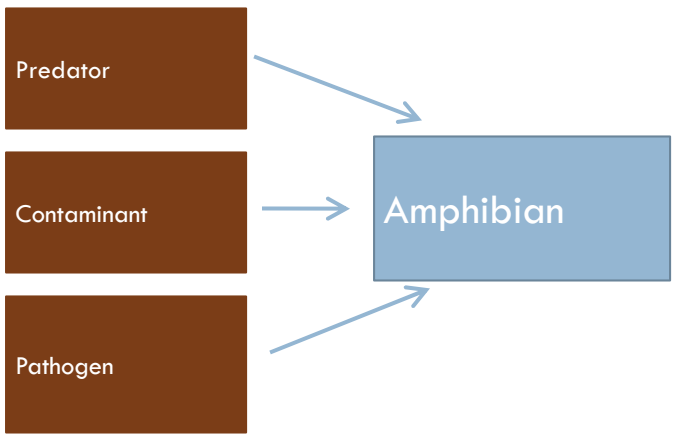
Multiple stressors

- In addition to contaminants and disease, there are several other stressors that exist

Various human impacts:

- Habitat destruction
- Global warming
- Invasive species

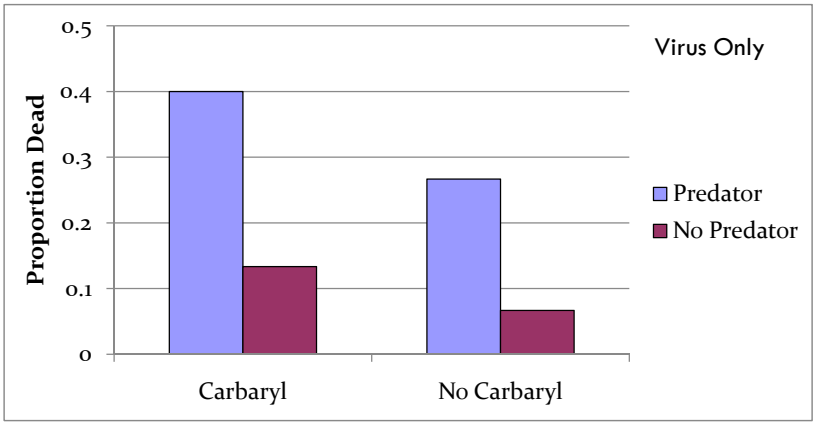
Stressors



Design

- Virus / No virus
- Carbaryl (500 µg/L) / No Carbaryl
- Predator Cue (Dragonfly nymph)/ No Cue

Mortality



Kerby and Storfer 2011, *Ecohealth*

Conclusions

- Despite pesticides having no lethal effect on their own, they likely can play an important role
- Carbaryl, Chlorpyrifos, and Atrazine presence appear to increase mortality in virus exposed larvae
- Combining pesticides with each other and with predatory stress can decrease survival

Laboratory

- These studies were performed in a controlled laboratory
- No clear notion of how much these stressors add to the actual dynamics of Ranavirus
  - Ranavirus might be just as deadly without stressors

Future questions

- How much impact does agricultural and/or urban pollutants have on Ranavirus dynamics?
- What is the mechanism causing increased Ranavirus susceptibility to pesticides?
- How important is land use change in understanding emerging infectious disease?

Acknowledgements

People:

University of South Dakota:

Kirsten Wert , Jennifer Brown, Travis Snyders, Matt Kerby, Erica Geerdes

Washington State:

Andrew Storfer, Alison Hart

- Funding:
  - NSF MRI 0923419
  - NSF DEB 0548415
  - South Dakota Game, Fish and Parks
  - Missouri River Institute

Questions?