EFFECTS OF PESTICIDE EXPOSURE ON SUSCEPTIBILITY TO RANAVIRUS IN TIGER SALAMANDERS

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


- 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

![Graph showing mortality rates with different pesticide concentrations.](image)

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

- Predator
- Contaminant
- Pathogen

Amphibian
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?

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Questions?