Bd and Current-Use Pesticides in Water and Sediment in Amphibian Habitat in Colorado, Georgia, Idaho, Louisiana, Maine, and Oregon

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With help from: lots of others

Supported by USGS Toxics Program and Amphibian Research and Monitoring Initiative

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Just what is Bd?

- Batrachochytrium dendrobatidis
- a fungal pathogen linked to amphibian declines worldwide
- Causes the disease chytridiomycosis
- Can be, but is not always fatal
  - Some species are more resistant to the disease than others

- found in a wide range of locations from the tropics of Central America to the Boreal forests of Alaska
- Introduced by the use of African clawed frogs for pregnancy tests
  - Bullfrogs

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Science Questions

- What current use pesticides are frogs exposed to in aquatic habitats?
  - What are the potential effects of that exposure?
- Is Bd occurrence on frogs or in water related to pesticide occurrence
- Do pesticides affect frogs natural ability to resist Bd by affecting skin peptide production
  - Or by decreasing immunity

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Project Objectives

- Measure current-use pesticide concentrations in water, sediment, of pond habitat, and in frog tissue
- Measure the concentration of Bd in habitat water and on frogs
- Collect frog skin samples for skin peptide tests
- Collect ancillary hydrologic data
- Select sites from across the US
  - Some agricultural sites

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Study Hypothesis

- Water will contain a complex mixture of current-use pesticides
  - Including soluble compounds and fungicides
- Sediments will contain different pesticides
  - including pyrethroids, glyphosate, and other hydrophobic compounds
- Pesticides in frog tissue will reflect pesticides and degradates detected in water and sediment
- Bd will be detected more frequently in water and on amphibians from ponds with higher insecticide or herbicide concentrations
  - But maybe less so for fungicides

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Project People and Skills

- Collaboration between Toxics Substances Hydrology Program and Amphibian Research and Monitoring Initiative (ARMI)
- Herpetologists /Biologist
  - Gary Fellers, Erin Muths, Jerry Longcore, Hardin Waddle, Jamie Barichivich, David Pilliod, Laura Roberson
- Hydrologists
  - Me, Tara Chestnut, Dan Calhoun, Tim Reilly, Chauncey Anderson, Dennis Demcheck, and Mark Hardy
- Chemists
  - Kelly Smalling, Kathy Kuivila, Mike Meyer, Julie Kirshtein

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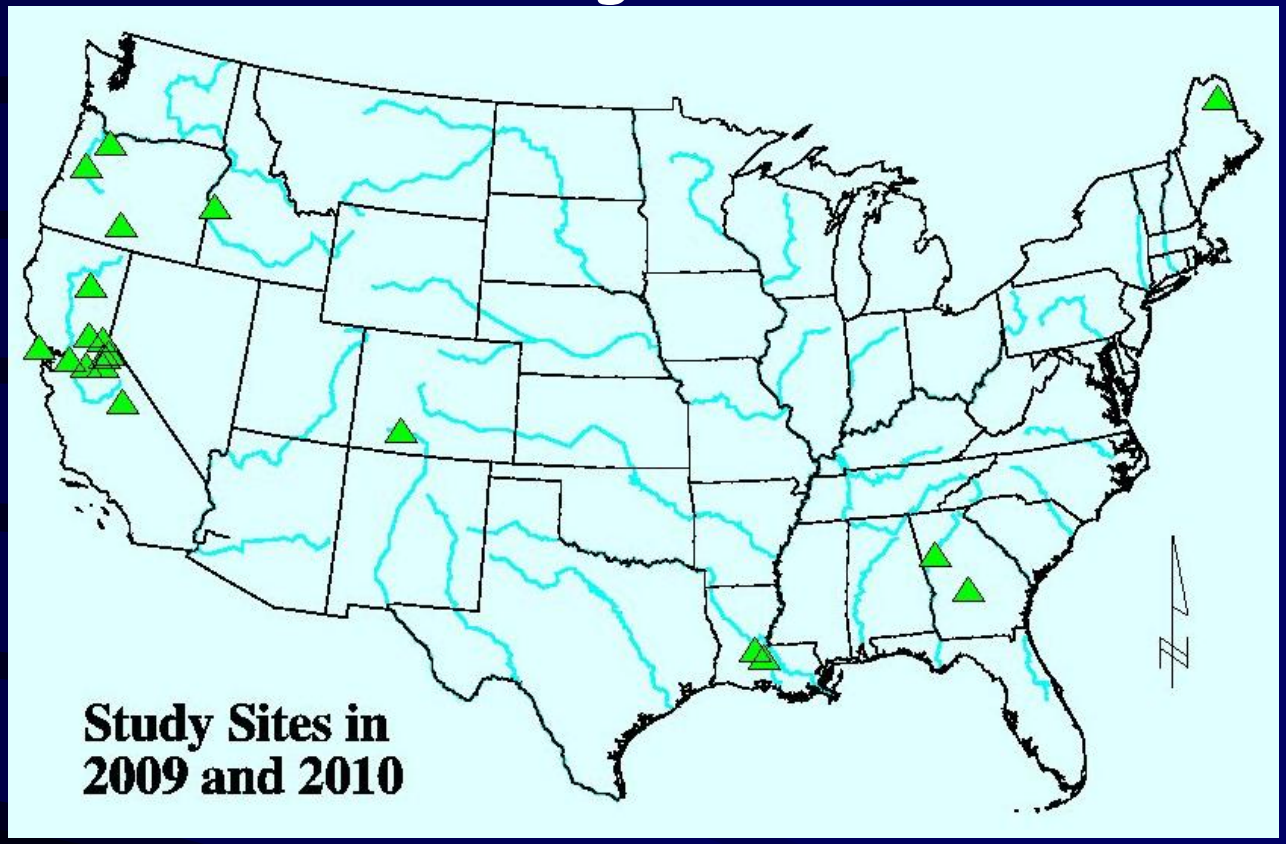
Study Sites



- In 2009 sites in ME(2), CO(2), and OR(3)
- In 2010 sites in CO(3), OR(2), ID(2), GA(2), and LA(2)
- 18 different sites total – not including 10 in CA

18 Sites are typically vernal pools, small ponds or first order streams

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Monitoring Methods

- Sampled frogs, water, and sediment concurrently in spring, water again in pesticide use season
- Water and sediment analyzed for:
  - ~100 current use pesticides or pesticide degradates
    - Fungicides, glyphosate, OP oxon and diuron degradates
- Water and frogs analyzed for:
  - Bd – swabs on 5 of each species
  - Skin samples for peptide work
  - ~90 Pesticides in tissue

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Results I– Water

- Water Samples (27 total)
  - One or more pesticide detected at 15 of 18 sites
  - 19 pesticides detected - 8 herbicides, 7 fungicides, 3 insecticides,1 degradate
  - AMPA, atrazine, azoxystrobin, glyphosate detected most frequently
  - Clomazone (2.88 μg/L), malathion (2.84 μg/L) and glyphosate (1.63 μg/L) were detected at the highest concentrations

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Results 2 – Sediment

- Sediment Samples (20 total)
  - One or more pesticide detected at all 18 sites
  - 19 pesticides detected - 7 fungicides, 5 herbicides, 4 insecticides, 3 degradate
  - p,p'-DDE, bifenthrin, chlorothalonil , pyraclostrobin were detected most frequently
  - Chlorpyrifos (444 μg/kg), tebuconazole (130 μg/kg), and p,p'-DDE (128 μg/kg) were detected at the highest concentrations
    - Much higher than water

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Results 3 – Frog Tissue

- Tissue Samples (44 total – only CO and GA)
  - One or more pesticide detected in frogs from all 7 sites
  - 10 pesticides detected - 3 fungicides, 1 herbicides, 3 insecticides, 3 degradate
  - p,p'-DDE, methoprene, myclobutanil, and simazine were detected most frequently
  - p,p'-DDE (0.92 μg/L), simazine (0.62 μg/L) , methoprene (0.5 μg/L) were detected at the highest concentrations
    - Lower than water and sediment

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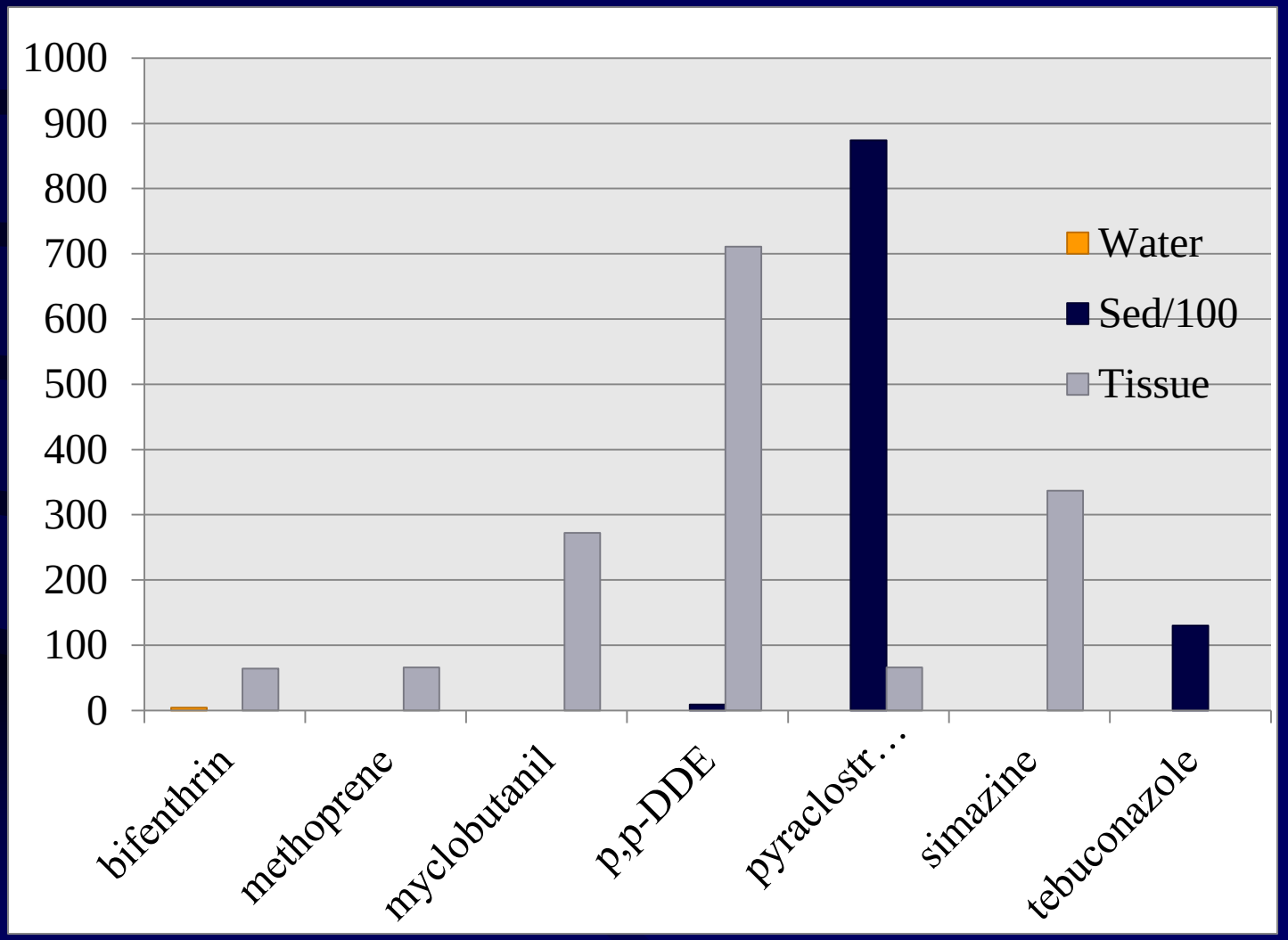
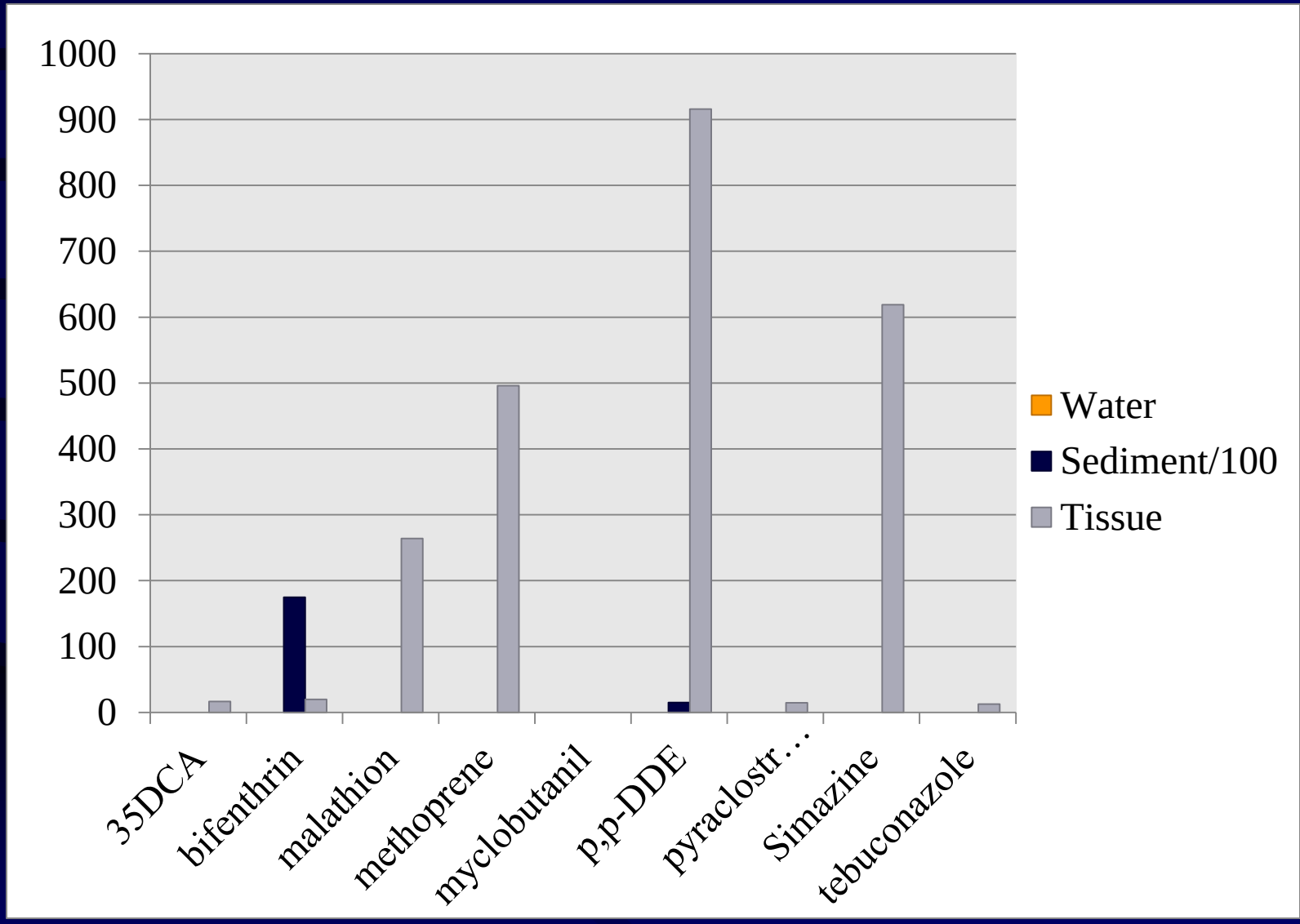
Results – Colorado



Concentrations in PPT except for sediment

Results – Georgia



Concentrations in PPT except for sediment

Study Conclusions

- Water did contain a complex mixture of current-use pesticides including fungicides
- Sediments did contain different pesticides
  - Pyrethroids and other hydrophobic compounds
- Pesticides in frog tissue did reflect pesticides and degradates detected in sediment
  - Less so for water, and some in neither
- Bd will have to a story for the next conference

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Questions?

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