Food webs and contaminants

Implications for NRDAR at the land-water interface

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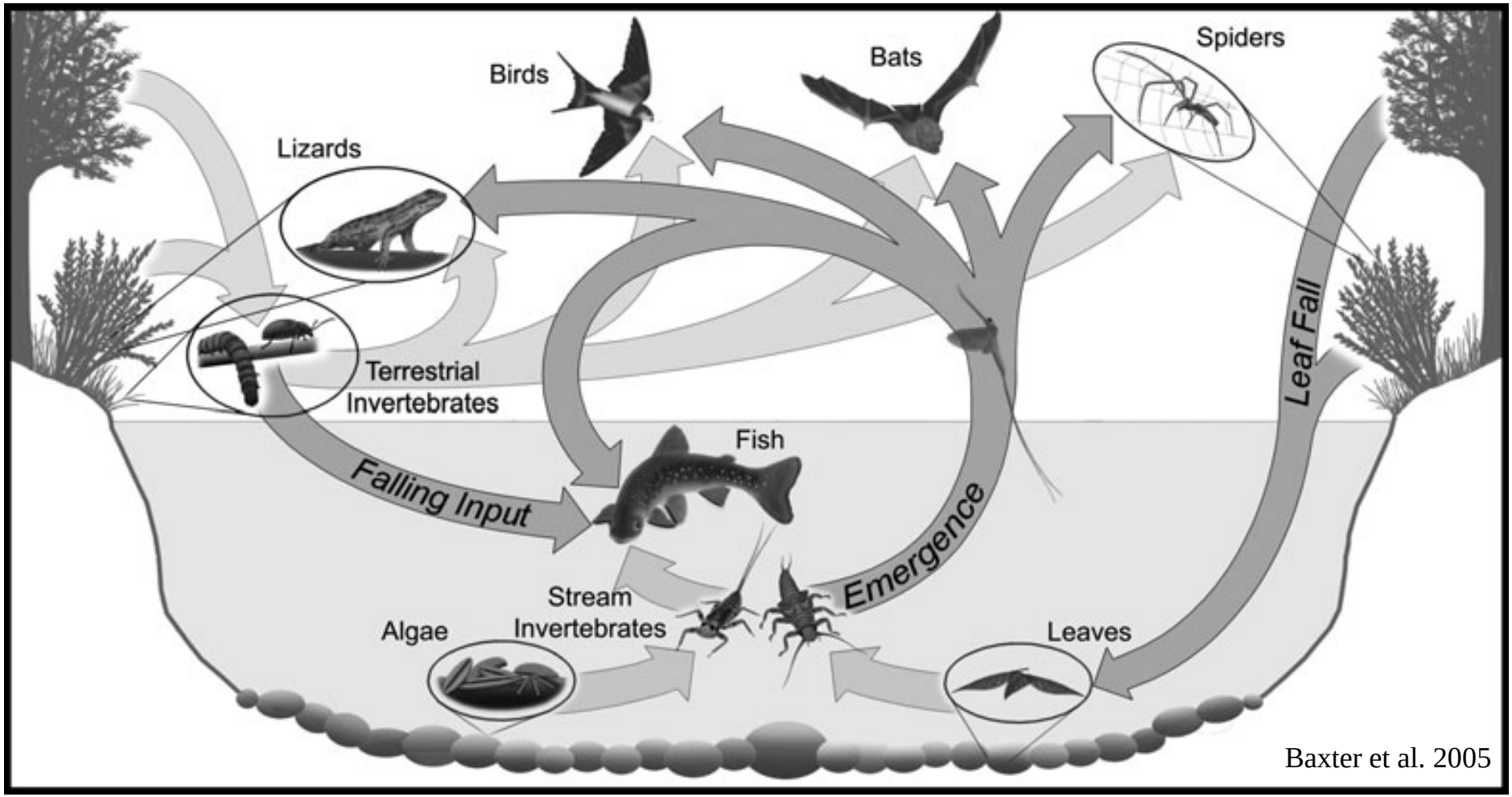
USGS
science for a changing world

How do we think about damage?

- Aim: Broaden the discussion about natural resource injuries and restoration in linked freshwater-terrestrial ecosystems from a food web perspective.

Freshwater-Terrestrial Linkages



Baxter et al. 2005

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Consequences of aquatic stressors

Take Homes

1. Indirect impact of contaminants on fish mitigated by terrestrial invertebrate subsidies.

2. Cascading or “ripple” effects of aquatic contaminants on terrestrial consumers (spiders, birds, bats etc.)

3. Predicting when you might have a food loss problem, an exposure problem, both or neither.

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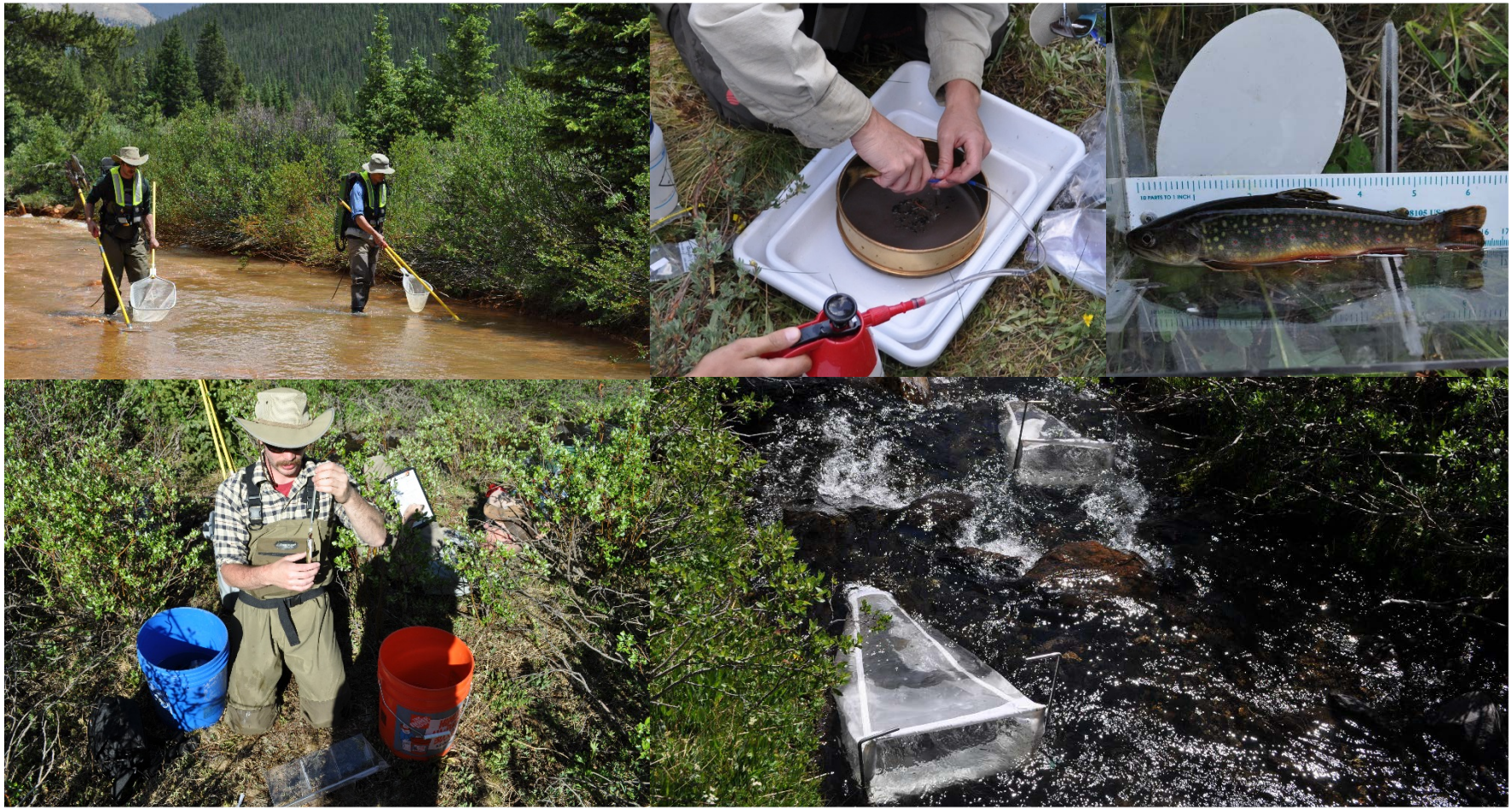
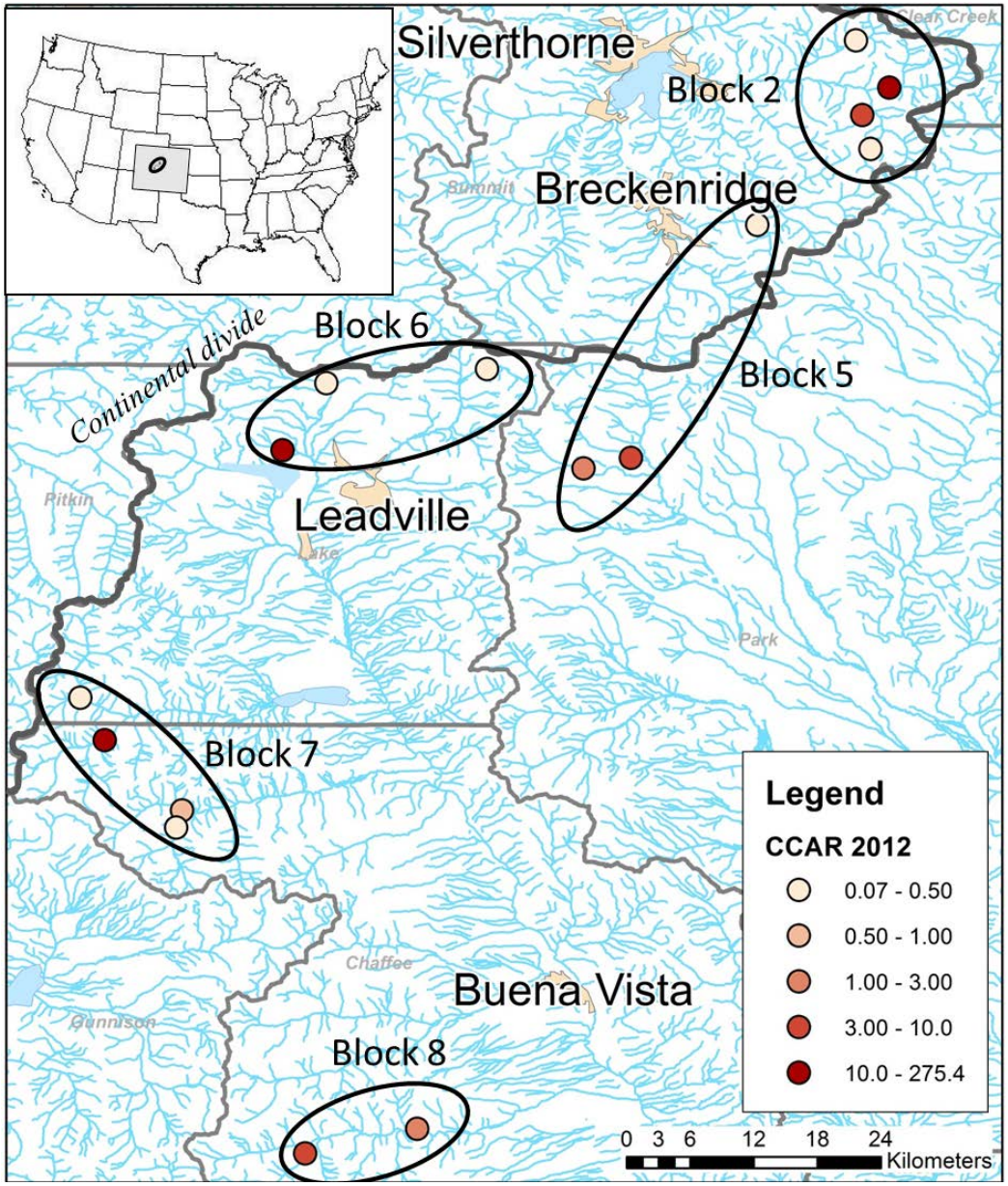
How do stream metals affect use of terrestrial resources by fish?

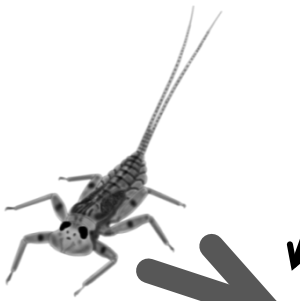



Silverthorne
Block 2
Breckenridge
Summit
Clear Creek
Block 6
Continental divide
Block 5
Pitkin
Leadville
Lake
Park
Block 7
Chaffee
Buena Vista
Gunnison
Block 8
Legend
CCAR 2012
0.07 - 0.50
0.50 - 1.00
1.00 - 3.00
3.00 - 10.0
10.0 - 275.4
0 3 6 12 18 24
Kilometers

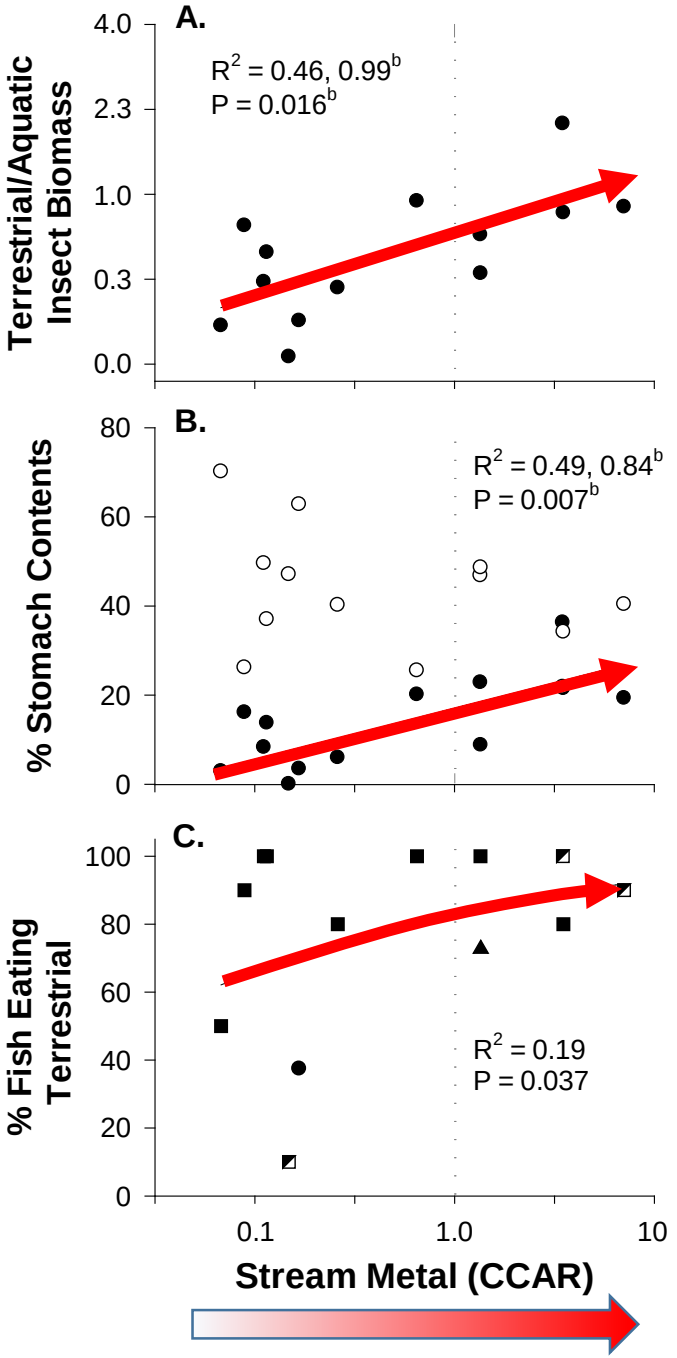

Kraus et al. 2016, *JAE*

Stream Trout Diet

Metal:
Low



10% of insect biomass in diet



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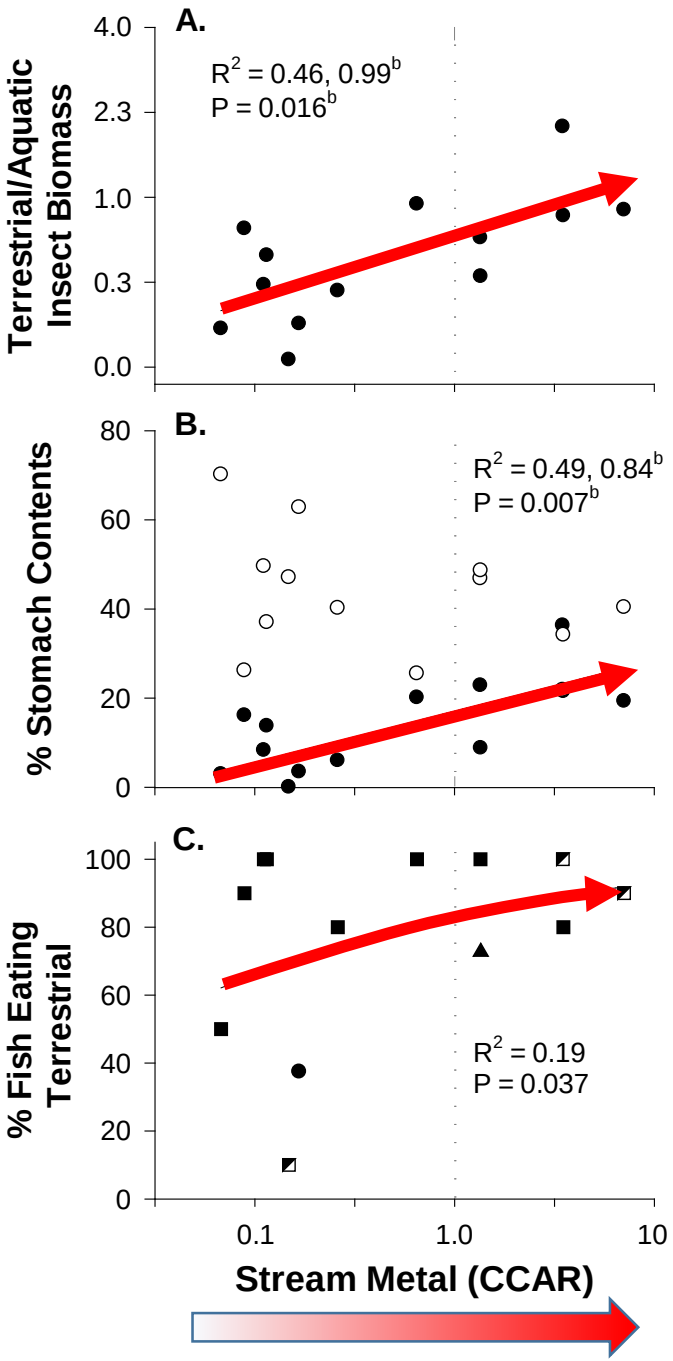
Kraus et al. 2016, *JAE*

Stream Trout Diet

Metal:
Moderate

54% of insect biomass in diet

More metals = more terrestrial subsidies



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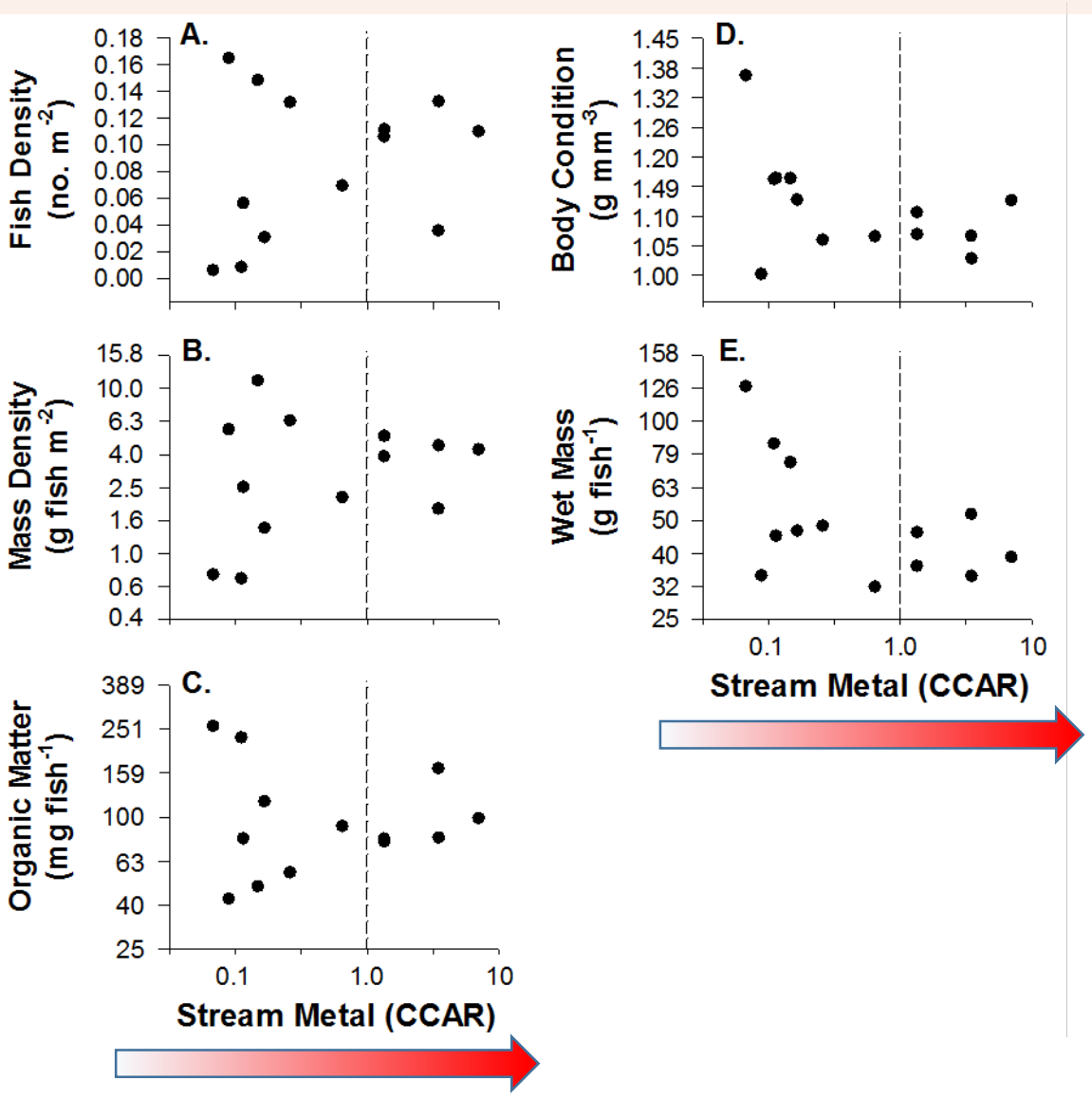
Kraus et al. 2016, *JAE*

Stream Trout Density and Condition

Compensatory?



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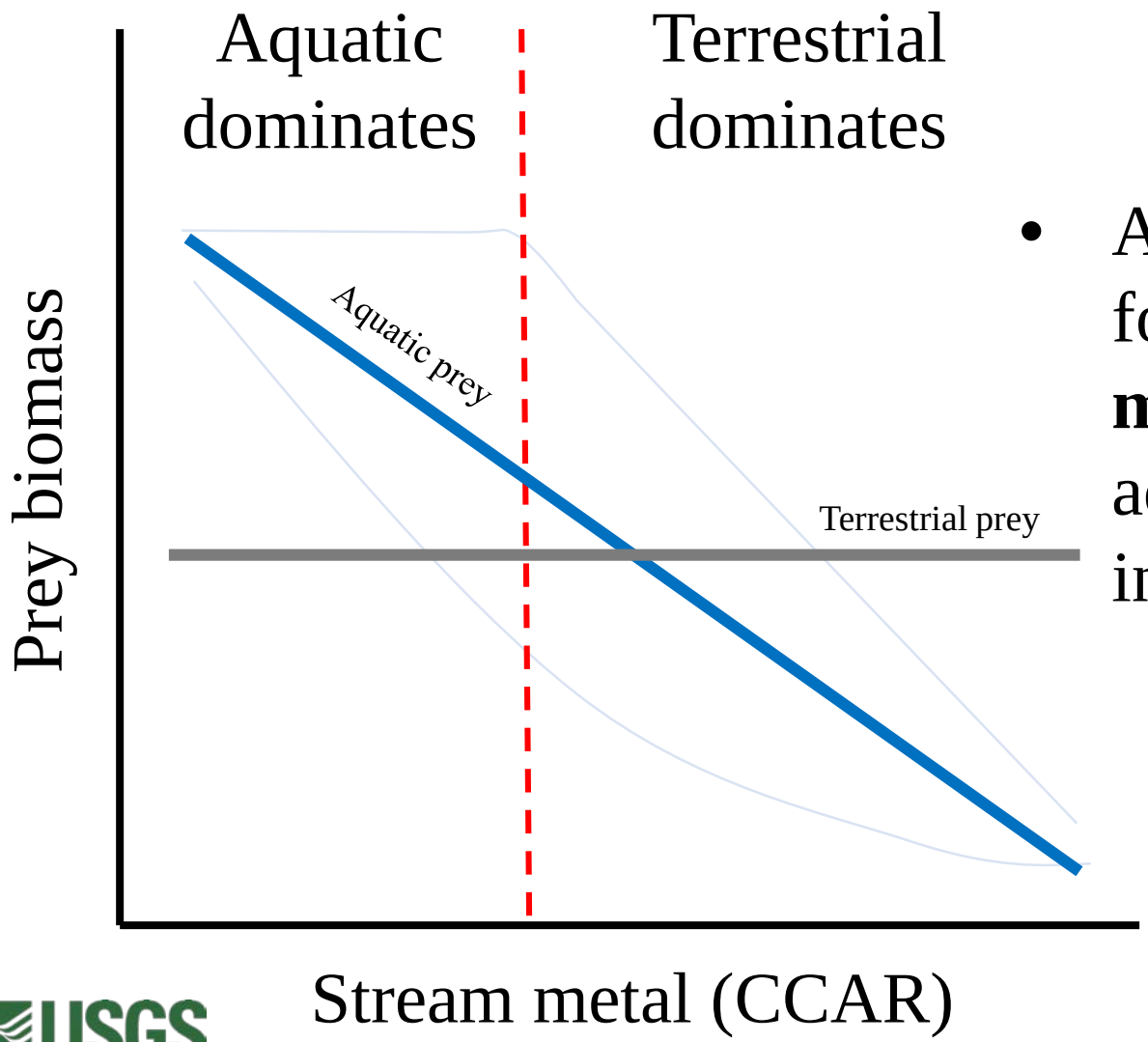
Kraus et al. 2016, *JAE*

Basis of Production



- Aquatic and riparian food webs may become **more terrestrial** as aquatic stressors increase.

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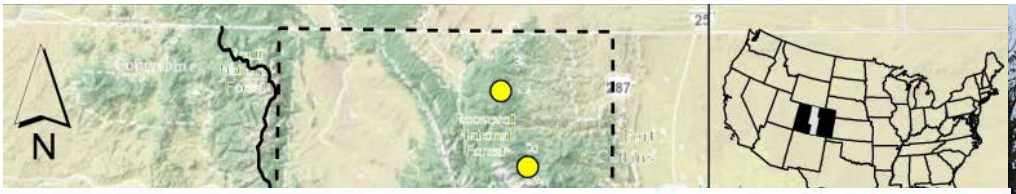
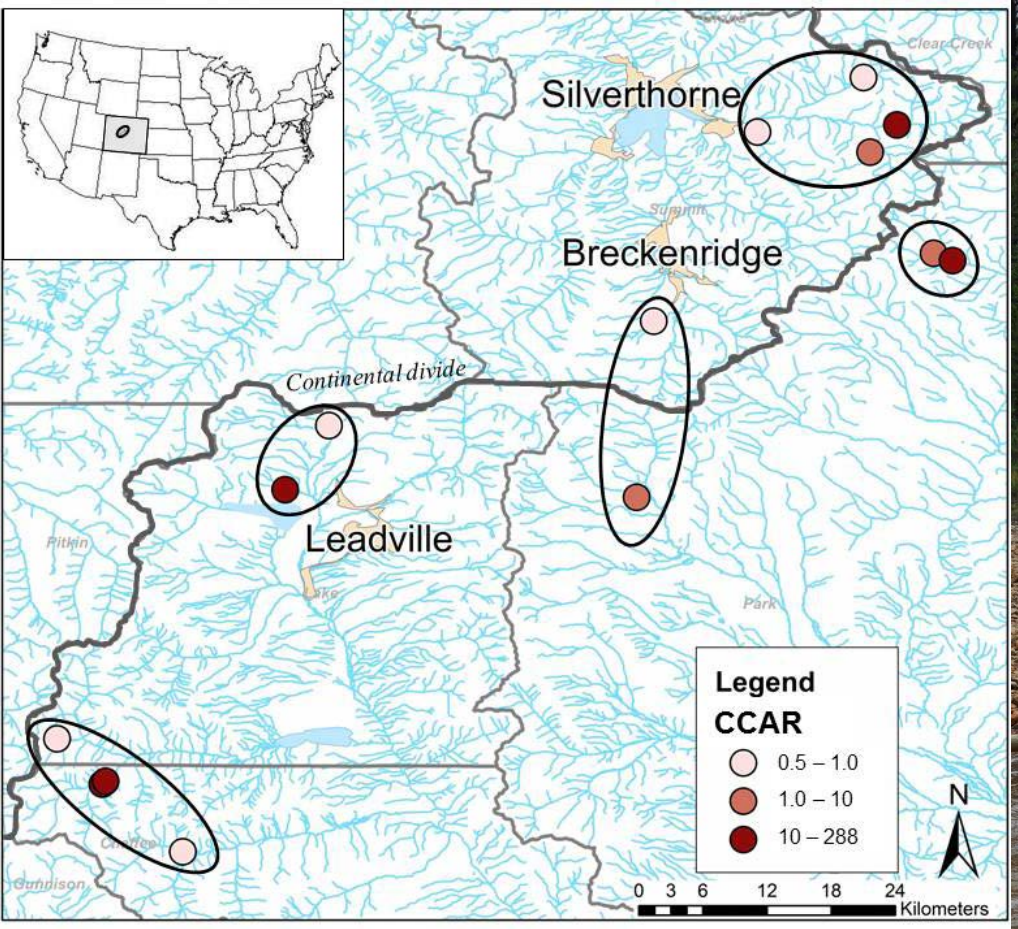
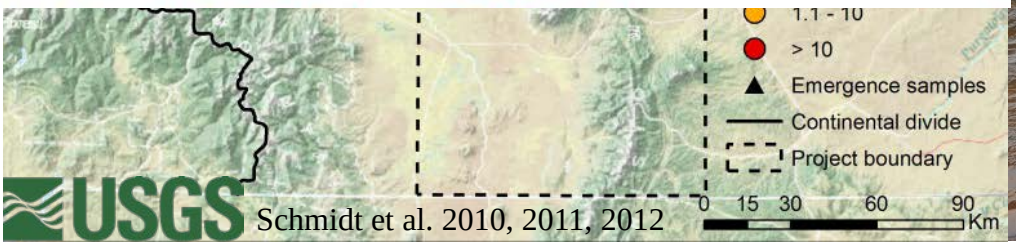




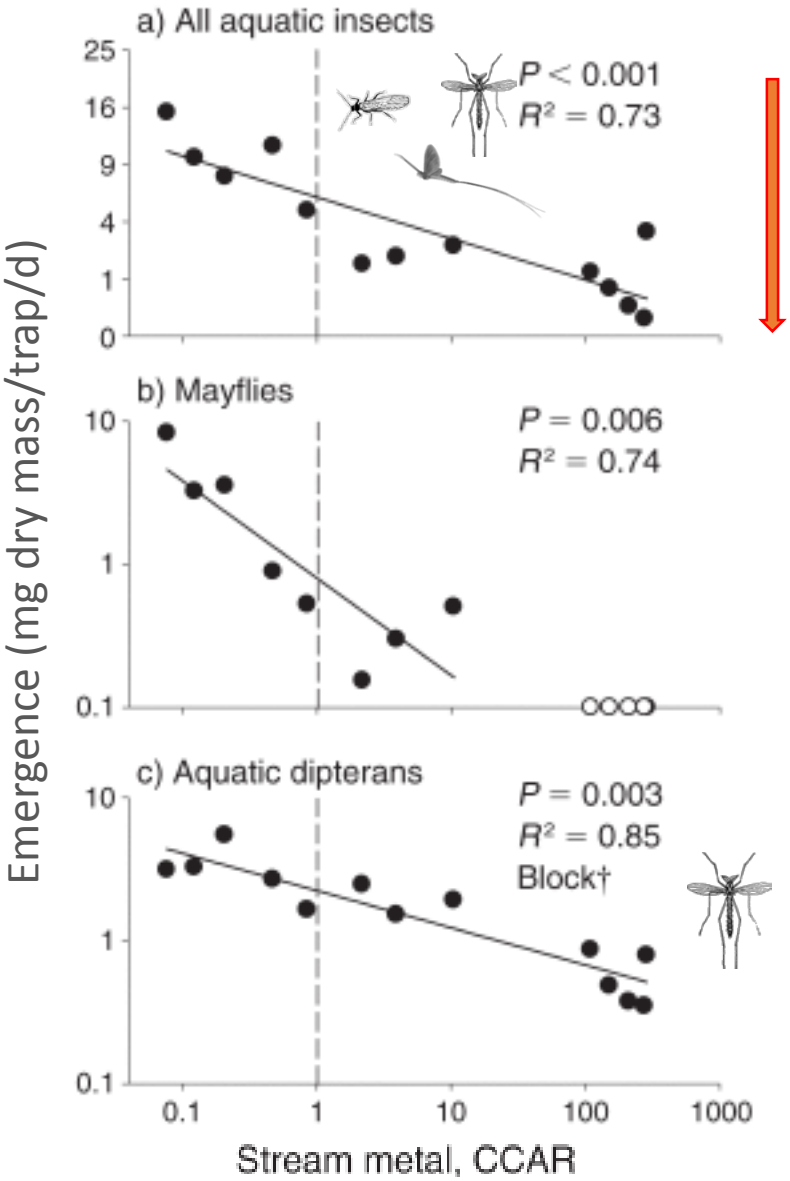


Schmidt et al. 2010, 2011, 2012

Kraus et al. 2014, *Eco Apps*

Emergence Production

Trace metals

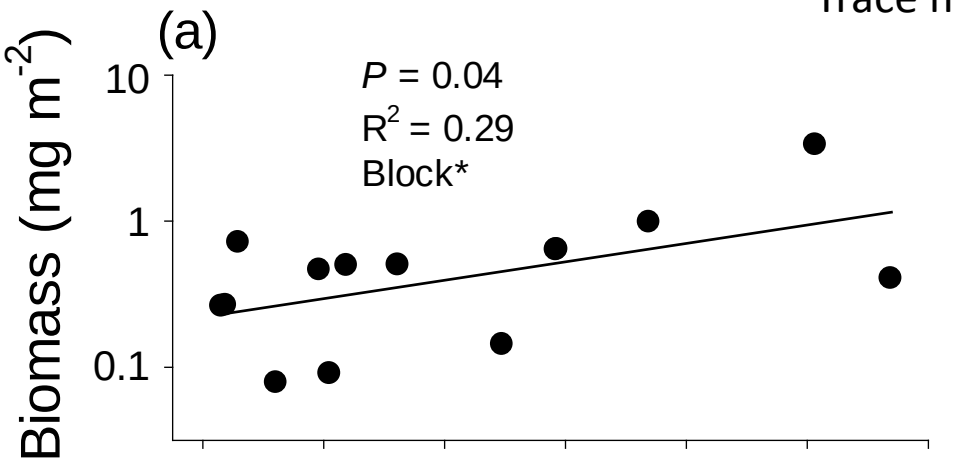


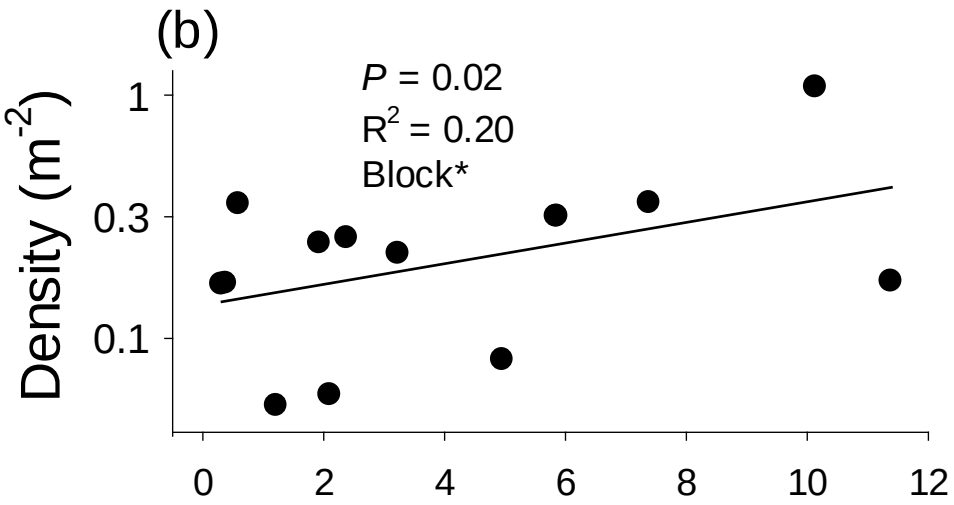
97% loss

Kraus et al. 2014, *Eco Apps*

Web-building spiders

Trace metals





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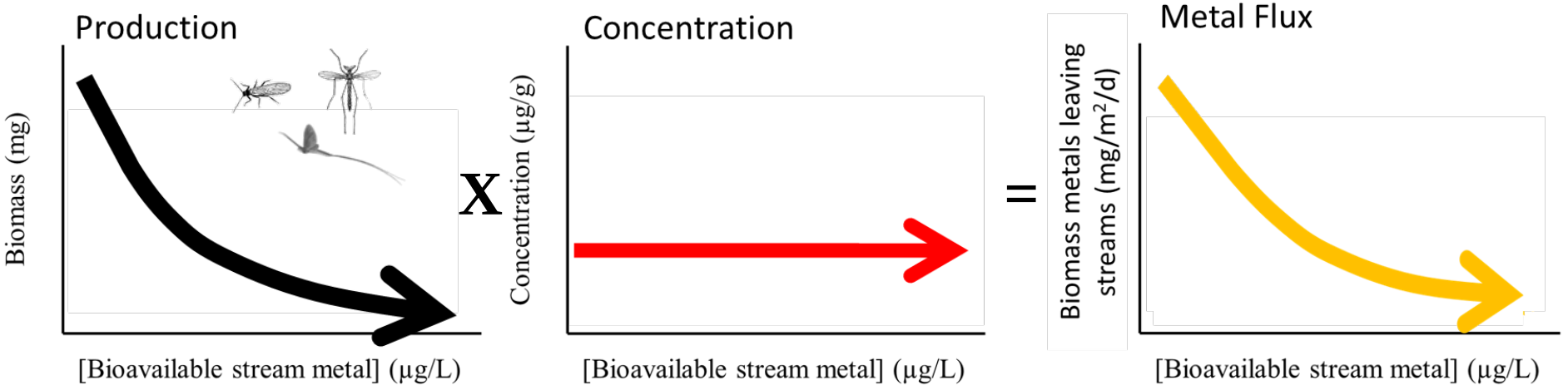
Kraus et al. 2014 Eco Apps

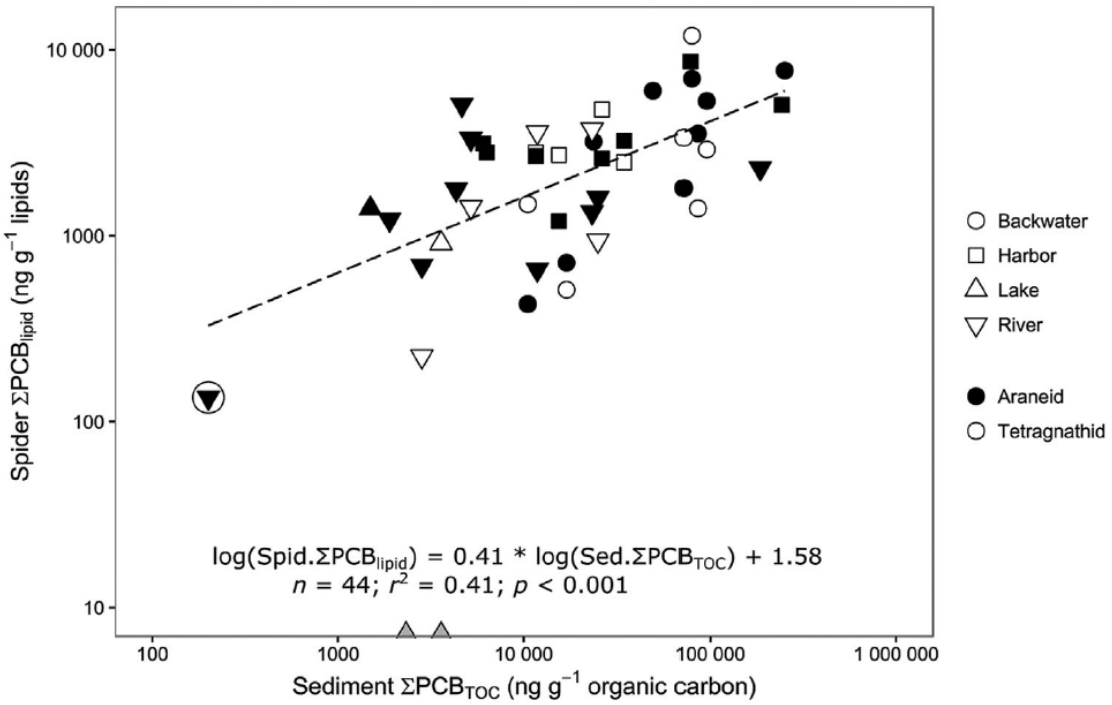
Metal Accumulation and Flux



Web-building spiders: PCBs

Lipid-corrected PCB concentrations up to ~10,000 ng/g

"Contaminant vector"



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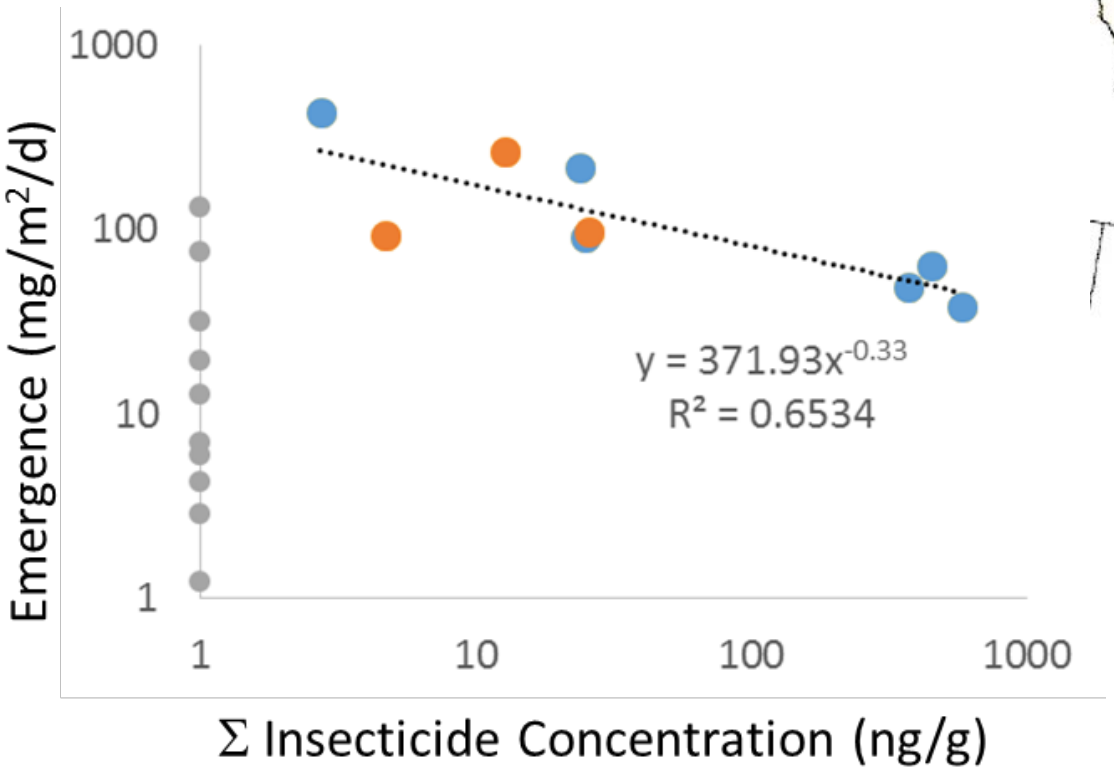
Kraus et al. 2017 ET&C

Adult aquatic insects: Pesticides

Current-use Pesticides



- Intense agriculture
- Critical habitat for water fowl
- Insectivorous bird declines

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Kraus et al. In prep

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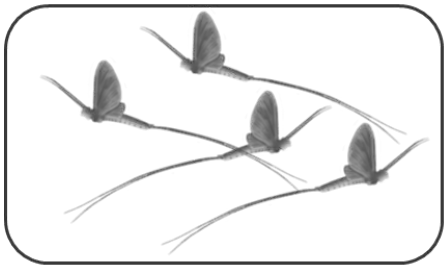
Framework for Predicting Effects

Contaminant
Ecosystem
Community
Individuals
Habitat

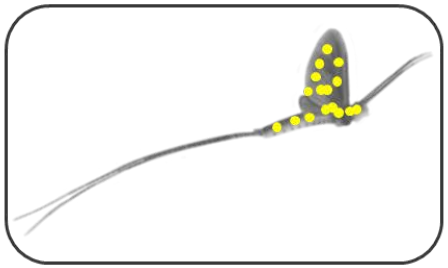
Emergence



mg dry mass/m^2/d

x

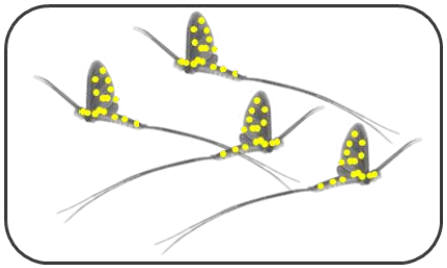
Concentration



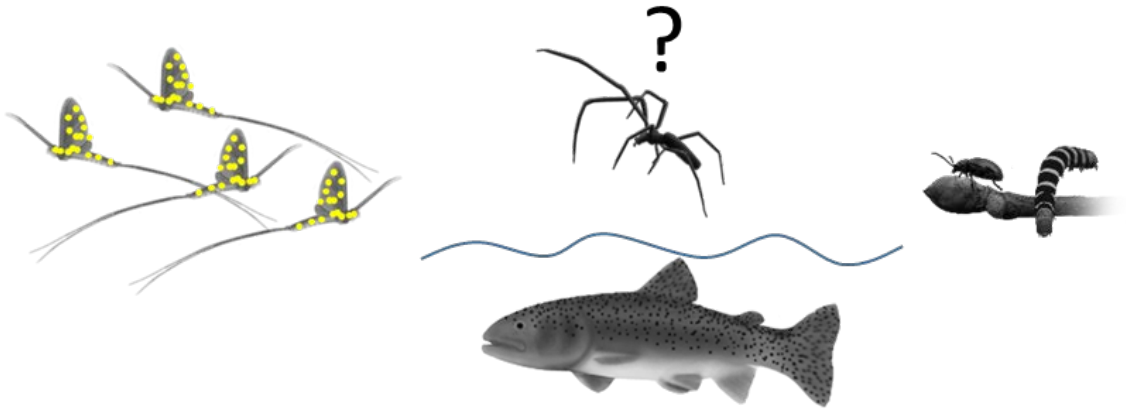
µg contaminant/g dry mass

=

Flux



µg contaminant/m^2/d



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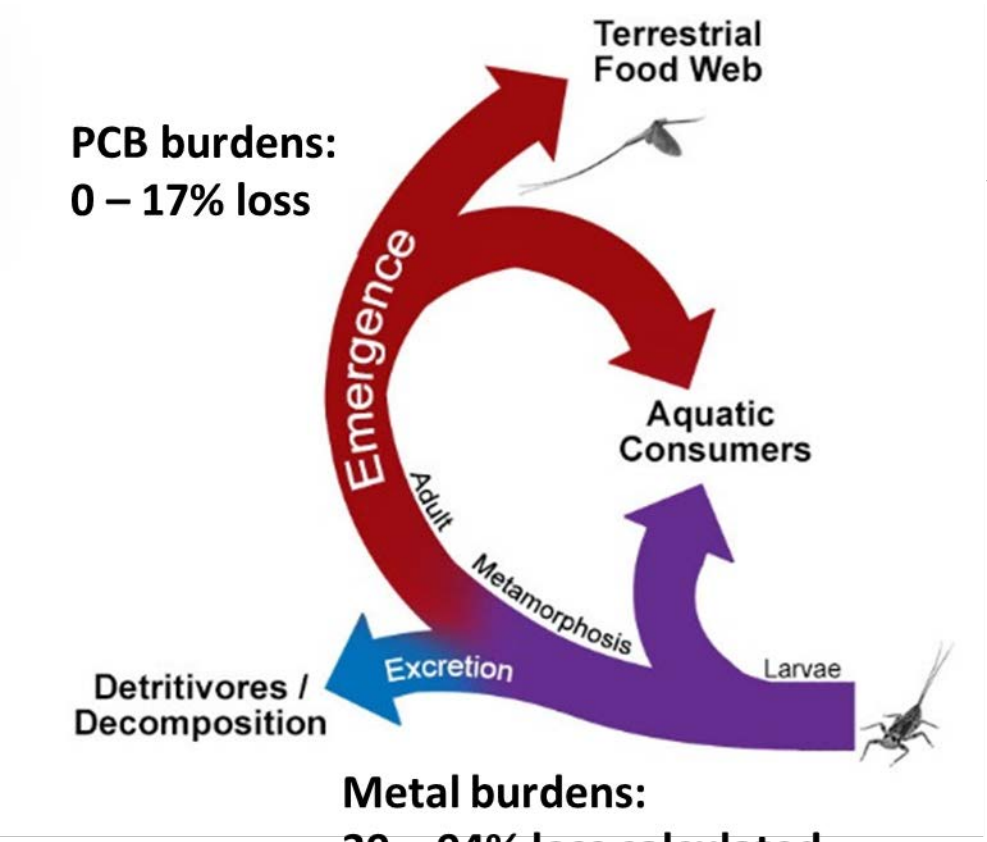
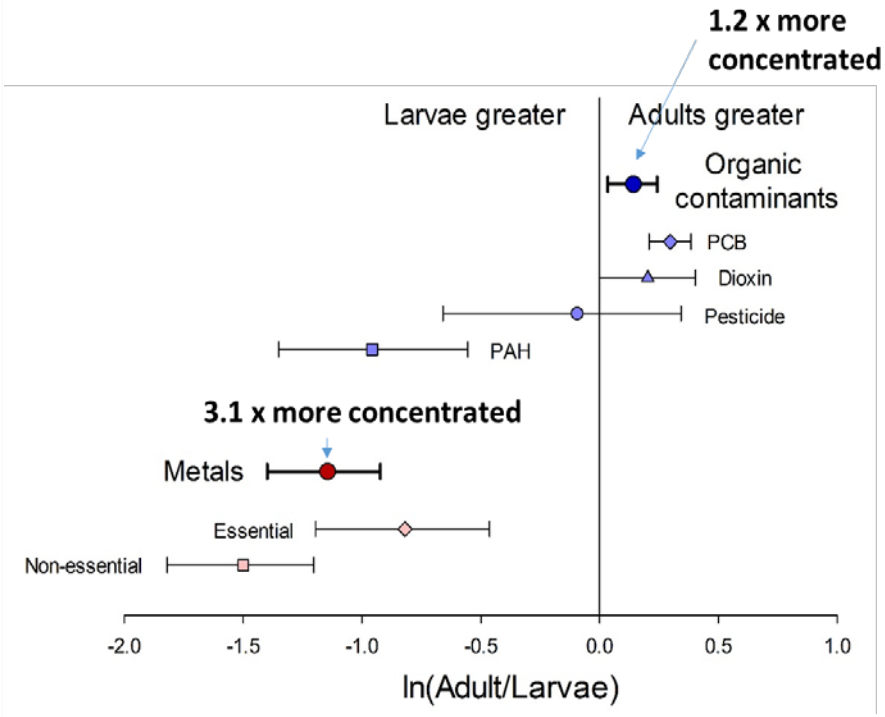


Metal burdens:
39 – 94% loss calculated
0 – ~100% loss reported



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Kraus et al. 2014 ES&T

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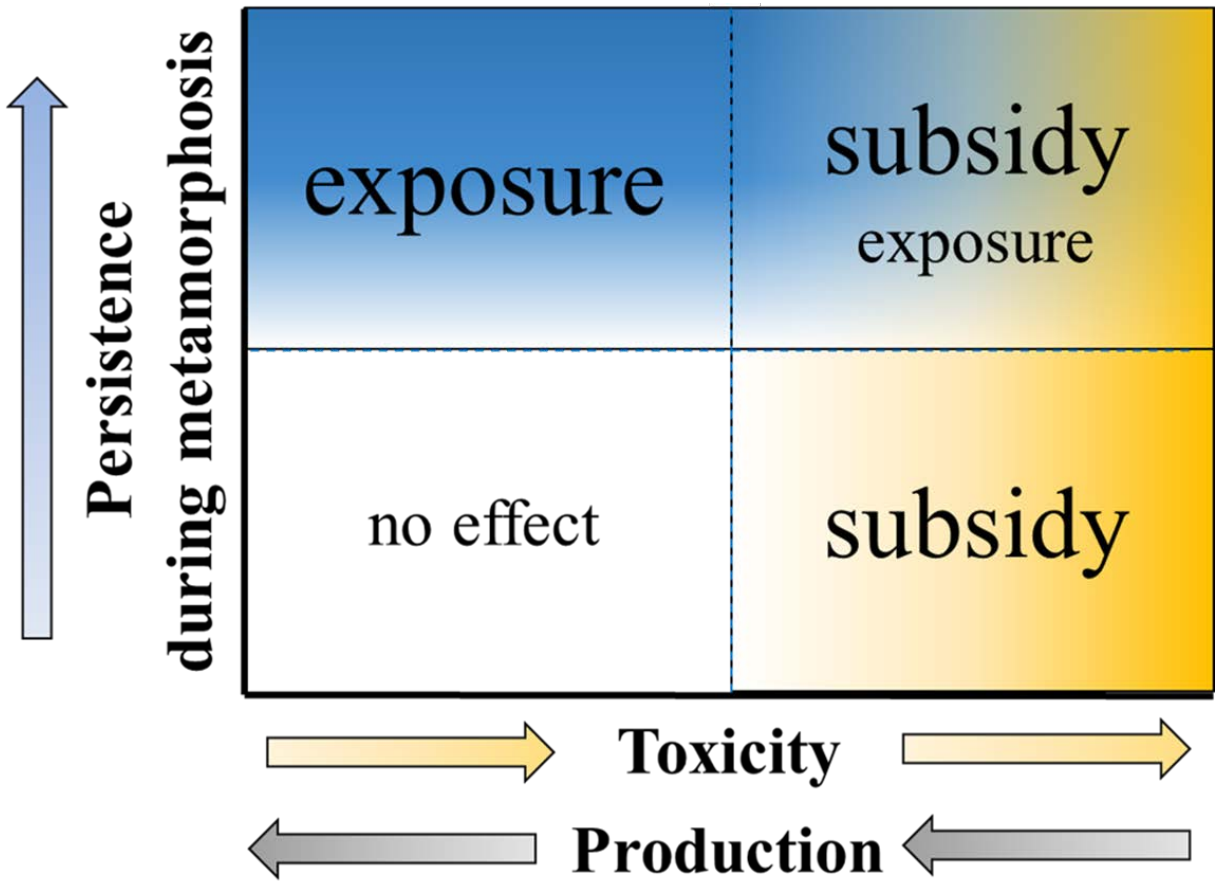

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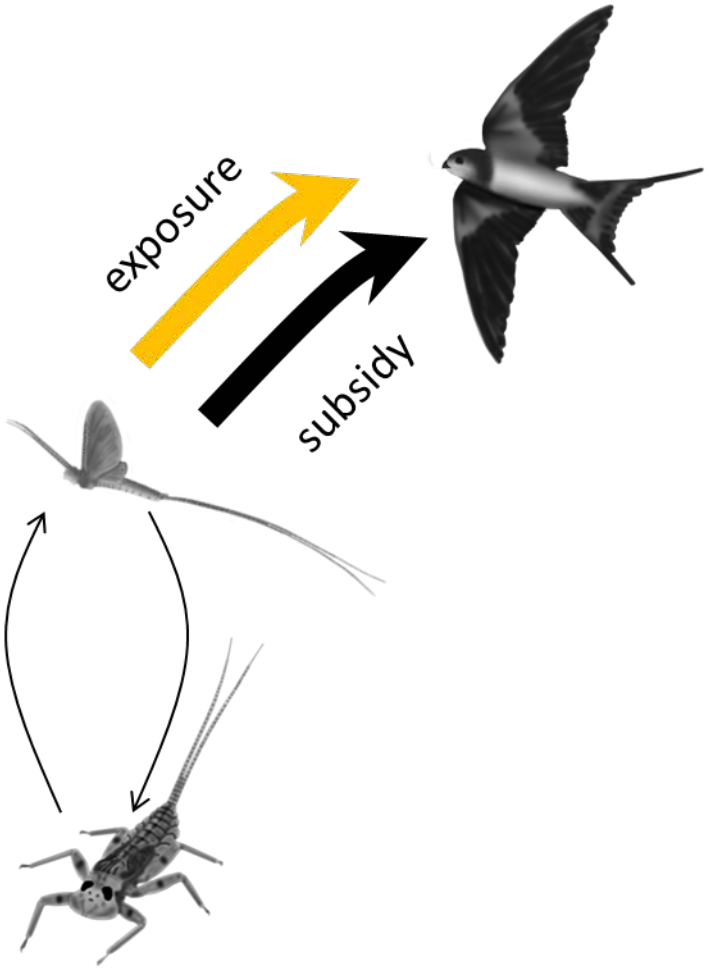
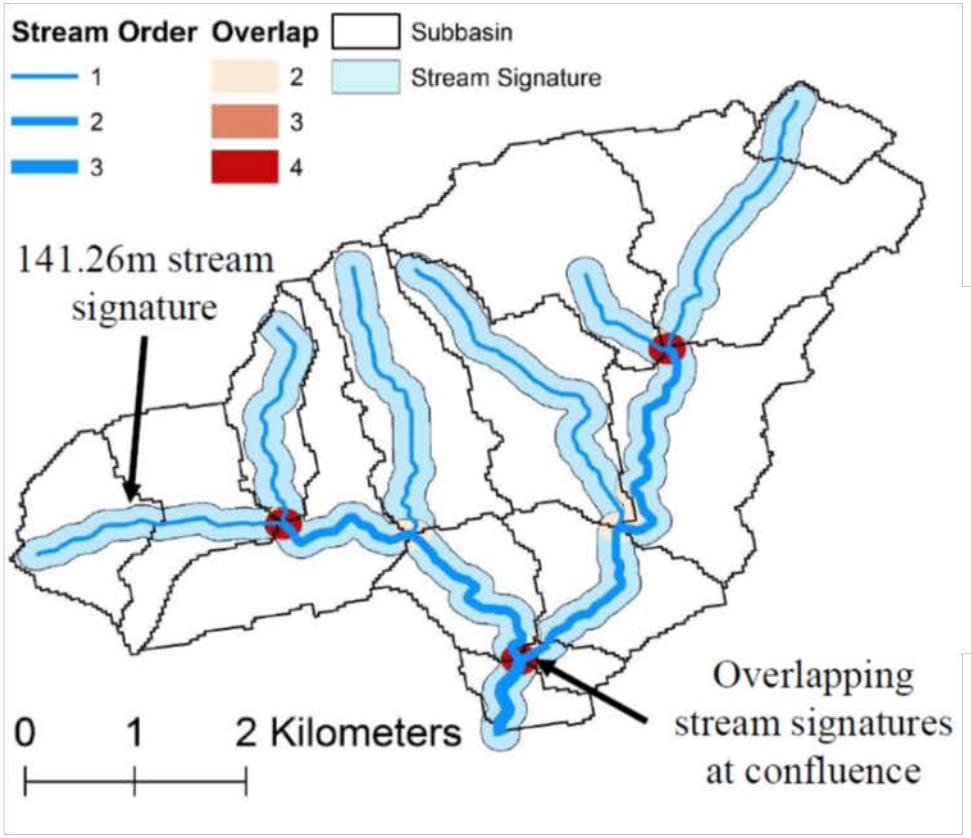


Colin Talbert, USGS



Kopp and Allen, U Oklahoma

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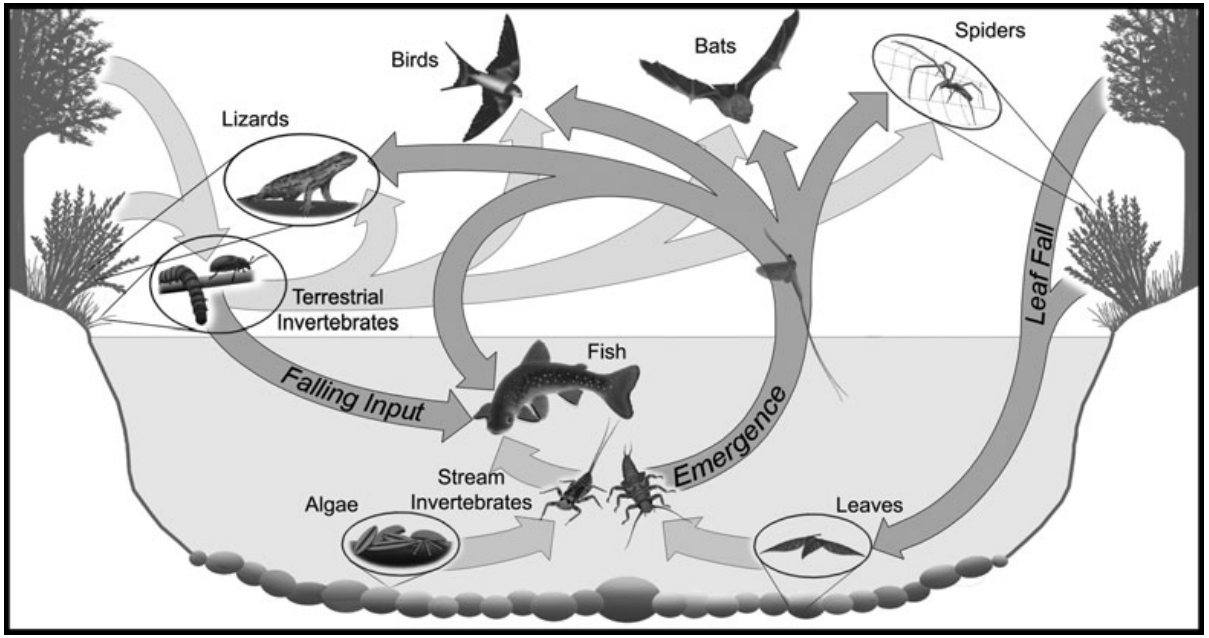

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