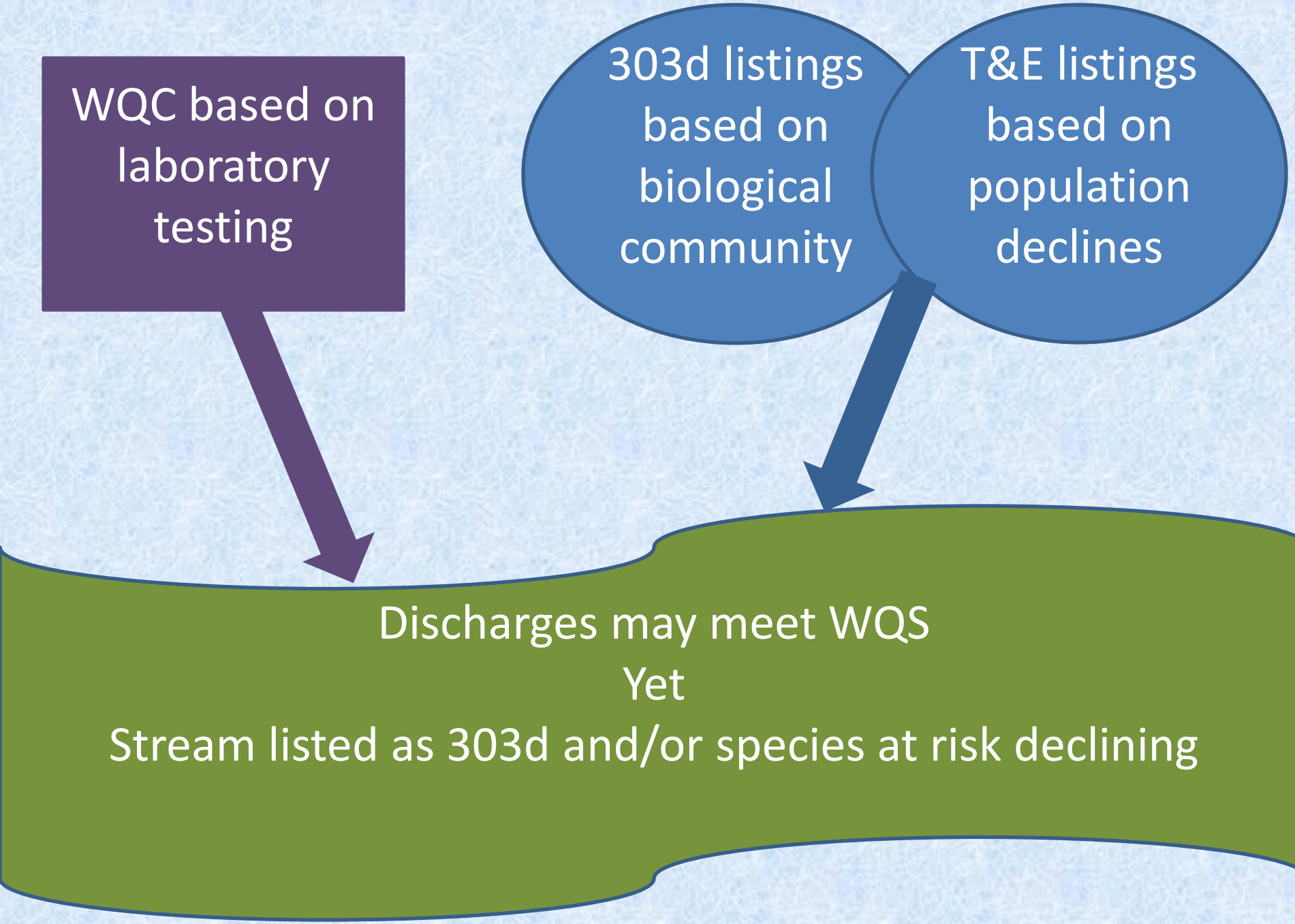
Northwest Environmental Advocates

Incorporation of Field or Meso/Microcosm Data to Validate Criteria in Watersheds Supporting Federally Listed Species

Why are the data needed?

How can data be incorporated?

T&E Aquatic Species Nationwide

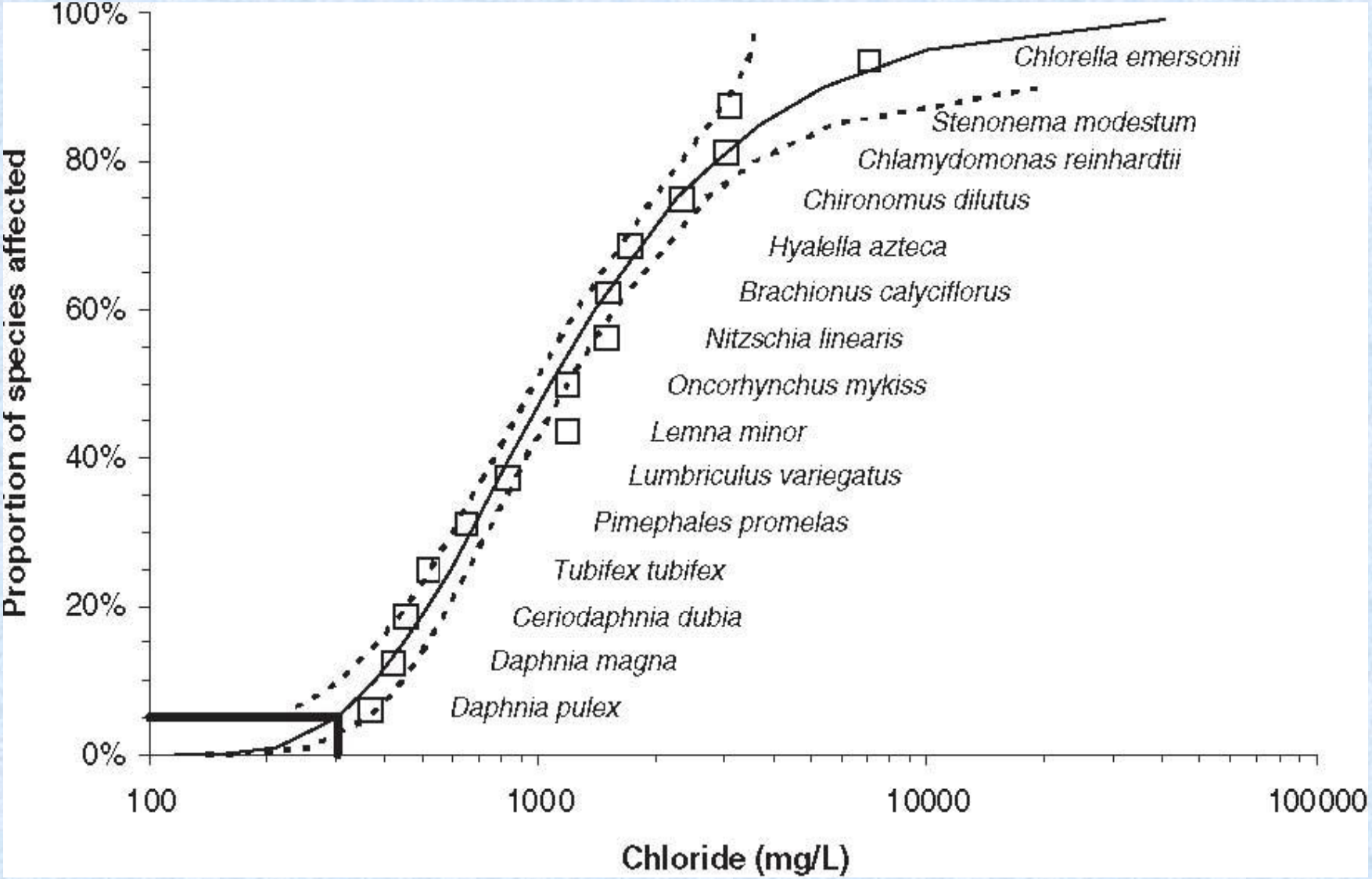

WQC based on laboratory testing
303d listings based on biological community
T&E listings based on population declines
Discharges may meet WQS
Yet
Stream listed as 303d and/or species at risk declining

Potential Factors

- Differences between tested and rare species in species sensitivity distribution (SSD)
- Listed species may be in the 5% not protected by a WQC
- Additional stressors in water bodies
- Contaminant-induced maladaptive behaviors
- Indirect effects on food webs
- Exposure duration (acute vs life long)
- Absence of behavioral endpoints

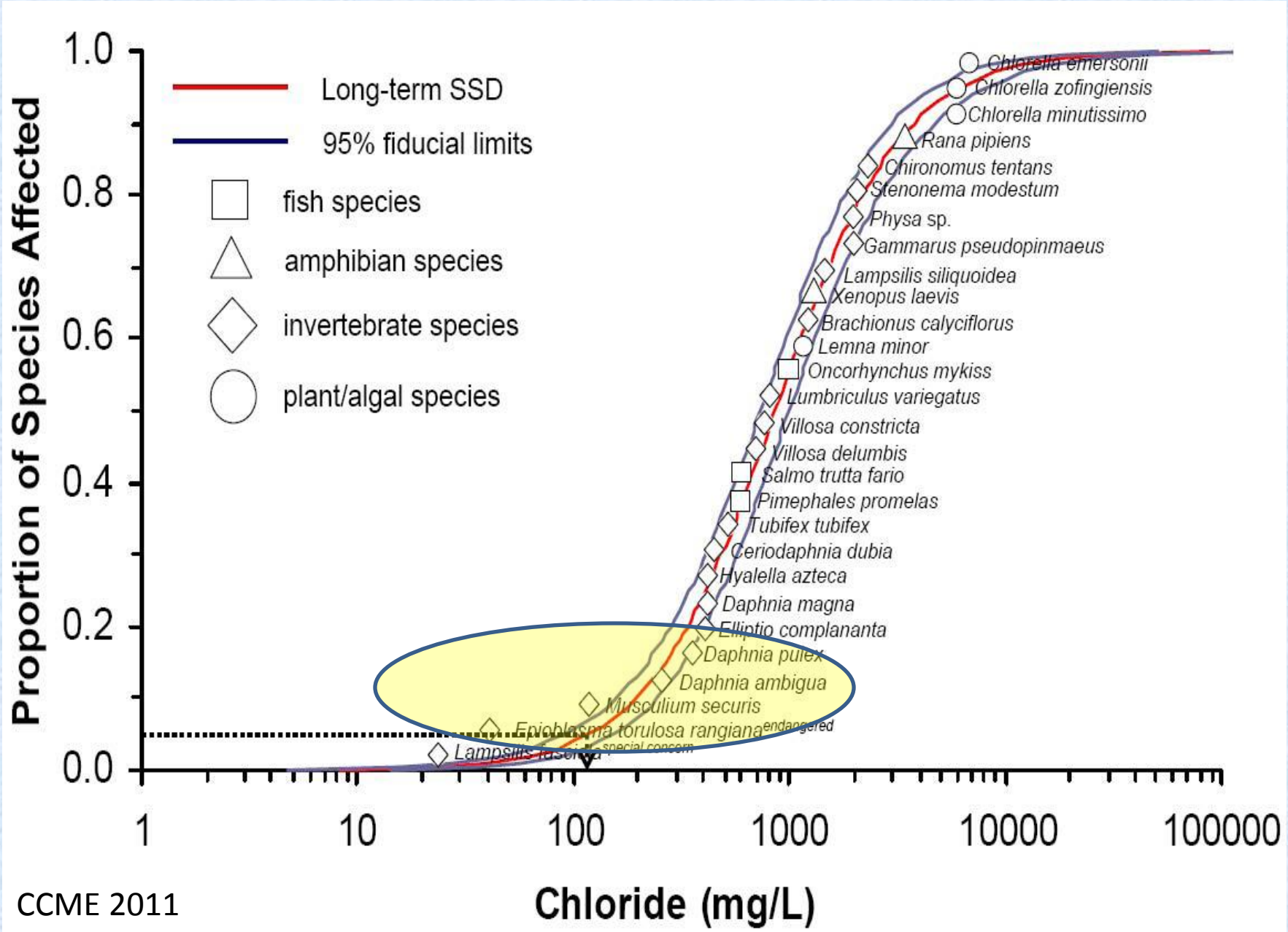
Field, Mesocosm and Microcosm Examples

Tested vs Resident Species



Elphick et al. 2011

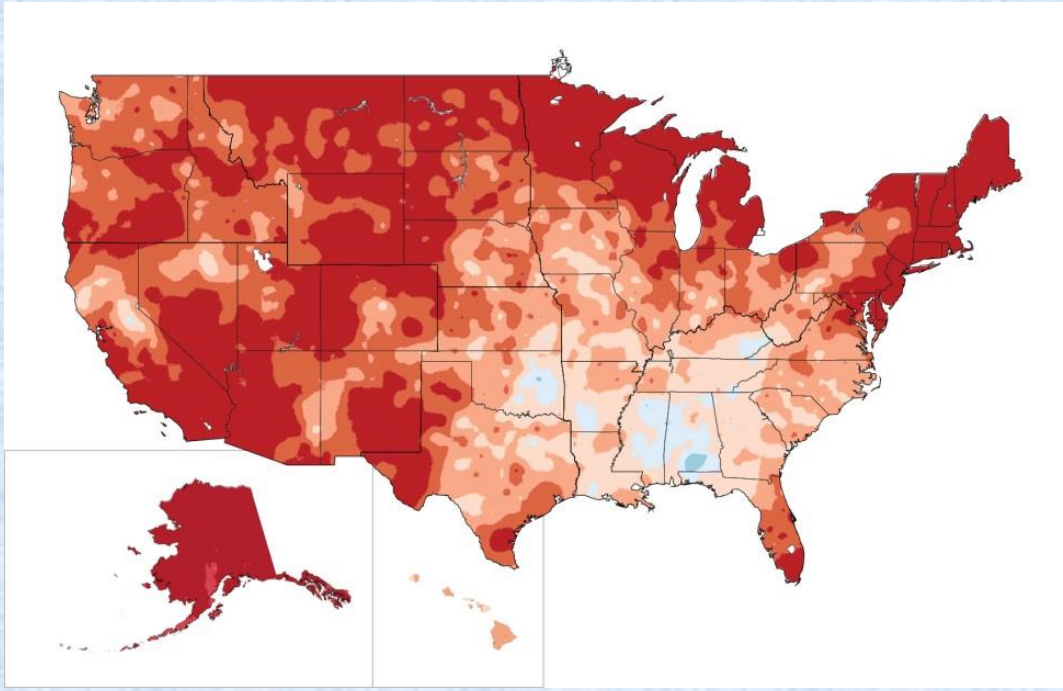
Effect of Including Data for Two Rare Species

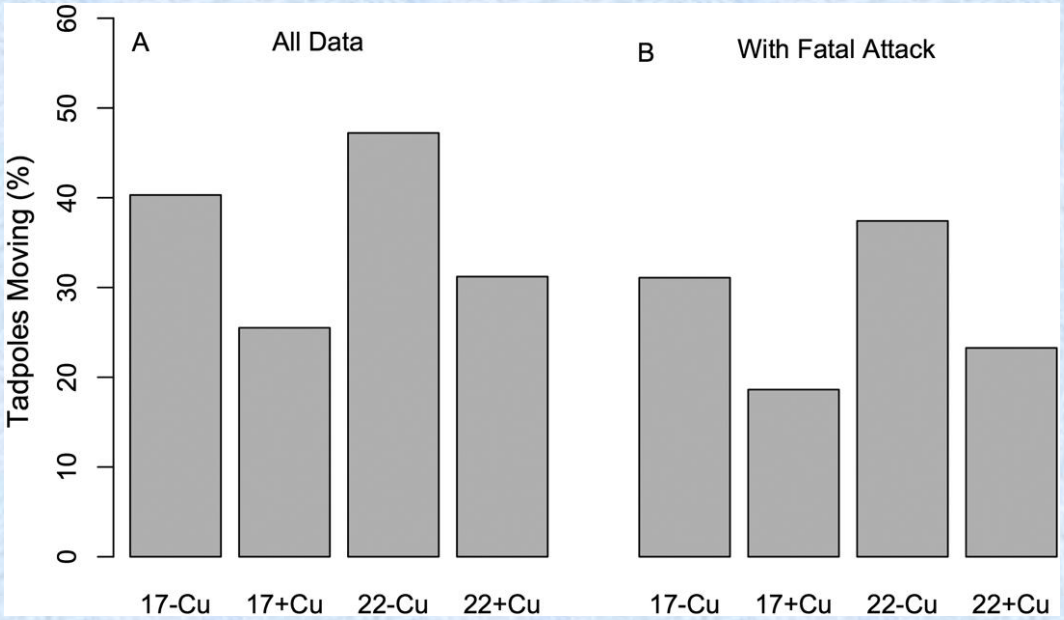


CCME 2011

Additional stressors
Maladaptive behaviors

- Amphibians – worldwide decline sensitive to metals
- Copper – point and non-point sources
- Climate change - warmer waters



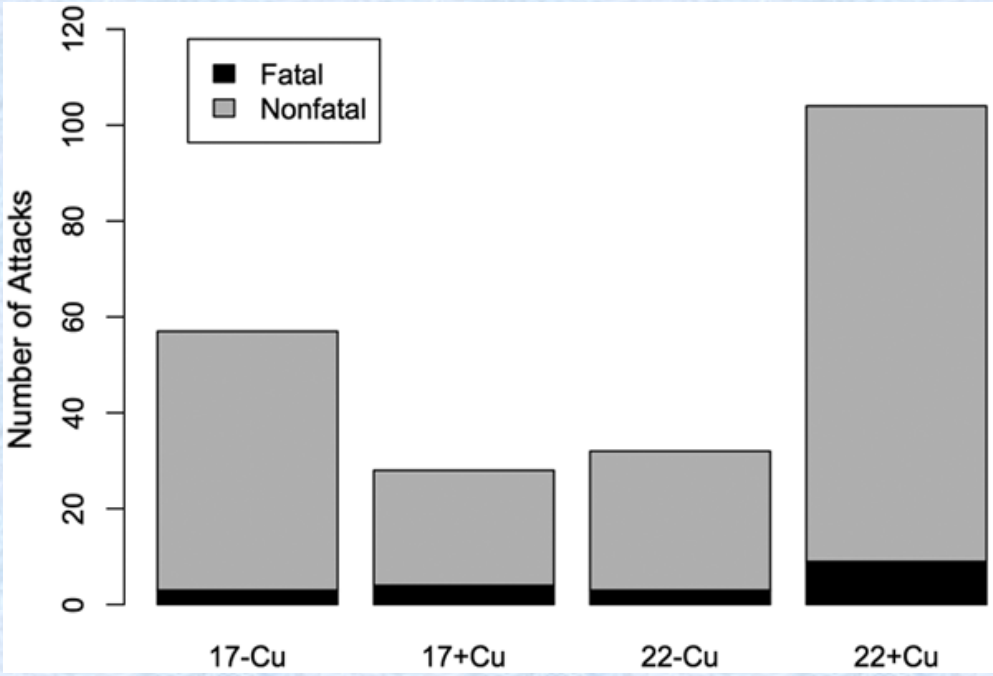


Copper decreased tadpole activity

Increased susceptibility to predation

Temperature increased dragonfly activity

Increased tadpole predation

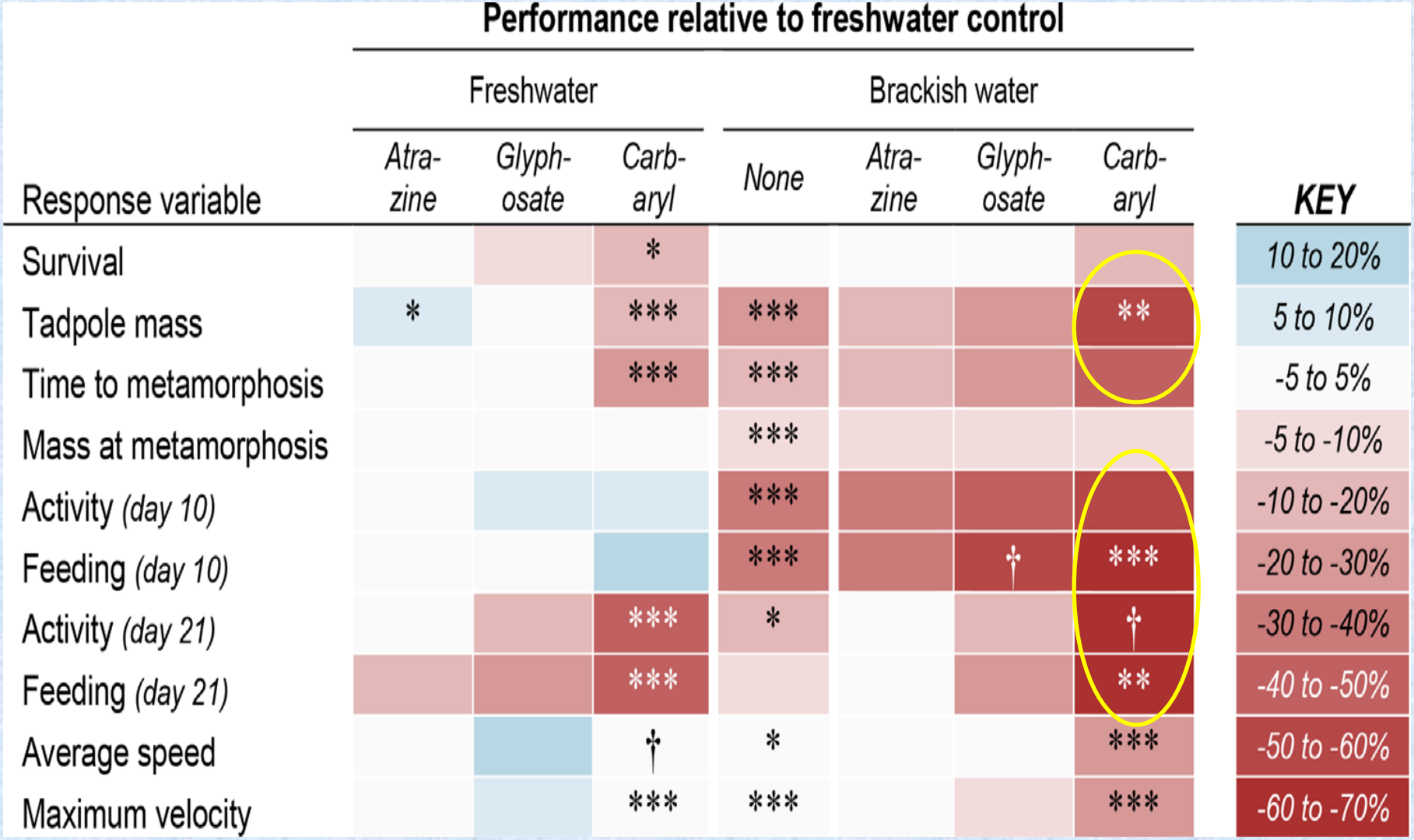


Reeves et al. 2015

Additional stressors
Maladaptive behaviors

- Amphibians
  - 35 listed
  - 43 species in review
  - Sensitive to pesticides
- Carbaryl
  - agricultural/residential
  - widely used
- Salinity
  - sea level rise
  - deicer use
  - irrigation
  - mining/O&G

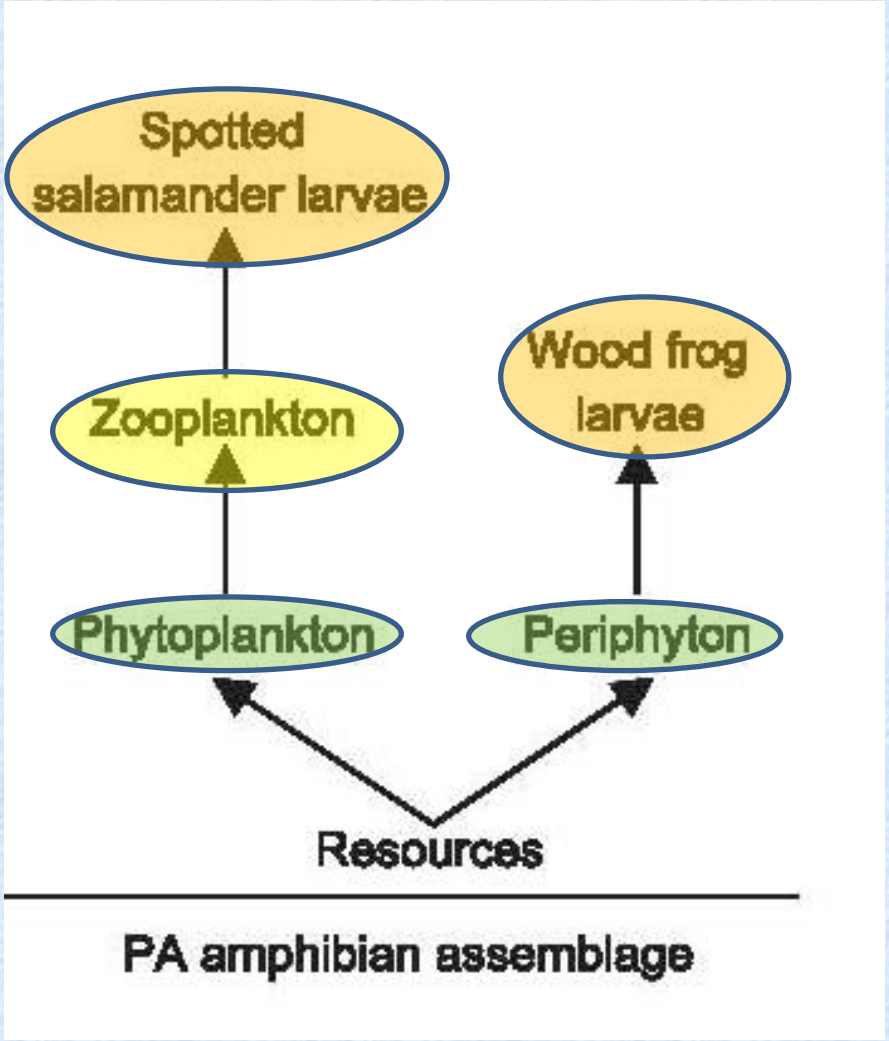
Decreased feeding resulting in slower growth/development
Decreased movement affects predator avoidance and survival



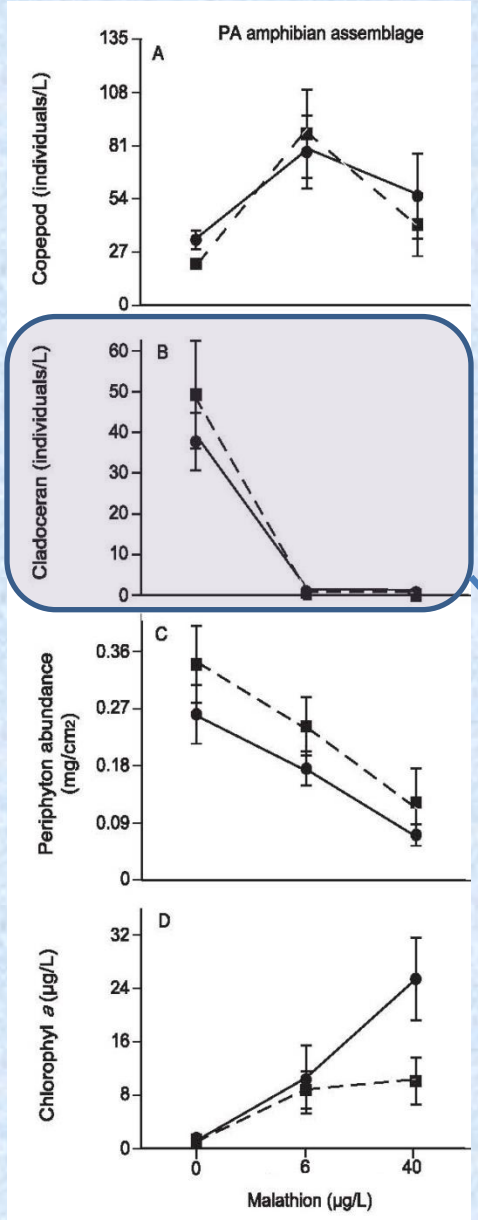
Wood and Welch 2015

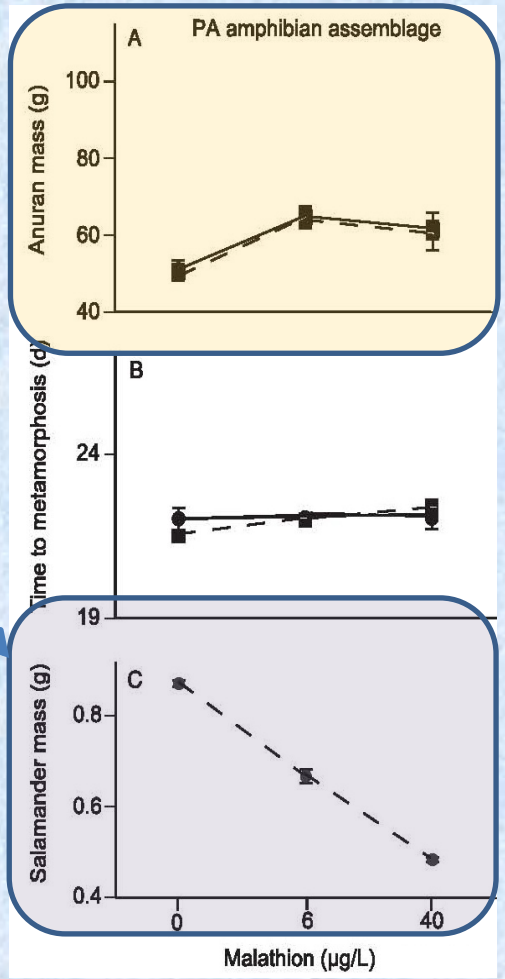
Indirect Effects via Food Webs

- Amphibians –
  under represented in lab
  suited to mescosms
- Low dose pesticide exposure relevant to environment
- Simple Food Web –
  different sensitivities
  evident interactions



Hua and Relyea 2012





Selective toxicity in prey
Perturbs food web balance

Selective indirect effects in predators without direct toxicity

Annual exposures could eliminate entire populations

Hua and Relyea 2012

Exposure Duration and Endpoints

- Freshwater mussels
  - under represented in lab
  - Uniquely sensitive to some chemicals
  - Sessile; complex life history; long lived
- Metal mixtures –
  - typical environmental exposure
- Sediments & Pore Water
  - relevant to filter feeders that burrow
- Lab Testing & Field Surveys-
- -combination warranted to understand toxicity

Correspondence of laboratory testing and field survey

	Field impact	Field no impact
Lab toxic	33%	0%
Lab nontoxic	27%	40%

Potential Factors for Discrepancy:
Lifetime exposure of mussels
Effects on reproduction not assessed

Critical population reductions for rare species

Besser et al. 2009 and Roberts et al. 2009

Why are the data needed?

- Water quality critical to T&E aquatic species
- 274 aquatic species under review for T&E
- Difficult logistics for lab testing T&E species
- Lifetime and full life cycle exposure effects
- Indirect toxicity via food web perturbations
- Ubiquity of environmental stressors including climate changes

How can data be incorporated?

- Incorporate laboratory toxicity data for T&E species or closely related surrogates into SSDs
- Include mesocosm/*in situ* studies with T&E species in SSDs
- prioritize chronic studies and sublethal endpoints in setting WQC
- Consider field monitoring data encompassing T&E distributions in assessing the need for WQC revisions

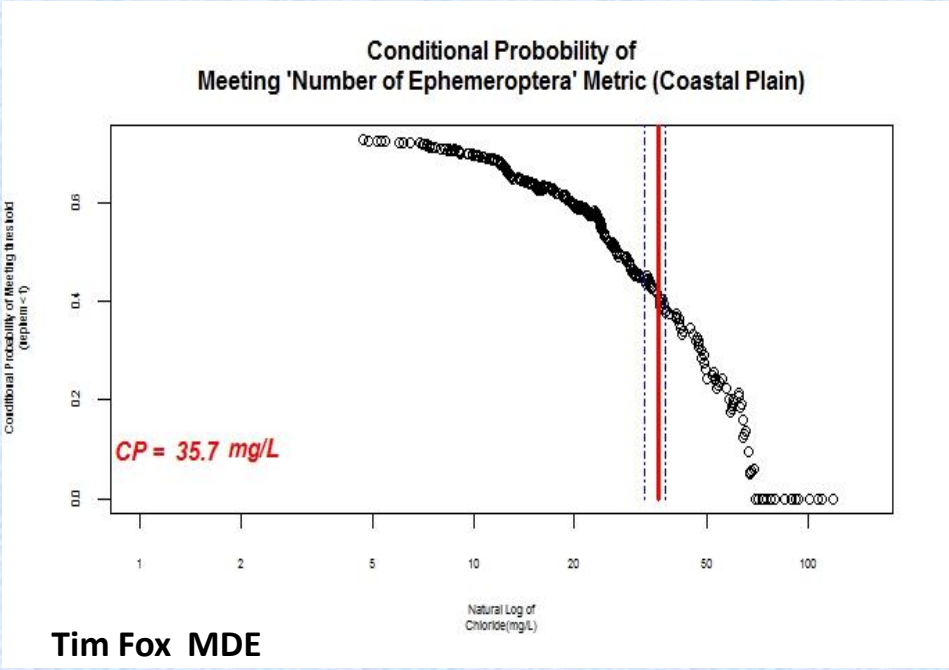
T&E Toxicity Data in SSD

- derive unique WQC for watersheds with sensitive taxa (e.g., ammonia)
- select surrogates for testing in consultation with T&E species experts (e.g., FWS, NOAA, academics)
- add weight to quality studies with T&E species in deriving WQC

T&E Mesocosm/*In Situ* Studies

- Enables testing species difficult to sustain in lab
- Allows for extended exposures
- Enables testing of mixtures/other stressors
- Incorporates behavioral responses
- Facilitates assessment of indirect effects
- Used for EPA pesticide approvals
- Evaluation guidance available from other countries

T&E in Field Monitoring Data



Tim Fox MDE

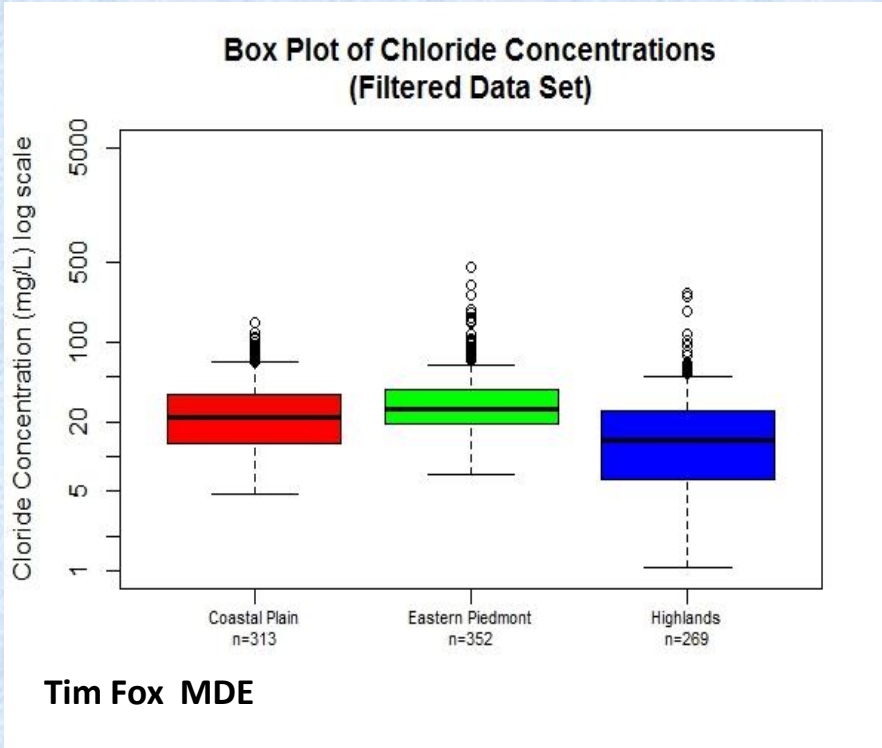
Demonstrated to be effective for:

-conductivity (e.g., Appalachians)

-chloride (e.g., Maryland)

Signals failure of WQC to protect sensitive species

Useful for documenting effectiveness of revisions to WQC or state standards



Tim Fox MDE

Captures effects of:

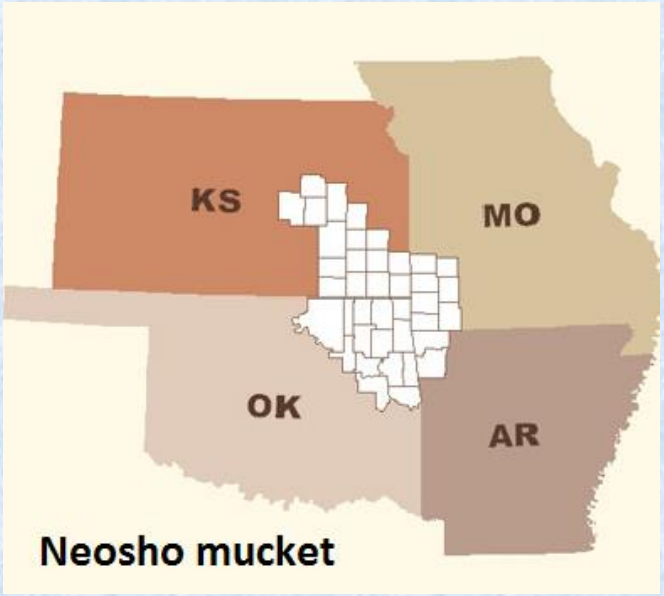
long term exposures

multiple life stages

multiple stressors

Indirect effects

Federal Strategy



- T&E species ranges cross state boundaries
- States provide inconsistent protection
- Inefficient and ineffective protection at the permit-specific level
- Federal review of toxicity data for laboratory and field studies needed to ensure standardization

Acknowledgements

- Mari Reeves – USFWS AK
- Dave Mosby and Andy Roberts – USFWS MO
- Tim Fox – Maryland Department of the Environment
- Monica Nowierski – Ontario Ministry of the Environment and Climate Change

Centers for Disease Control and Prevention

Per- and Polyfluorinated Substances (PFAS) Factsheet

The per-and polyfluoroalkyl substances (PFAS) are a group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water. Fluoropolymer coatings can be in a variety of products. These include clothing, furniture, adhesives, food packaging, heat-resistant non-stick cooking surfaces, and the insulation of electrical wire. Many PFAS, including perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), are a concern because they:

- do not break down in the environment,
- can move through soils and contaminate drinking water sources,
- build up (bioaccumulate) in fish and wildlife.

PFAS are found in rivers and lakes and in many types of animals on land and in the water.

PFAS Exposure in People

PFAS persist in the environment and exposure in people can occur by consuming PFAS-contaminated water or food. Exposure may happen by using products that contain PFAS.

How PFAS Affect People's Health

Human health effects from exposure to low environmental levels of PFAS are uncertain. Studies of laboratory animals given large amounts of PFAS indicate that some PFAS may affect growth and development. In addition, these animal studies indicate PFAS may affect reproduction, thyroid function, the immune system, and injure the liver. Epidemiologic studies on PFAS exposure evaluated several health effects. Descriptions of these studies are available at: https://www.atsdr.cdc.gov/pfas/. More research is necessary to assess the human health effects of exposure to PFAS.

Levels of PFAS in the U.S. Population

Since 1999, CDC scientists have measured at least 12 PFAS in blood serum (the clear portion of blood). Blood serum is obtained from participants, aged 12 years and older, who have taken part in the National Health and Nutrition Examination Survey (NHANES) (Fourth National Report on Human Exposure to Environmental Chemicals, Updated Tables). By measuring PFAS in serum, scientists can estimate the amount of PFAS in people's bodies.

CDC scientists found four PFAS (PFOS, PFOA, PFHxS or perfluorohexane sulfonic acid, and PFNA or perfluorononanoic acid) in the serum of nearly all of the people tested. This indicates widespread exposure to these PFAS in the U.S. population. The data tables showing results since 1999 are available here: https://www.cdc.gov/exposurereport/.

Finding a measurable amount of PFAS in serum does not imply that the levels of PFAS cause an adverse health effect. Biomonitoring studies on levels of PFAS provide physicians and public health officials with reference values. These reference values can determine whether people have been exposed to higher levels of PFAS than the general population. Biomonitoring data also help scientists plan and conduct research on exposure and health effects.

Additional Resources

Agency for Toxic Substances and Disease Registry

- Toxicological Profile for Perfluoroalkyls

- Information about Per- and Polyfluoroalkyl Substances and Your Health

Environmental Protection Agency

- https://www.epa.gov/pfas

Page last reviewed: May 2, 2022

Washington Department of FISH & WILDLIFE (/)

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Living with wildlife (/species-habitats/living)

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Habitat recovery and protection (/species-habitats/habitat-recovery)

Sampling locations

English sole

Mussels

Pacific herring

Juvenile Chinook

Adult Chinook

Aquatic invasive species (/species-habitats/invasive)

Wildlife diseases (/species-habitats/diseases)

Amphibians and reptiles of Washington (/species-habitats/amphibians-reptiles)

Marine toxic contaminants (/species-habitats/science/marine-toxics)

Wildlife viewing (/species-habitats/wildlife-viewing)

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Aquatic

Shortface lanx *(Fisherola nuttalli)*

Photo by Montana Field Guide - Montana Natural Heritage Program, Copyright

Top view of a shortface lanx's shell and foot

Category: Molluscs

Common names: Giant Columbia River limpet

State status: Candidate (/species-habitats/at-risk/listed?state_status=25402)

Vulnerability to climate change (More details)

Low	Low-Moderate	Moderate	Moderate-High	High

If you see this species, please share your observation using the WDFW wildlife reporting form (/get-involved/report-observations). Providing detailed information such as a photo and exact coordinates will improve the confidence and value of this observation to WDFW species conservation and management.

The shortface lanx is an uncommon aquatic snail in Washington; its population size has a declining trend. Currently in the state, large populations of this snail persist in the Okanogan River and the Hanford Reach of the Columbia River; small populations are found in the Methow and Grand Ronde rivers. The species requires clear, cold, well-oxygenated waters, and is threatened by pollution and siltation.

Description and Range

invasive species (/species-habitats/invasive)

Wildlife diseases (/species-habitats/diseases)

Amphibians and reptiles of Washington (/species-habitats/amphibians-reptiles)

Marine toxic contaminants (/species-habitats/science/marine-toxics)

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Physical description

Shortface lanx is a small pulmonate (lunged) snail in the family Lymnaeidae. It is also known as Giant Columbia River limpet because it has a low, flat conical shell, but it is not a limpet. The shell may be between 0.3 to 0.5 inches long, 0.25 to 0.4 inches wide, 0.12 to 0.2 inches high; size of adults varies with stream size. The shells are described reddish or brown in color.

Ecology and life history

Shortface lanx are found in unpolluted, cold, well-oxygenated perennial streams and rivers, generally 100 to 325 feet wide, with a cobble-boulder substrate. Within such streams it is found primarily on diatom-covered rocks at the edges of rapids or immediately downstream from rapids in areas that have suitable substrate. These snails have not been found in areas with silt or mud substrates, extreme seasonal variations in water level, an abundance of aquatic plants or algae, bedrock substrate, or where dredging or mining occurs.

Shortface lanx feeds by scraping algae and diatoms from rock surfaces in streams. The species may occasionally feed on other plant surfaces.

Fisherola snails are hermaphrodites but do not appear to be self-fertilized, thus mating occurs between two individuals. Eggs are laid from spring to autumn in gelatinous capsules attached to plants, stones, or other objects. They lack a free-swimming larval stage, and hatchlings are morphologically similar to adults, except that they lack a functional reproductive system. Young snails appear to grow rapidly and require only a few months to reach full size.

Individual *F. nuttalli* probably live for only one year, as this species breeds once and dies afterwards (semelparous breeding).

Individuals are present year-round in the streams they inhabit, but they are inactive during the winter.

Geographic range

This species was historically present throughout much of the Columbia River drainage in Washington, Montana, Oregon, Idaho, and British Columbia, but most populations were extirpated due to habitat loss

resulting from dams, impoundments, water removal, and pollution. This species is now presumed extirpated in Montana and possibly in British Columbia.

Currently in Washington, large populations of the species persist in the Okanogan River and the Hanford Reach of the Columbia River; small populations are found in the Methow and Grand Ronde rivers.

The species also occurs in the lower Deschutes River in Oregon, and the Snake River in Oregon and Idaho. In Idaho, it occurs in the Middle and Upper Snake River reaches from Elmore County, upstream to at least Bingham County. Populations also occur in the Salmon River and Hells Canyon of the Snake River including parts of Nez Perce and Idaho Counties. Additional small populations are found in Oregon in the Grande Ronde, John Day, and Imnaha Rivers, and the lower Columbia River near Bonneville Dam.

For maps of range-wide distribution and conservation status of this species, check out NatureServe Explorer and the International Union for Conservation of Nature's Redlist.

Climate vulnerability

Conservation

This species is identified as a **Species of Greatest Conservation Need** (SGCN) under the State Wildlife Action Plan (/species-habitats/at-risk/swap) (SWAP). SGCN-classified species include both those with and without legal protection status under the Federal or State Endangered Species programs, as well as game species with low populations. The WDFW SWAP is part of a nationwide effort by all 50 states and five U.S. territories to develop conservation action plans for fish, wildlife and their natural habitats—identifying opportunities for species' recovery before they are imperiled and more limited.

This species is identified as a **Priority Species** under WDFW's Priority Habitat and Species Program (/species-habitats/at-risk/phs). Priority species require protective measures for their survival due to their population status, sensitivity to habitat alteration, and/or recreational,

commercial, or tribal importance. The PHS program is the agency's main means of sharing fish and wildlife information with local governments, landowners, and others who use it to protect priority habitats for land use planning.

For aquatic snails, limiting factors may include hardness, acidity, dissolved oxygen, salinity, high temperature, and food availability as associated with depth. Snails are uncommon in habitats with surface acidity greater than pH 5. Dissolved oxygen limits diversity, so severely polluted waters (oxygen consumed by algae blooms) are often devoid of freshwater snails excepting pollution-tolerant species. Most species live in the shallows, (depths less than 10 feet) where food abundance is greatest. As a result, drastic water fluctuations (draw-downs) may cause declines in snail populations.

Conservation Threats and Actions Needed

- Fish and wildlife habitat loss or degradation
  - **Threat:** Pollution and siltation.
  - **Action Needed:** Protect water quality.
- Agriculture and aquaculture side effects
  - **Threat:** Pollution and siltation.
  - **Action Needed**: Develop management recommendations.

See the **Climate vulnerability** section for information about the threats posed by climate change to this species.

Resources

Get razor clam information (/fishing/shellfishing-regulations/razor-clams)

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