

Derivation and application of taxon-specific criteria: Additional resolution in WQC recommendations

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Invited expert meeting on revising USEPA's guidelines
for deriving aquatic life criteria,
September 14-16, 2015, Arlington, VA

Overview

- Re-visit the Taxon-Specific Water Quality Criteria concept
- Go through a worked example
- Integration with Water Quality Criteria problem formulation

Taxon-Specific WQC concept



Proposed Revisions to EPA's Aquatic Life Criteria Guidelines: Taxon-specific Criteria

*Presentation to the Science Advisory Board
September 21, 2005*

Presented by

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On behalf of the

The Taxon-specific Criteria Subcommittee

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Taxon-Specific WQC concept

- *National general aquatic life use criteria* - derived to be generally protective of a large number of taxa; not meant to protect all species all of the time
- *National taxon-specific criteria* - derived to protect a species, genus, or family that is not adequately protected by a national general aquatic life use criterion

Taxon-Specific WQC concept

- In addition to national general criteria, natural resource and risk managers may want to ensure protection of “special status” taxa:
 - species or genera **known to be sensitive** to a pollutant (potentially under-protected by national general aquatic life criteria for that pollutant)
 - taxa that a risk evaluation indicates **may be sensitive and which have a designated special status**:
 - commercial, recreational, cultural, or ecological importance to a Tribe, State or Territory
 - Federally-listed threatened and endangered species

Tools for Taxon-Specific Criteria (not the focus today)

- Recalculate with target species data
- Interspecies correlation estimates
- Species sensitivity distributions
- Apply empirical uncertainty factors based on variability within a target taxonomic level

Purpose of Taxon-Specific Criteria

- Companion national recommendations to provide for the protection of special status taxa as designated by the ESA, State, Territory, or Tribe
 - For use by natural resource and risk managers depending on the level of protection they seek to implement
 - Facilitate State standards development
 - Facilitate Endangered Species Act consultation

Hypothetical example - ammonia

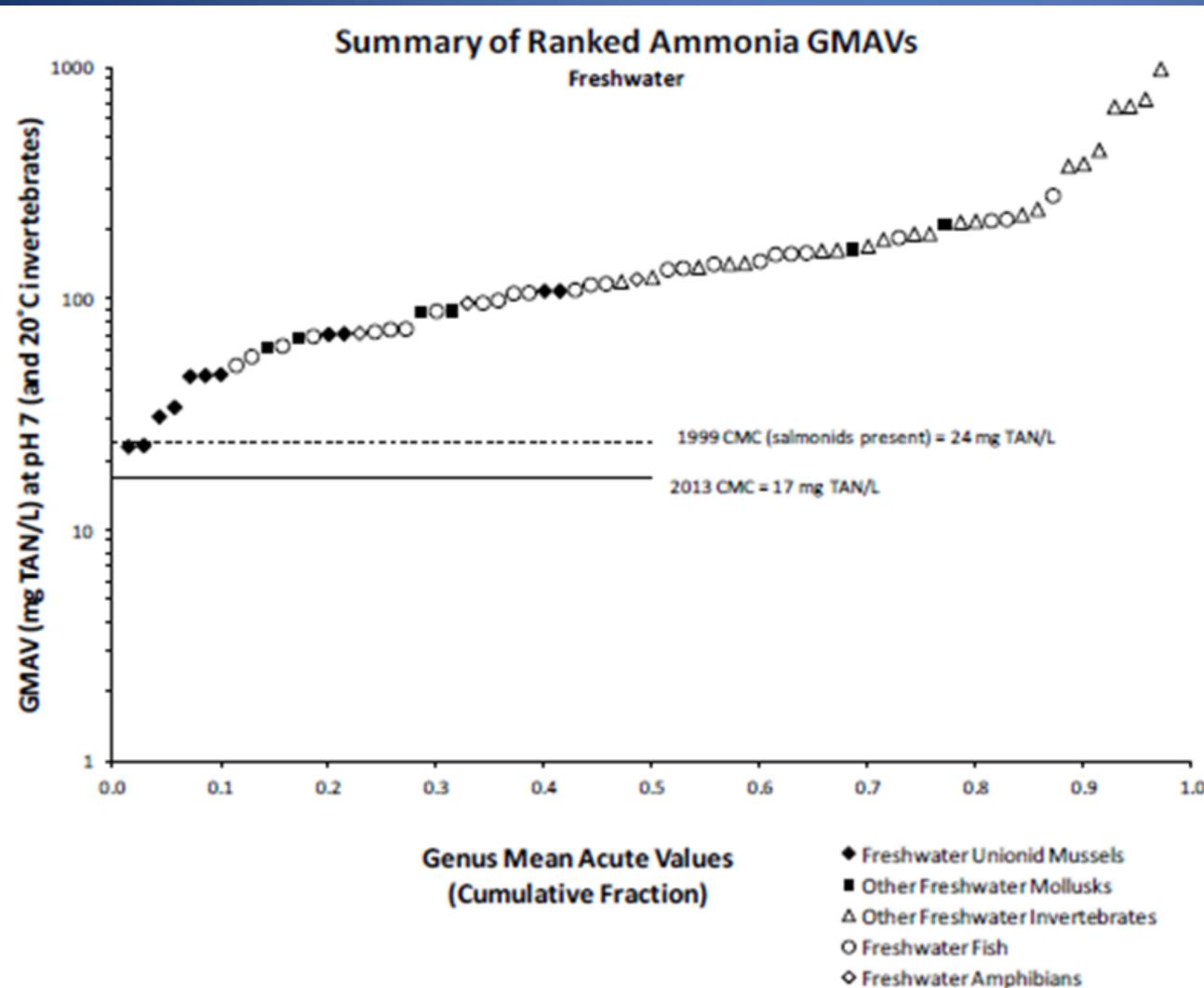
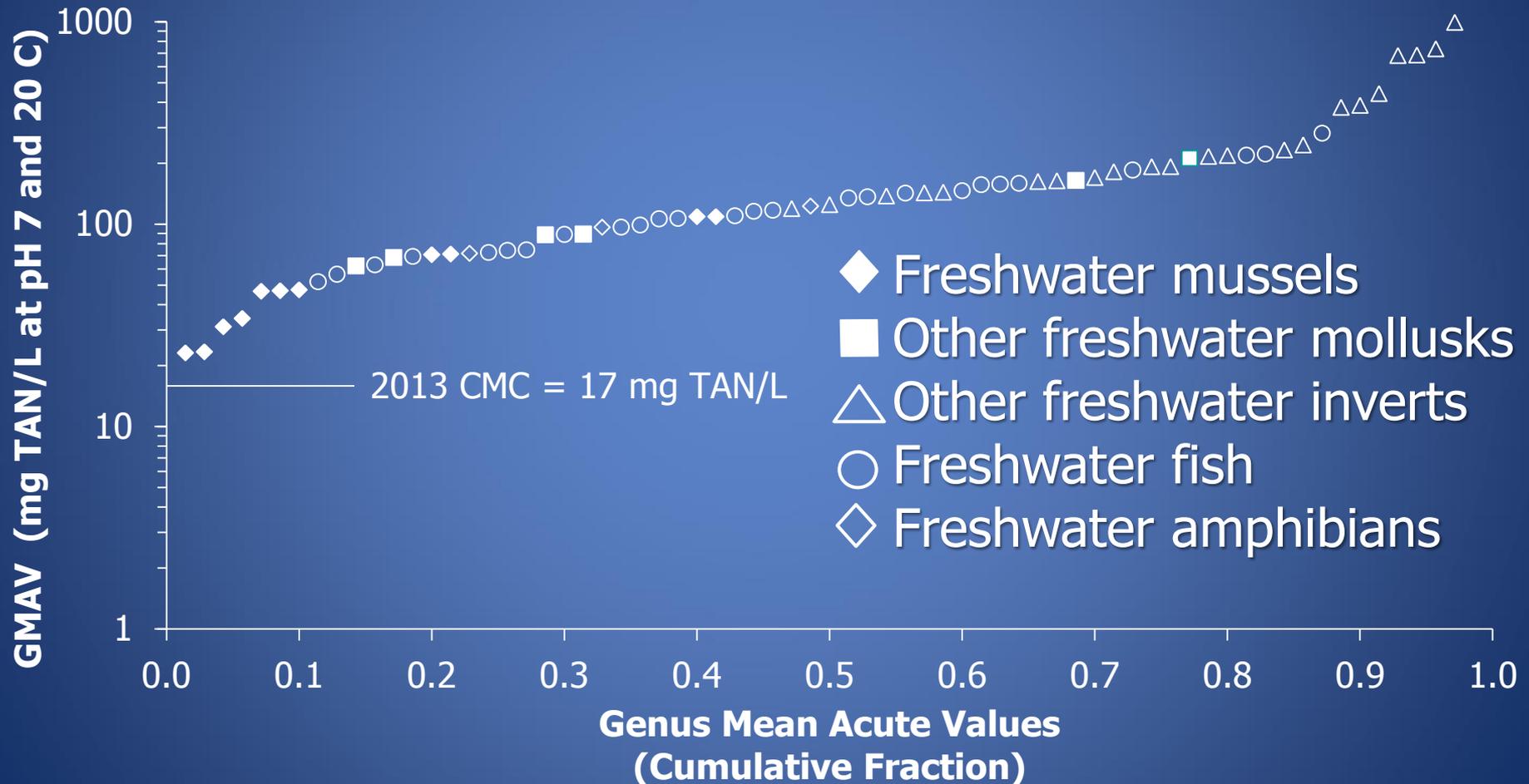


Figure 3 from USEPA 2013. Aquatic life ambient water quality criteria for ammonia - Freshwater

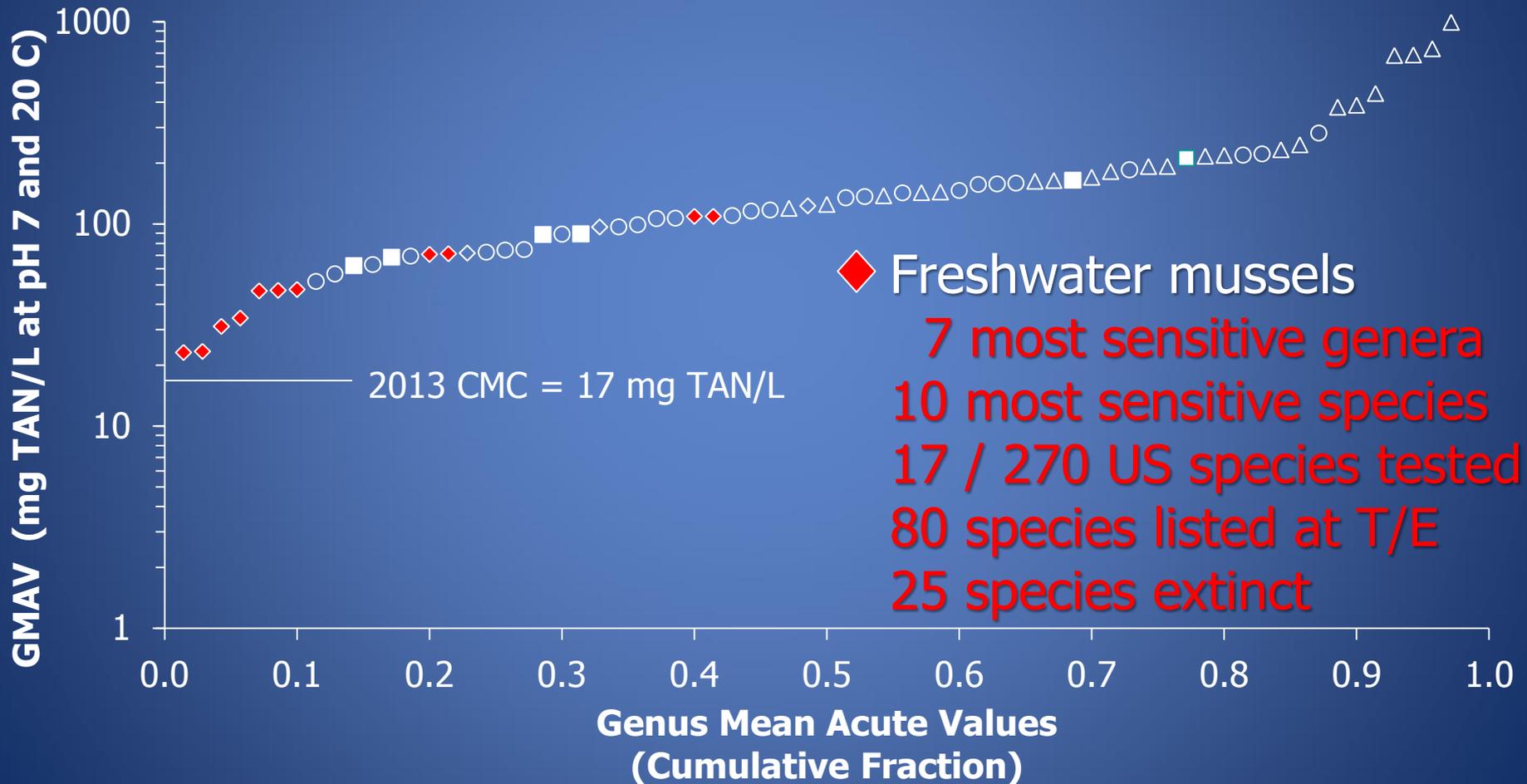
Same data, legend exaggerated

Summary of Ranked Ammonia GMAVs



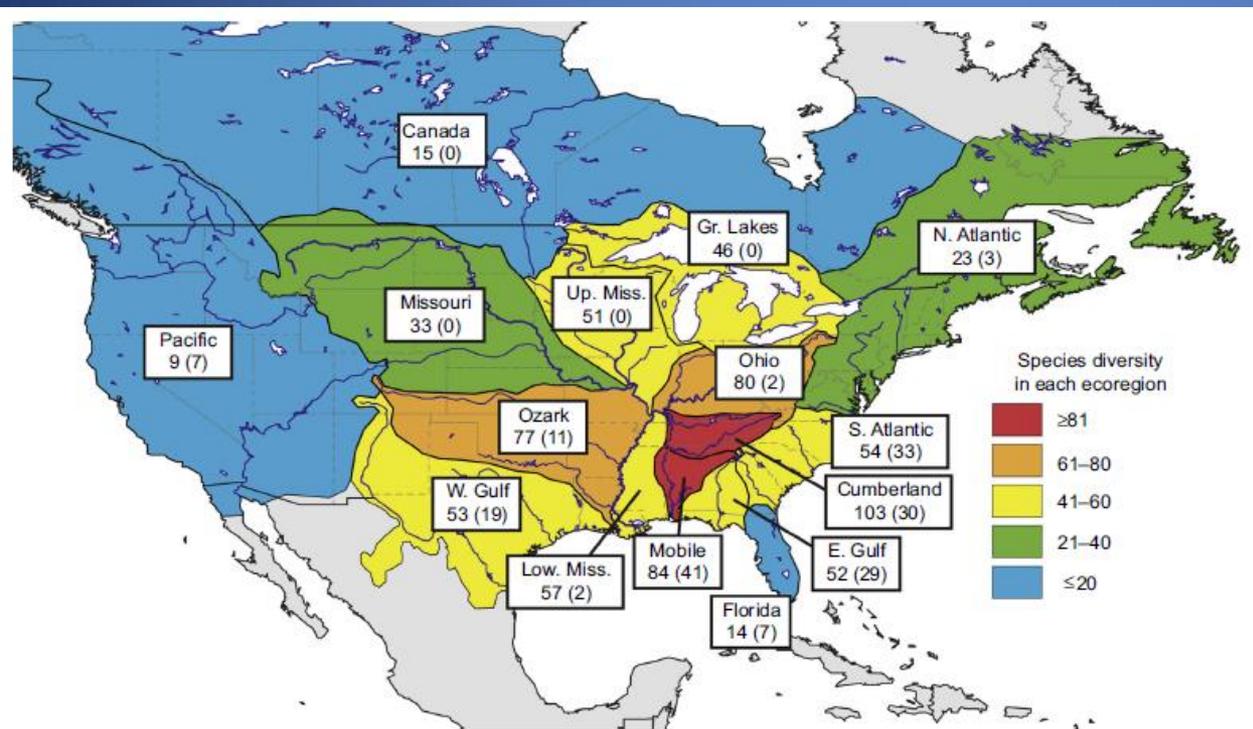
Ammonia and mussels

Summary of Ranked Ammonia GMAVs



Mussels - Where do they occur?

- Every region
- Southeast particularly speciose

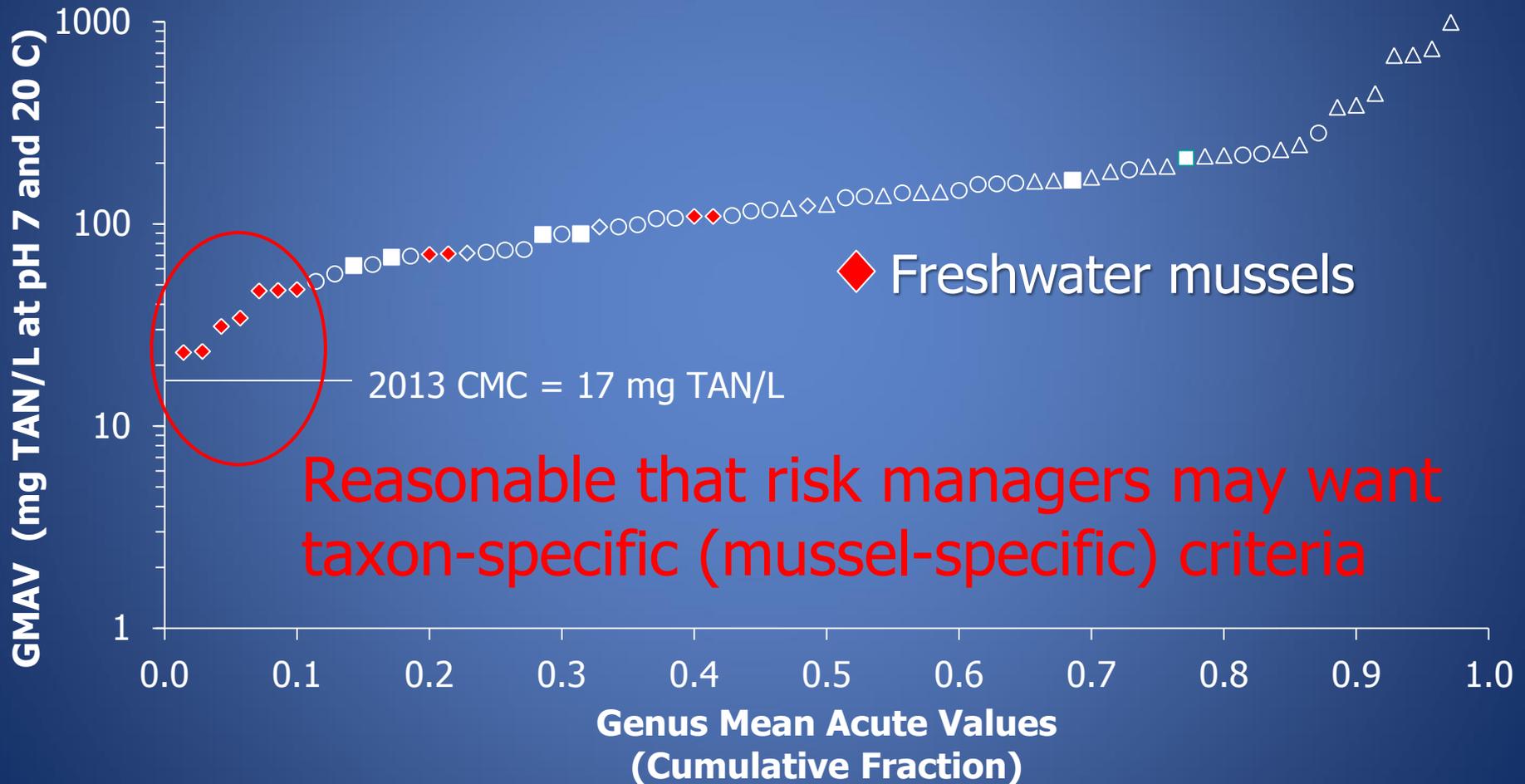


Freshwater mussel diversity and distribution

Cummings and Graf. 2015. Class Bivalvia. In Thorp and Covich's Freshwater Invertebrates. Thorp JH, Rogers DC (eds). Elsevier, New York, NY.

Ammonia and mussels

Summary of Ranked Ammonia GMAVs



Taxon-Specific WQC concept – Applied to Ammonia

- A common pollutant
- Mussels (mollusks) known to be sensitive to this pollutant
- Mussels of conservation concern due to declining biodiversity
- Mussel recovery efforts in progress
- Many species listed as t/e

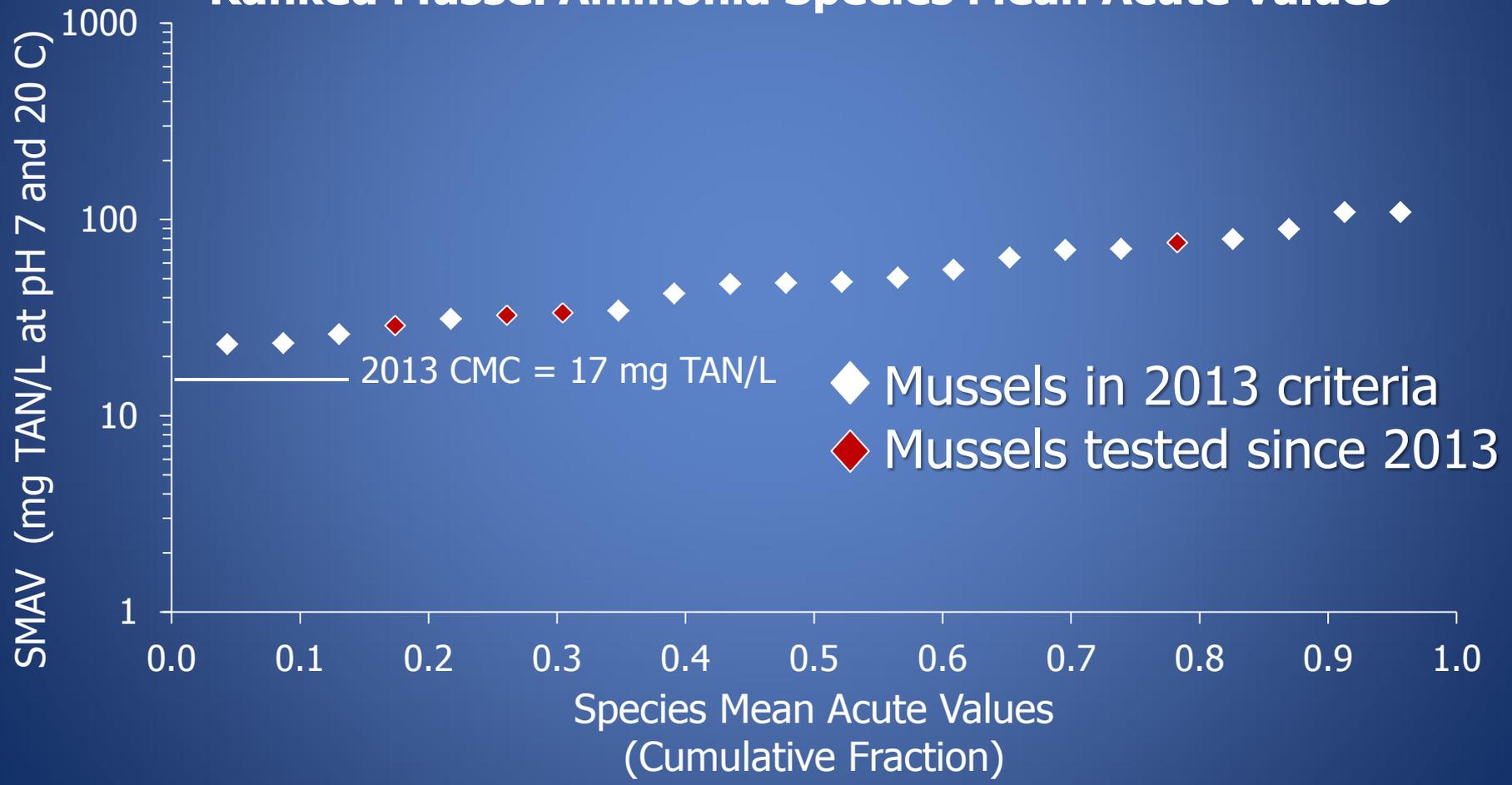
So taxon-specific criteria useful

Taxon (mussel)-specific criteria derivation considerations (acute)

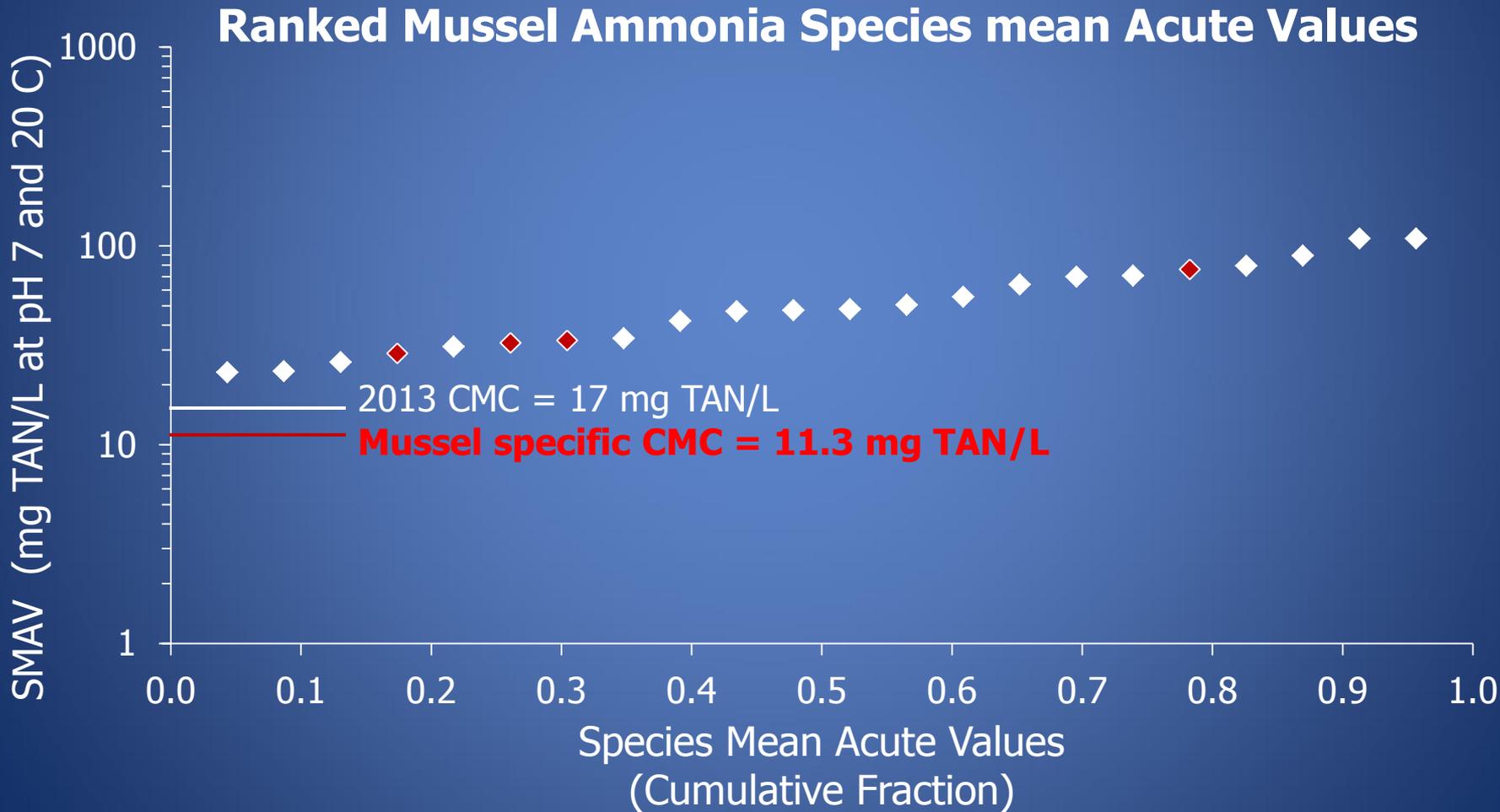
- Use data only for mussels in deriving limits to protect mussels
- Collapse data by species, rather than genus, to preserve resolution of inter-species variation
- Verify assumptions for estimating safe concentrations (e.g., SMAV/2 was acceptable for ammonia and mussels)

Ammonia and mussels

Ranked Mussel Ammonia Species Mean Acute Values



Ammonia and mussels



Hypothetical example - chronic

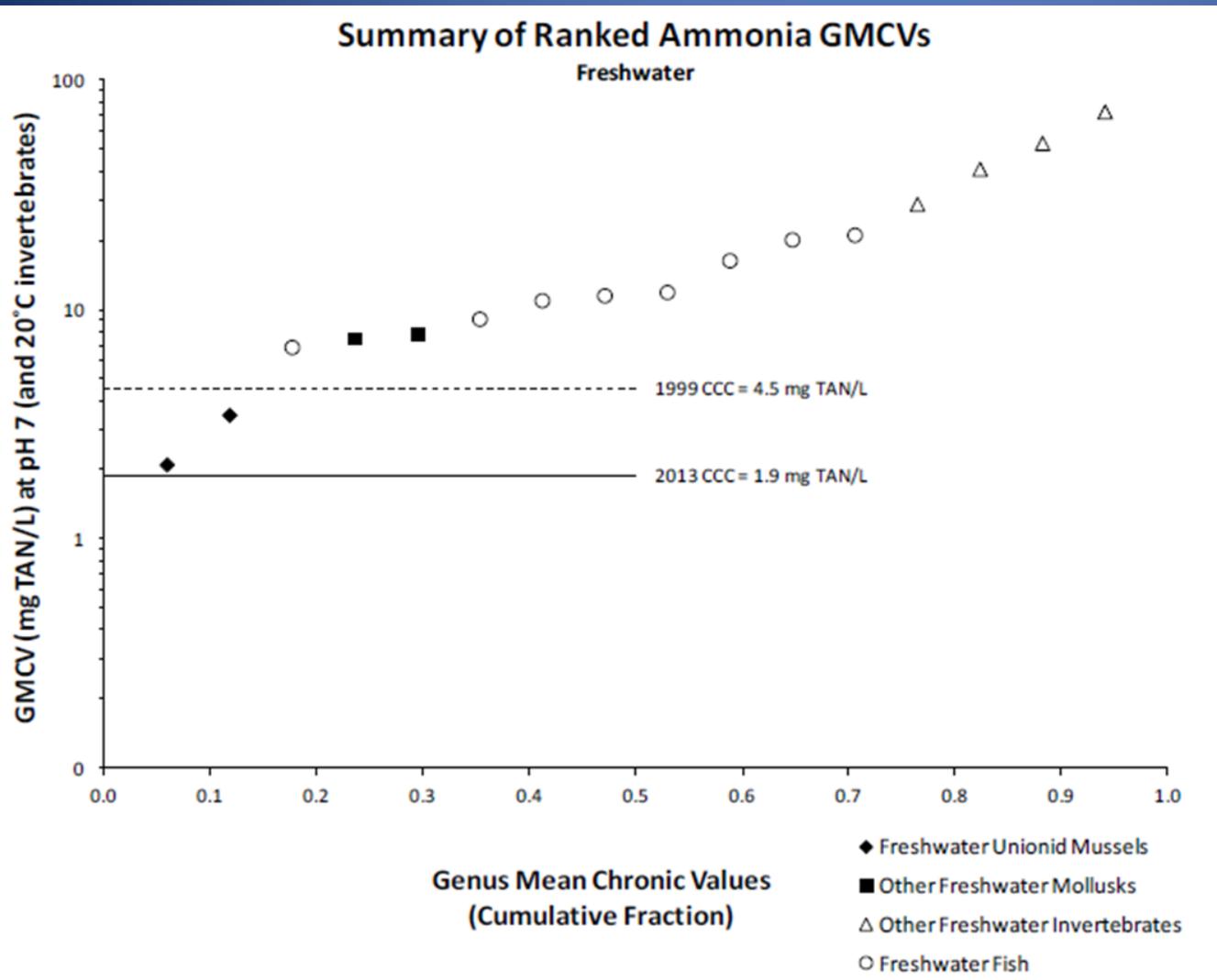


Figure 4 from USEPA 2013. Aquatic life ambient water quality criteria for ammonia - Freshwater

Hypothetical example - chronic

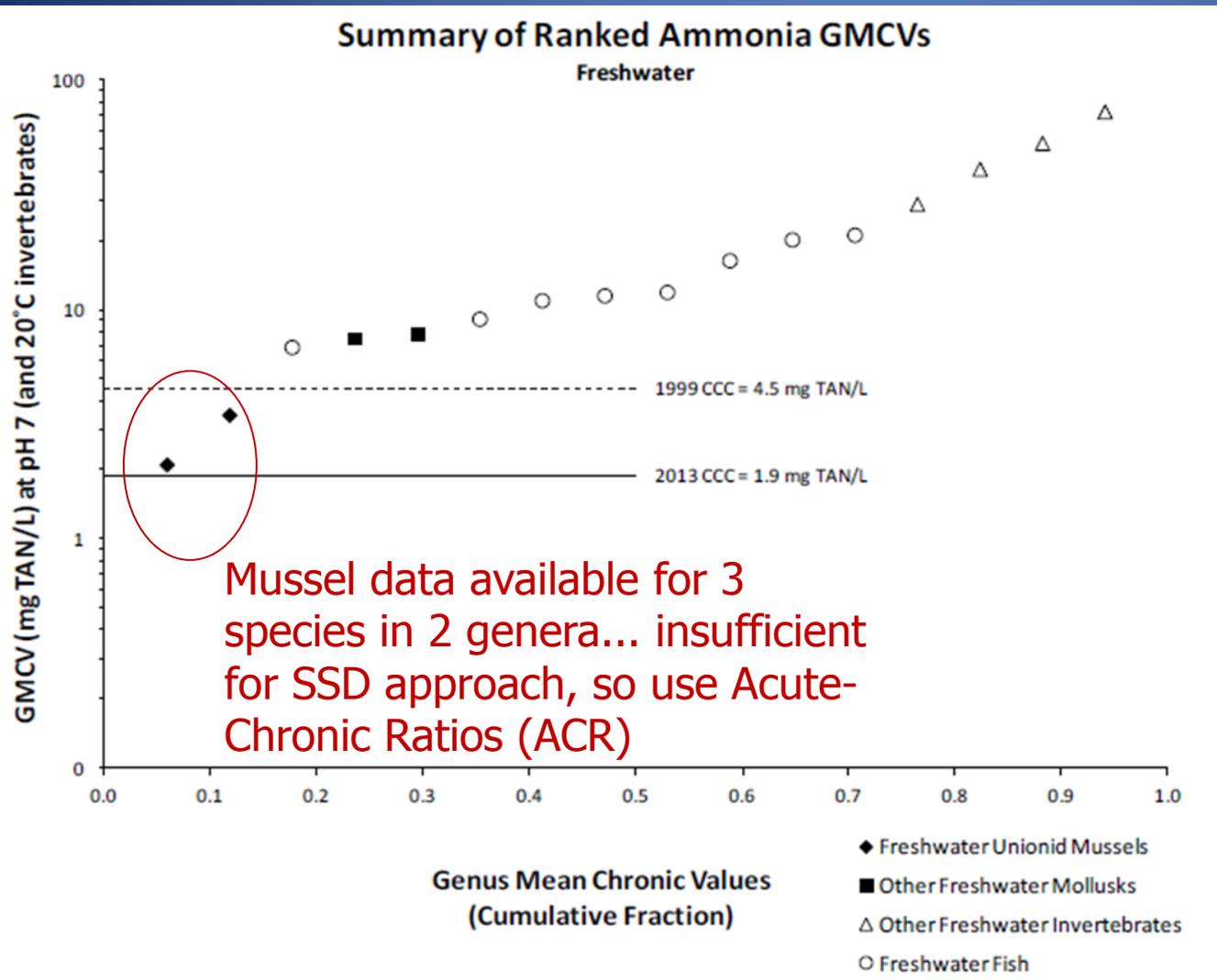


Figure 4 from USEPA 2013. Aquatic life ambient water quality criteria for ammonia - Freshwater

From Table F.1 in 2013 Ammonia WQC document:

From Table F.1 in 2013 Ammonia
WQC document:

Species	ACR
Wavy-rayed lampmussel	49.45
Fatmucket	9.028
Rainbow mussel	11.40
Fingernail clam	42.50
Pebblesnail	7.940

From Table F.1 in 2013 Ammonia WQC document:

From Table F.1 in 2013 Ammonia
WQC document:

Calculate ACRs by taxon of interest

Species	ACR	----- ACRs -----		
		Mussel	Bivalve	Mollusk
Wavy-rayed lampmussel	49.45			
Fatmucket	9.028			
Rainbow mussel	11.40	17.2		
Fingernail clam	42.50		21.6	
Pebblesnail	7.940			17.7

Hypothetical example - chronic

- From three SMCVs for mussels, a mussel-specific ACR of 17.2 applied to the FAV yields a mussel-specific instream chronic concentration of 1.3 mg TAN/L at pH 7 and 20°C
- From four SMCVs for bivalves, a bivalve-specific ACR of 21.6 yields a bivalve-specific instream chronic concentration of 1.0 mg TAN/L at pH 7 and 20°C

Hypothetical example - summary

- At the example pH 7 and 20°C, the bivalve-specific acute concentration is 1.5-fold lower than the 2013 WQC CMC and the bivalve-specific chronic concentration is 1.9-fold lower than the CCC
- Taxon-specific criteria could also tailor duration and frequency recommendations to the taxon of interest

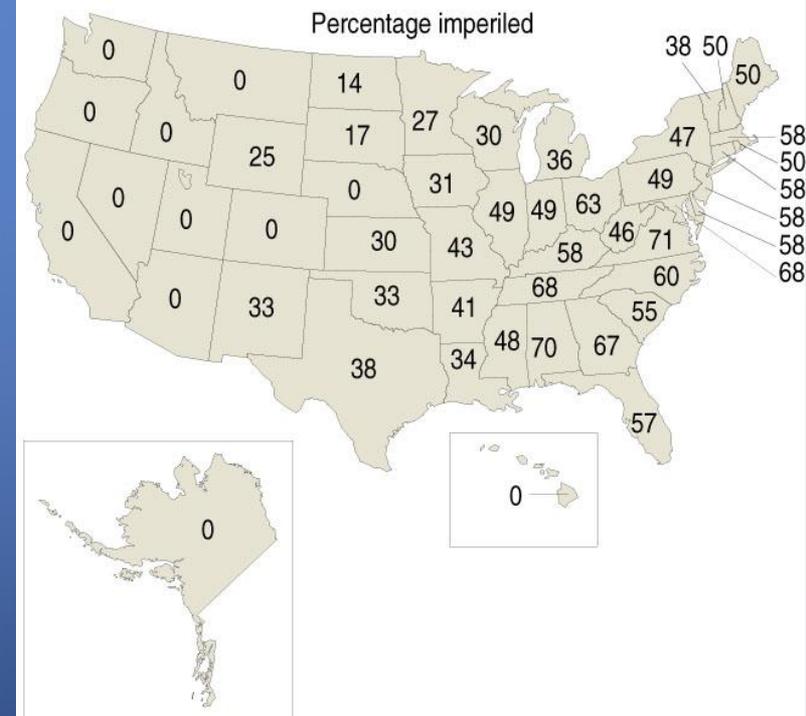
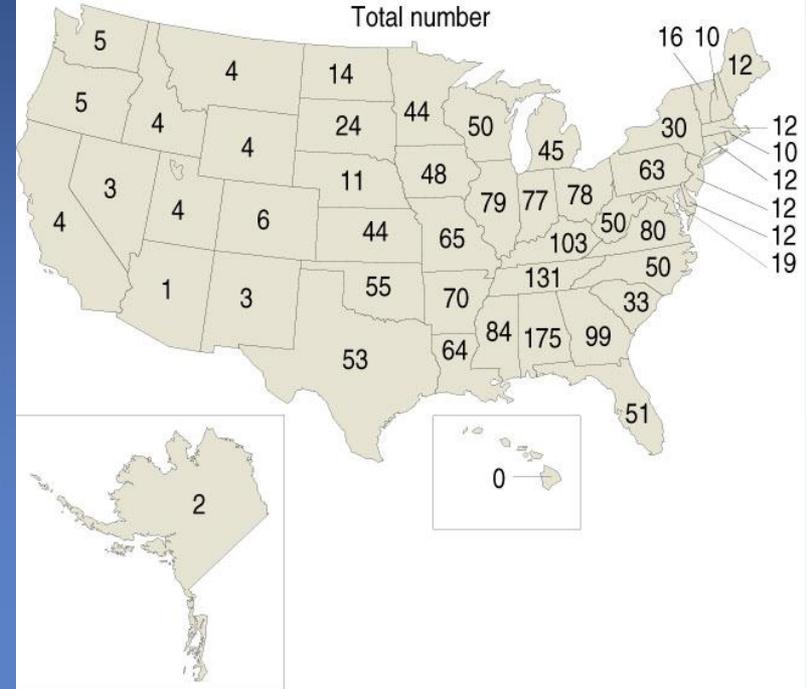
Example conclusions

- Mussels sensitive to ammonia and reasonable to expect some untested mussels will be more sensitive
- Data exist to craft science-based water quality recommendations for mussels (or bivalves, or mollusks)
- Mussels of conservation concern – endangered species consultations and recovery

Example conclusions

Number of freshwater mussel species historically known to occur within each state and the percentage classified as imperiled

Williams and Neves. 1995. Freshwater mussels: a neglected and declining aquatic resource. pp. 19-21, in E.T. LaRoe et al. (eds.). Our living resources: A report to the nation on the abundance, and health of U.S. plants, animals, and ecosystems. USDOJ, NBS, Washington DC.



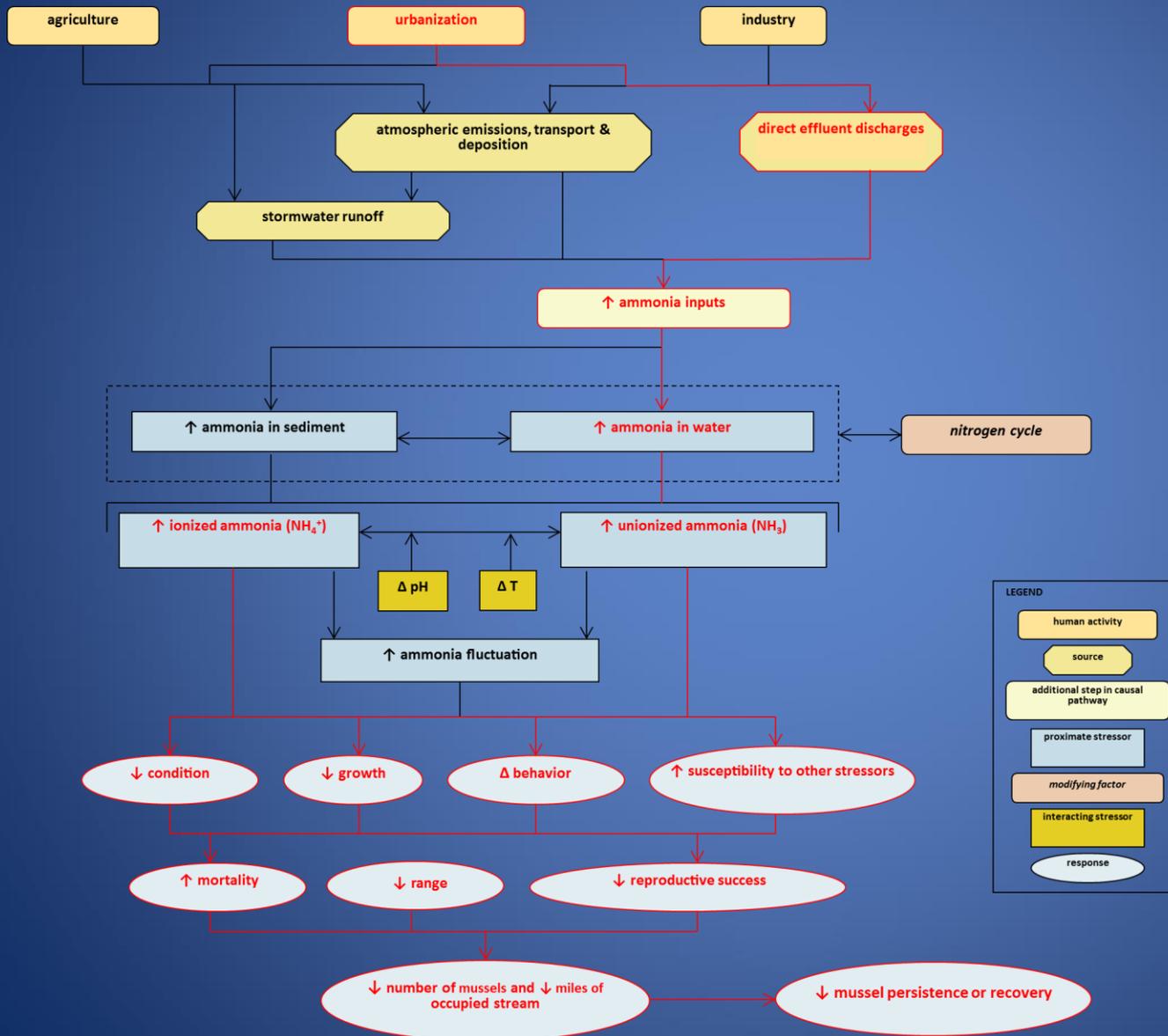
Southeastern biodiversity

Freshwater aquatic animal taxa	Number of species known for each taxon at various geographic divisions (various sources - draft)			
	North America	Southeast US	Alabama	North Carolina
Fishes	950	490	312	261
Reptiles and Amphibians		>150	139	98
Mussels	297	269	182	50
Clams	35	20		15
Snails	703	313	202	66
Insects	~ 6,500	>4,000		>2,340
Crayfish	353	330	88	46
Other crustaceans				30
Annelids				115
Other invertebrates				

Problem formulation - Ammonia

- A common pollutant
- Mussels (mollusks) known to be sensitive to this pollutant
- Mussels of conservation concern due to declining biodiversity
- Mussel recovery efforts in progress
- Many species listed as threatened / endangered

Problem formulation - Ammonia



Modified from Figure 2 in USEPA 2013. Aquatic life ambient water quality criteria for ammonia - Freshwater

Strategic Aspects of Taxon-Specific Criteria

- When problem formulation in deriving national WQC indicates certain taxa may be sensitive to that chemical, of special biodiversity or management significance, consider a taxon-specific criteria
 - species or genera **known to be sensitive** to a pollutant
 - taxa that a risk evaluation indicates **may be sensitive *and which have a special status***

Strategic Aspects of Taxon-Specific Criteria

- Science-based national recommendations, developed at the same time as general aquatic life criteria
 - Alternative values for applicable waters
 - Derived at national level, so included in all peer review and stakeholder feedback
 - Facilitate Endangered Species Act consultation

Conclusions

- Sensitive or special status taxa can be incorporated into problem formulation
- Taxon-specific criteria can provide risk managers with science-based options
- Inclusion of taxon-specific criteria within WQC recommendations may facilitate ESA consultations by providing probabilistic estimates of hazard based on the most relevant data



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