

May 1st, 10:30 AM - 12:00 PM

Protectiveness of Aquatic Life Criteria for Copper Against Olfactory and Behavioral Effects in Freshwater and Saltwater Fish

David DeForest

Windward Environmental, DavidD@windwardenv.com

Joseph Meyer

ARCADIS USA, Inc.

Robert Gensemer

GEI Consultants

Joseph Gorsuch

Copper Development Association

Burt Shephard

United States. Environmental Protection Agency

See next page for additional authors

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Speaker

David DeForest, Joseph Meyer, Robert Gensemer, Joseph Gorsuch, Burt Shephard, Jeanmarie Zodrow, and William Adams

Protectiveness of Aquatic Life Criteria for Copper Against Olfactory and Behavioral Effects in Freshwater and Saltwater Fish

David DeForest¹, Joe Meyer², Bob Gensemer³,
Joe Gorsuch⁴, Burt Shephard⁵, Jean Zodrow², Bill Adams⁶

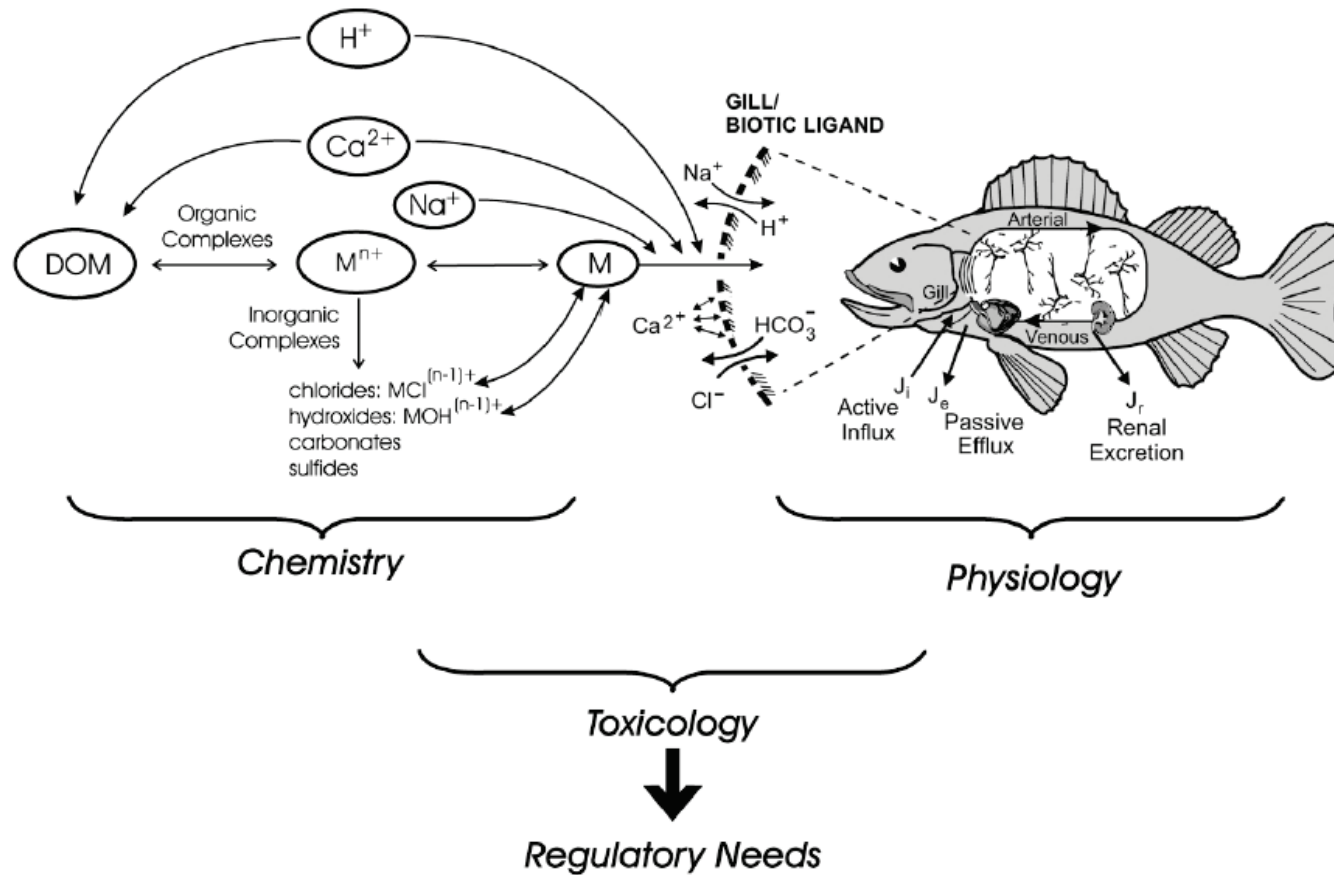
¹Windward Environmental, Seattle, WA; ²ARCADIS U.S., Inc., Lakewood, CO; ³GEI Consultants, Denver, CO; ⁴Copper Development Association Inc., Webster, NY; ⁵U.S. Environmental Protection Agency, Seattle, WA; ⁶Rio Tinto, South Jordan, UT

Salish Sea Ecosystem Conference, Seattle, WA – May 1, 2014

Copper Sources

- Surface runoff
 - Brake pad abrasion
 - Leaching from roofing materials and residential plumbing components
 - Pesticides; lawn and agricultural fertilizers
- Anti-fouling paints (direct release or runoff)
- *Puget Sound Toxics Report* (Ecology 2011)
 - Copper a Priority 1 level of concern in fresh water and nearshore marine areas
 - Recommended as priority for near-term actions (along with PAHs, DEHP, and petroleum)

Copper Bioavailability



Copper and Olfactory Impairment/ Behavioral Effects

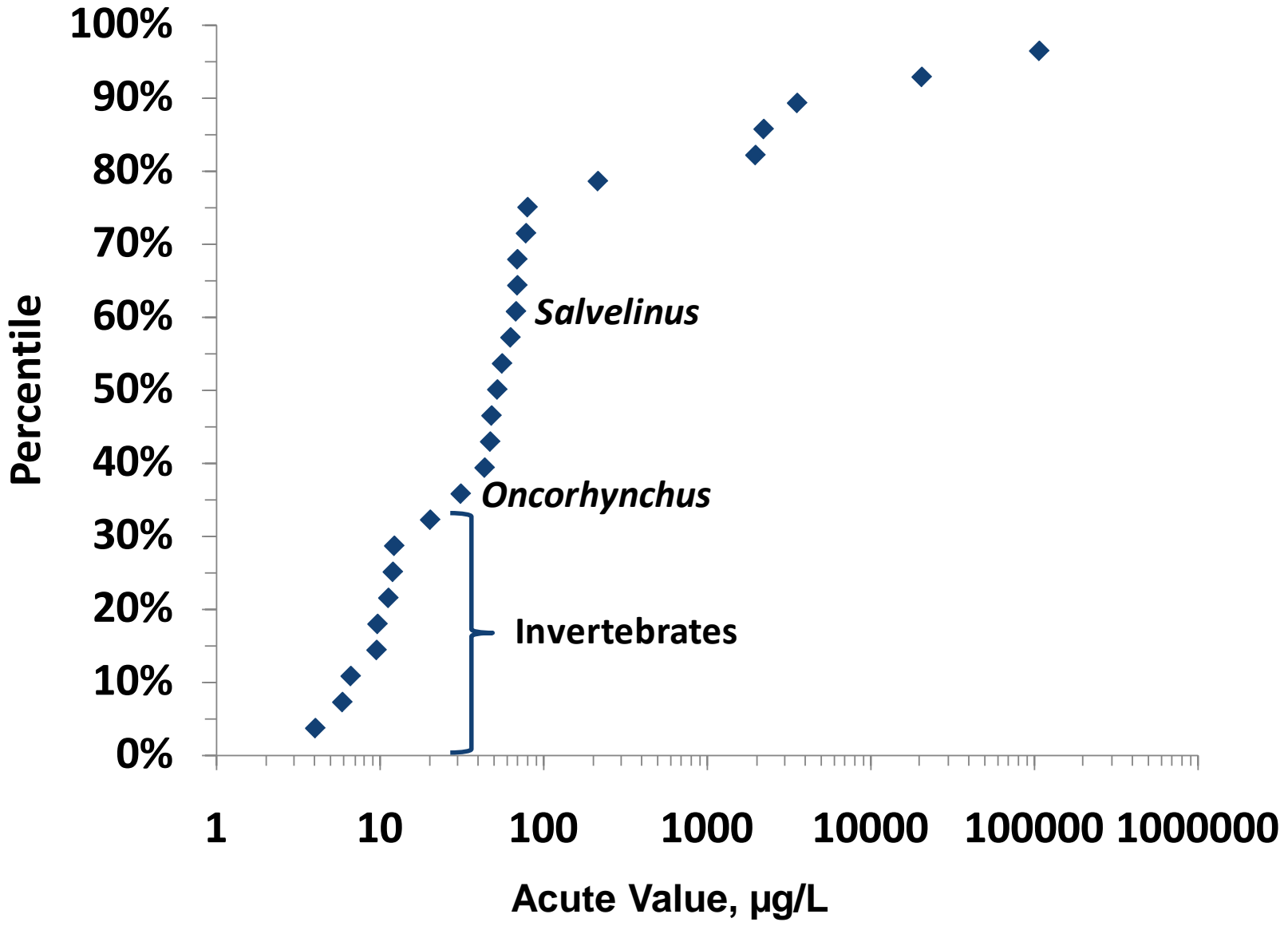
- Copper can impair olfactory function (sense of smell) in fish, including salmon
- DOC shown to mitigate against copper-induced olfactory impairment in juvenile coho, but hardness has negligible influence (McIntyre et al., 2008, *ES&T*, 42:1352-1358)
- DOC also shown to mitigate against behavioral responses to copper in juvenile Chinook (Kennedy et al., 2012, *ET&C*, 31:2281-2288)

Copper Water Quality Criteria (WQC)

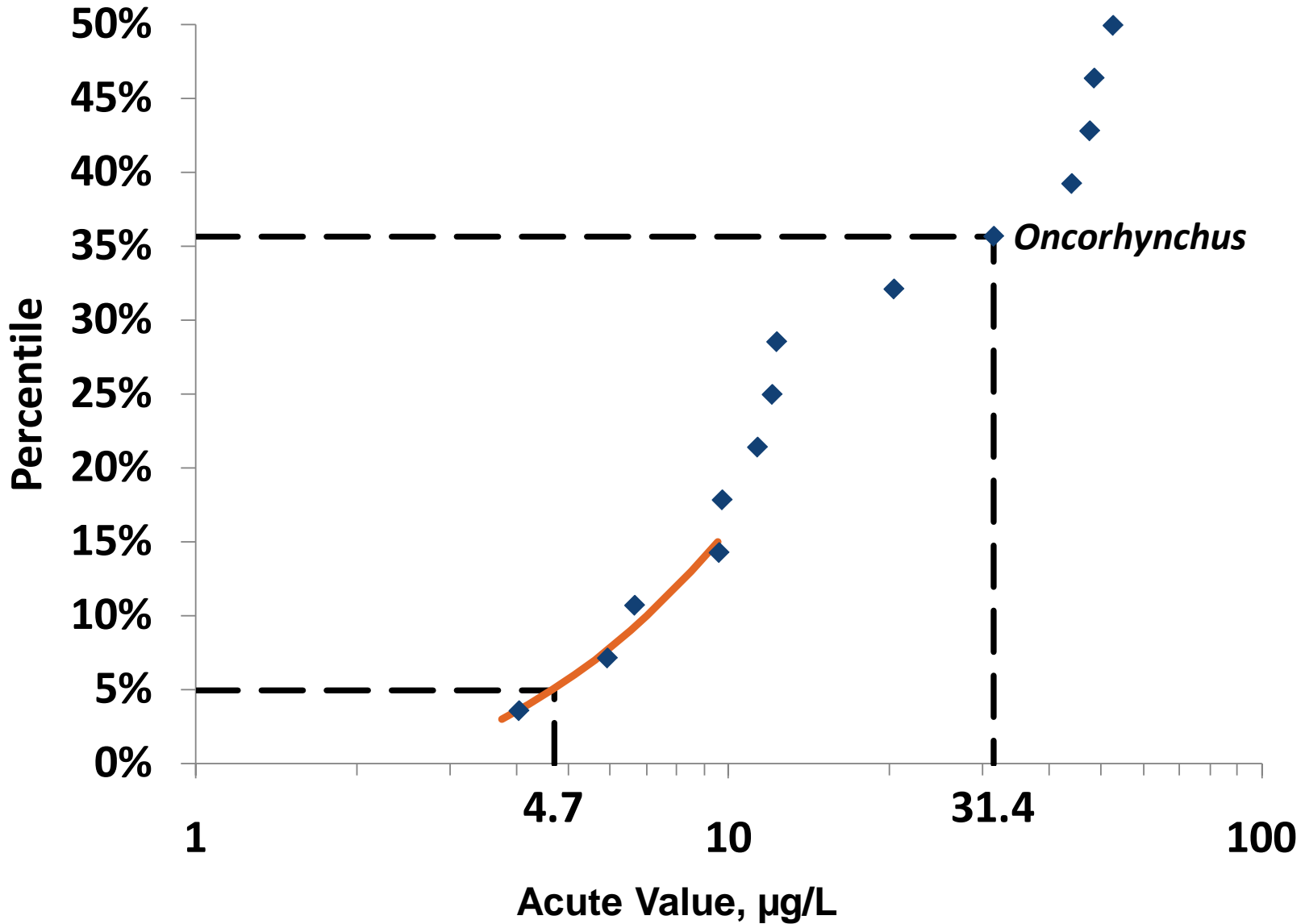
- Existing Washington State WQC:
 - Freshwater: hardness-based
 - Saltwater: fixed (not adjusted for water chemistry)
- USEPA-recommended WQC:
 - Freshwater: biotic ligand model (BLM)-based
 - Saltwater: currently fixed (*draft BLM-based saltwater criteria pending*)

Freshwater

Freshwater Copper WQC



Freshwater Copper WQC



RELATIONSHIP BETWEEN BIOTIC LIGAND MODEL-BASED WATER QUALITY CRITERIA
AND AVOIDANCE AND OLFACTORY RESPONSES TO COPPER BY FISH

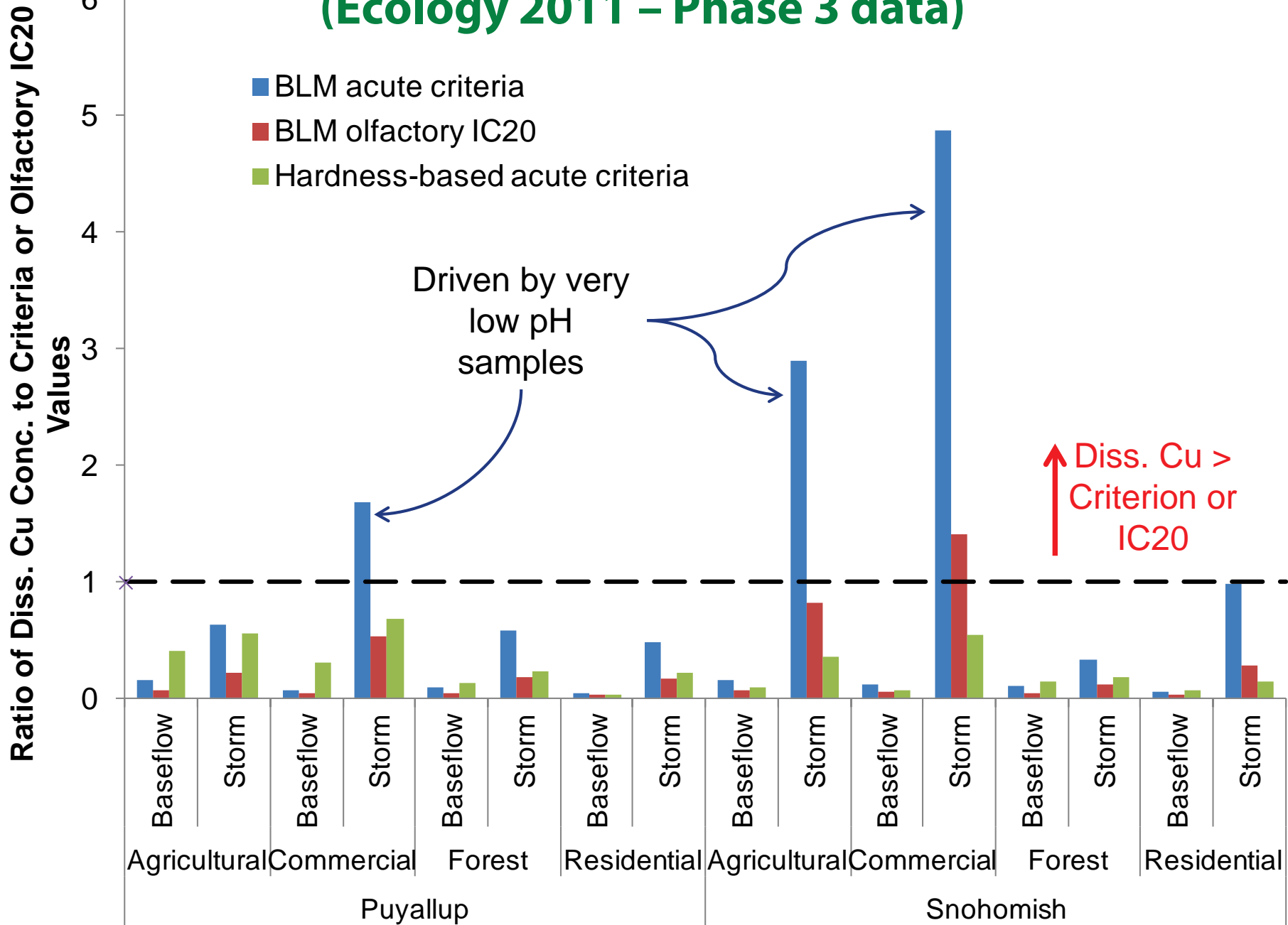
JOSEPH S. MEYER*† and WILLIAM J. ADAMS‡

†ARCADIS U.S., 1687 Cole Boulevard, Suite 200, Lakewood, Colorado 80401

‡Rio Tinto, 7760 North Boulder Drive, Lake Point, Utah 84074, USA

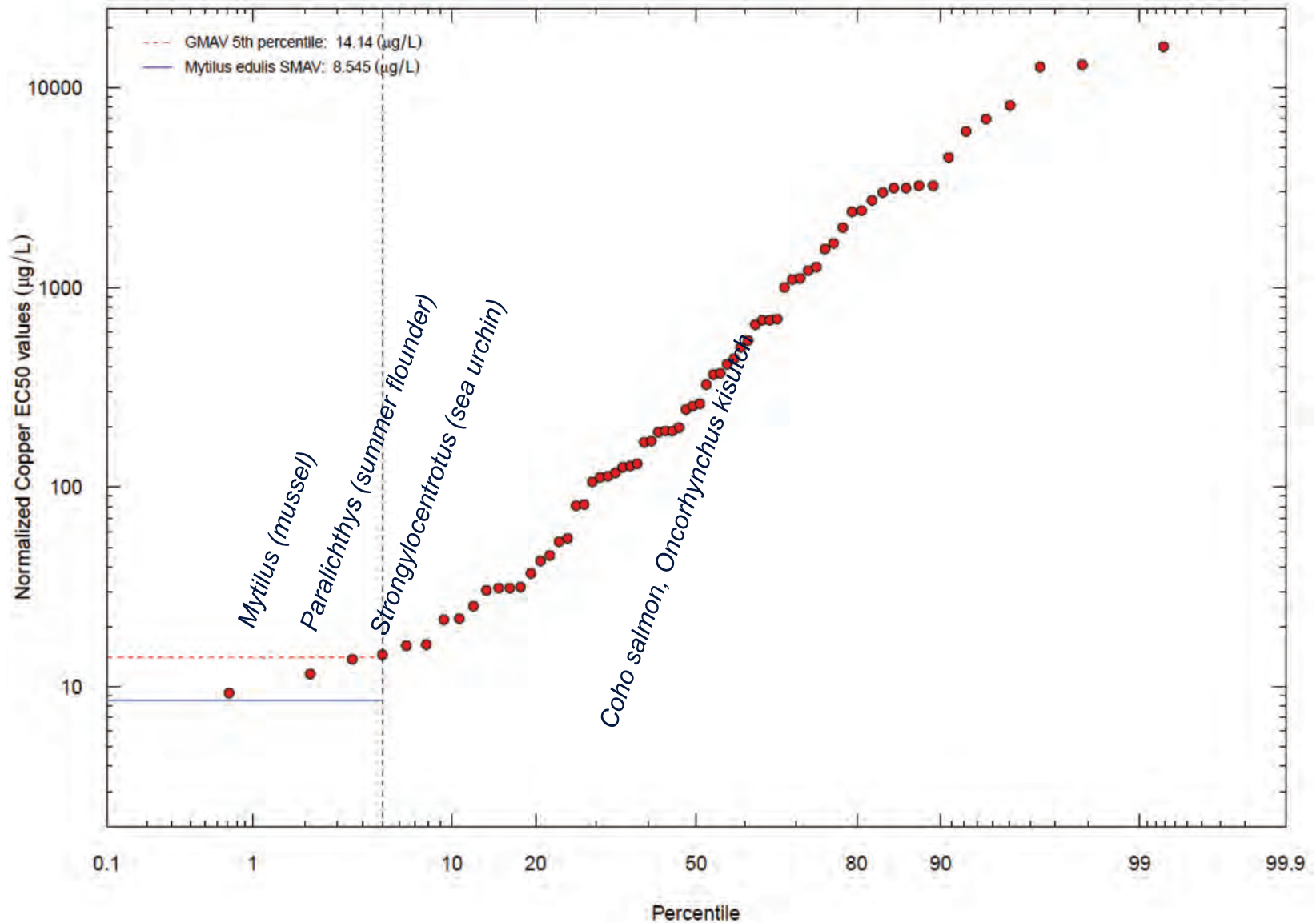
- BLM-based copper criteria protective against olfactory impairment and olfactory-mediated behaviors
 - Hardness-based copper criteria not always protective
- Parameterized existing BLM to predict IC20 values for olfactory impairment

Ratios of Diss. Cu Conc.'s to Criteria & Olfactory IC20s (Ecology 2011 – Phase 3 data)

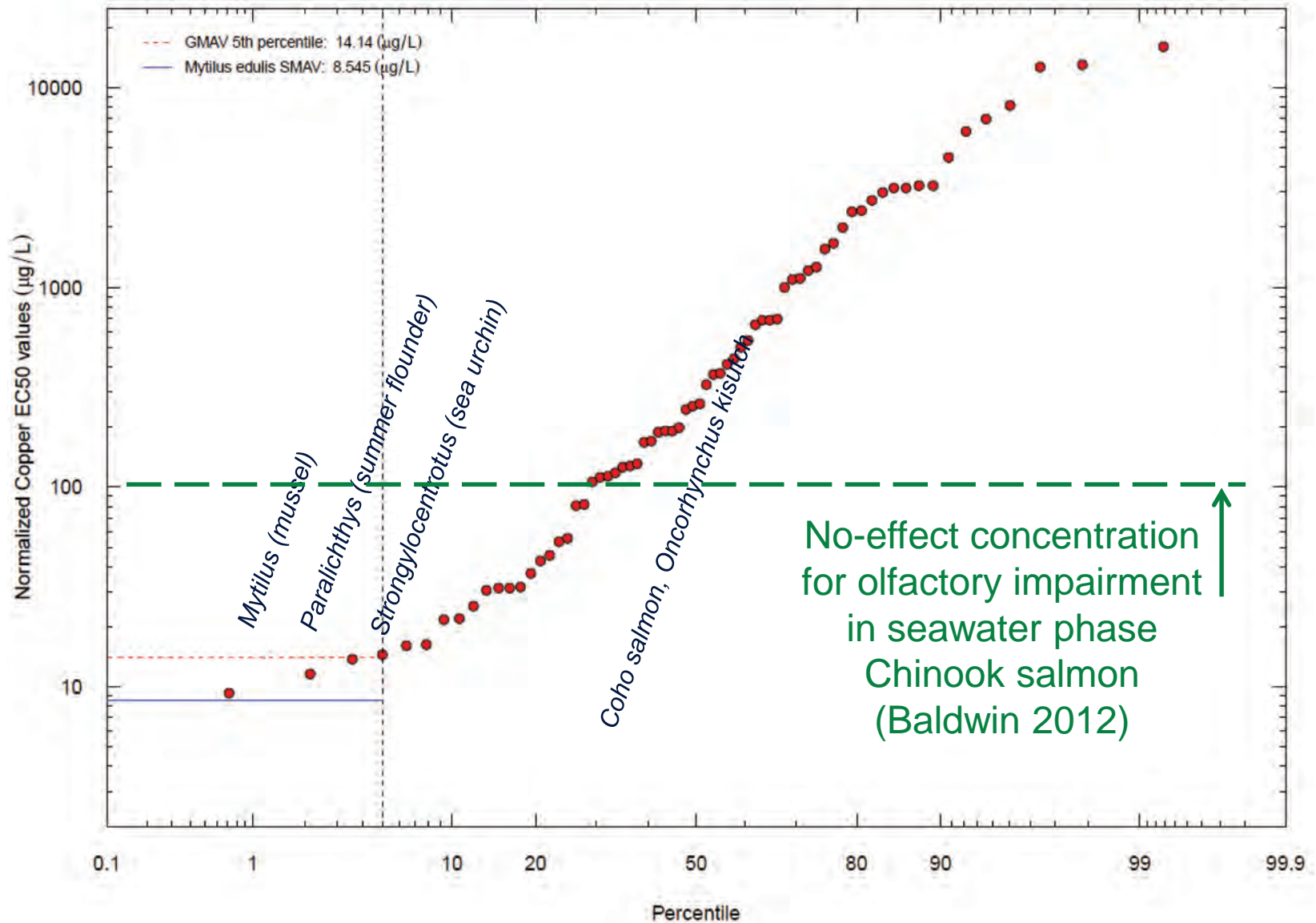


Saltwater

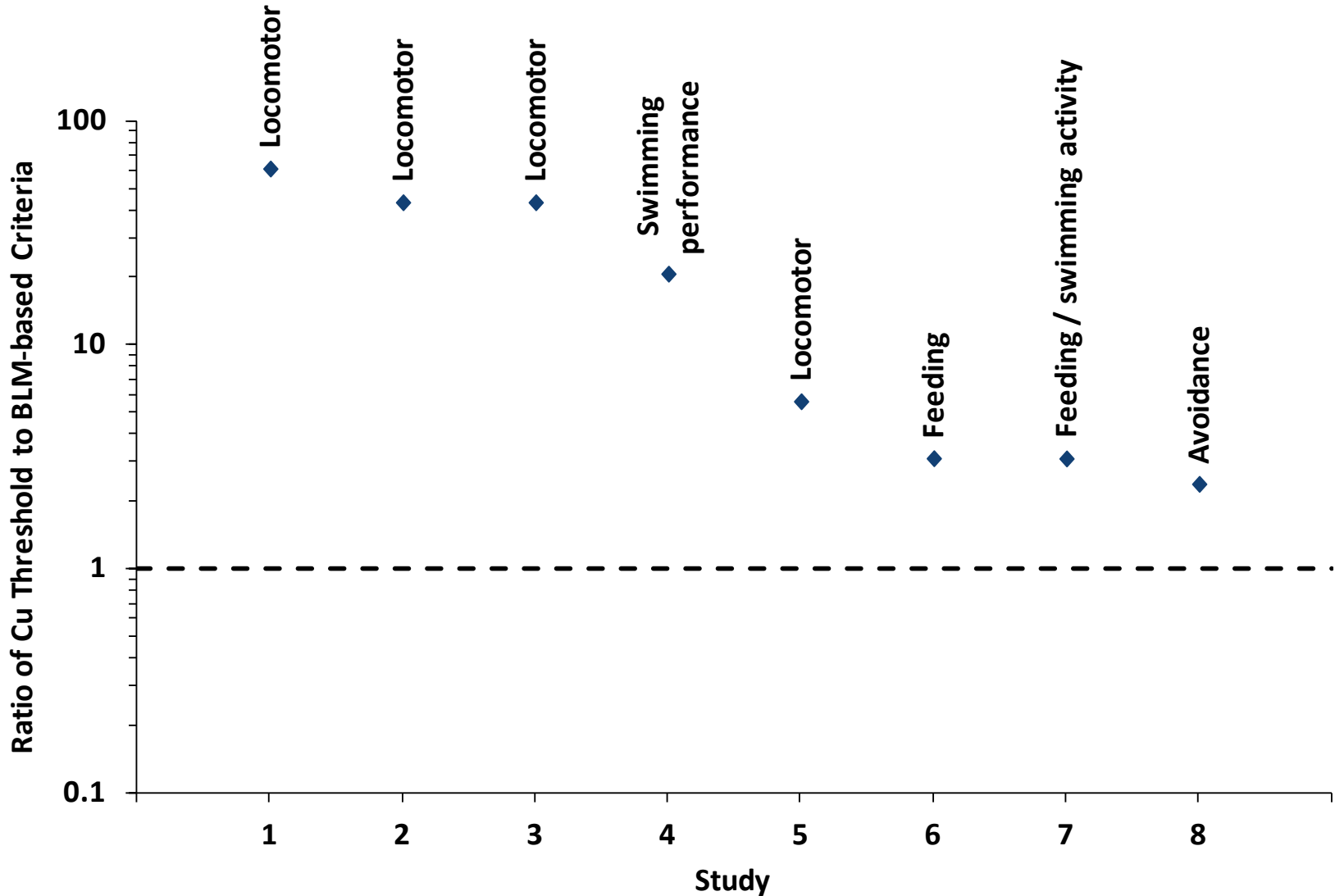
Saltwater Copper WQC



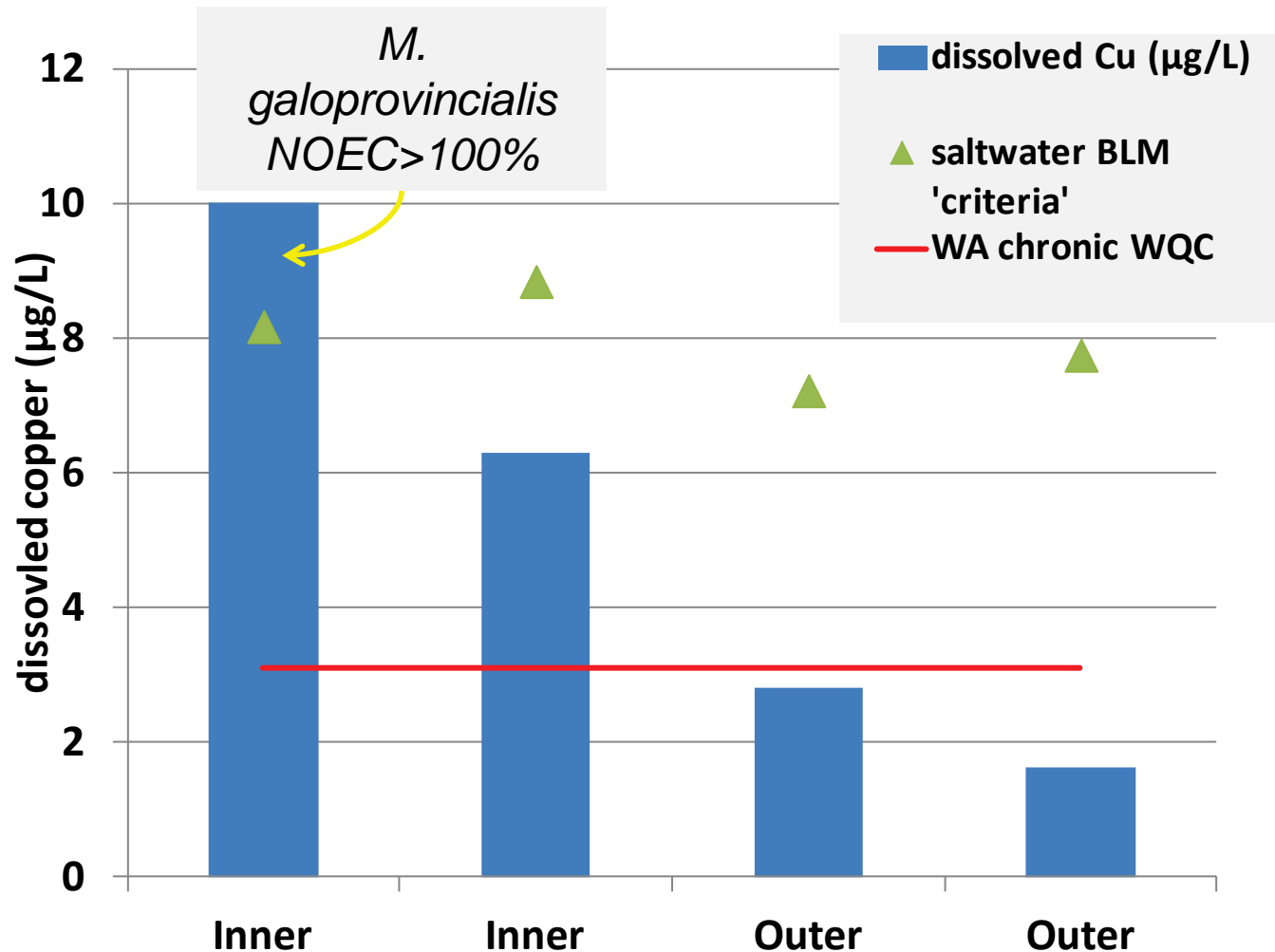
Saltwater Copper WQC



Ratios of Various Sub-lethal Effects Thresholds to Draft BLM-based Saltwater Cu Criteria



Saltwater Example - Marinas



Summary and Conclusions

- Water chemistry matters
 - Bioavailability-adjusted copper criteria appear to be protective against olfactory impairment and olfactory-mediated behaviors
 - Bioavailability should be considered in site-specific and regional assessments
 - Measurement of key parameters that influence metal bioavailability should become routine
- Many stressors in Salish Sea ecosystem
 - Use of BLM-based criteria helps identify locations and exposure scenarios where Cu is truly a concern