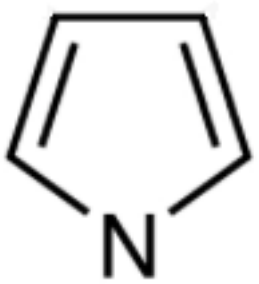
ANZECC 2000

A Silver Anniversary

Mike Fitzpatrick PhD

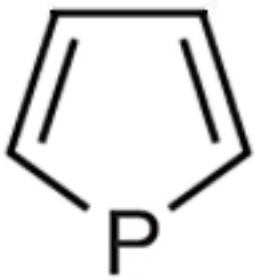
ecoLogical Solutions
Environmental Consultants

Caution - Perspectives of a Chemist

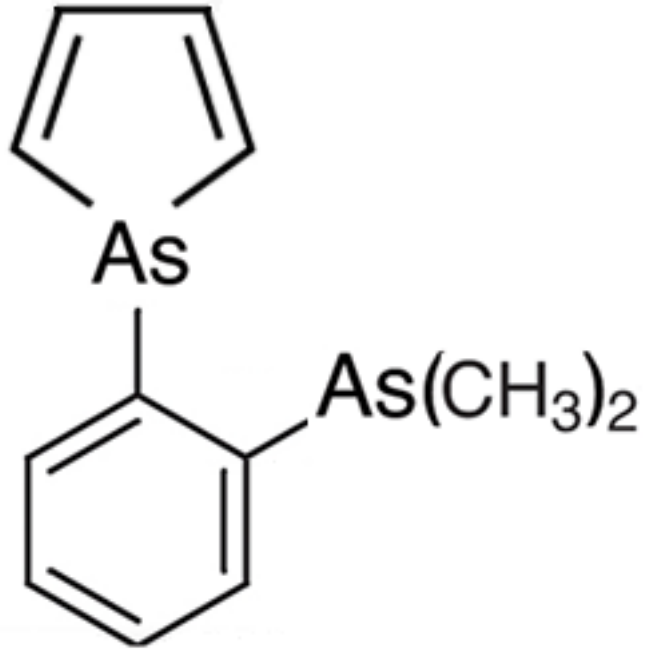


Nitrole

Pyrrole



Phosphole



bis-(dimethylphenylarsino)arsole

NATIONAL WATER QUALITY MANAGEMENT STRATEGY

An *Introduction* to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality

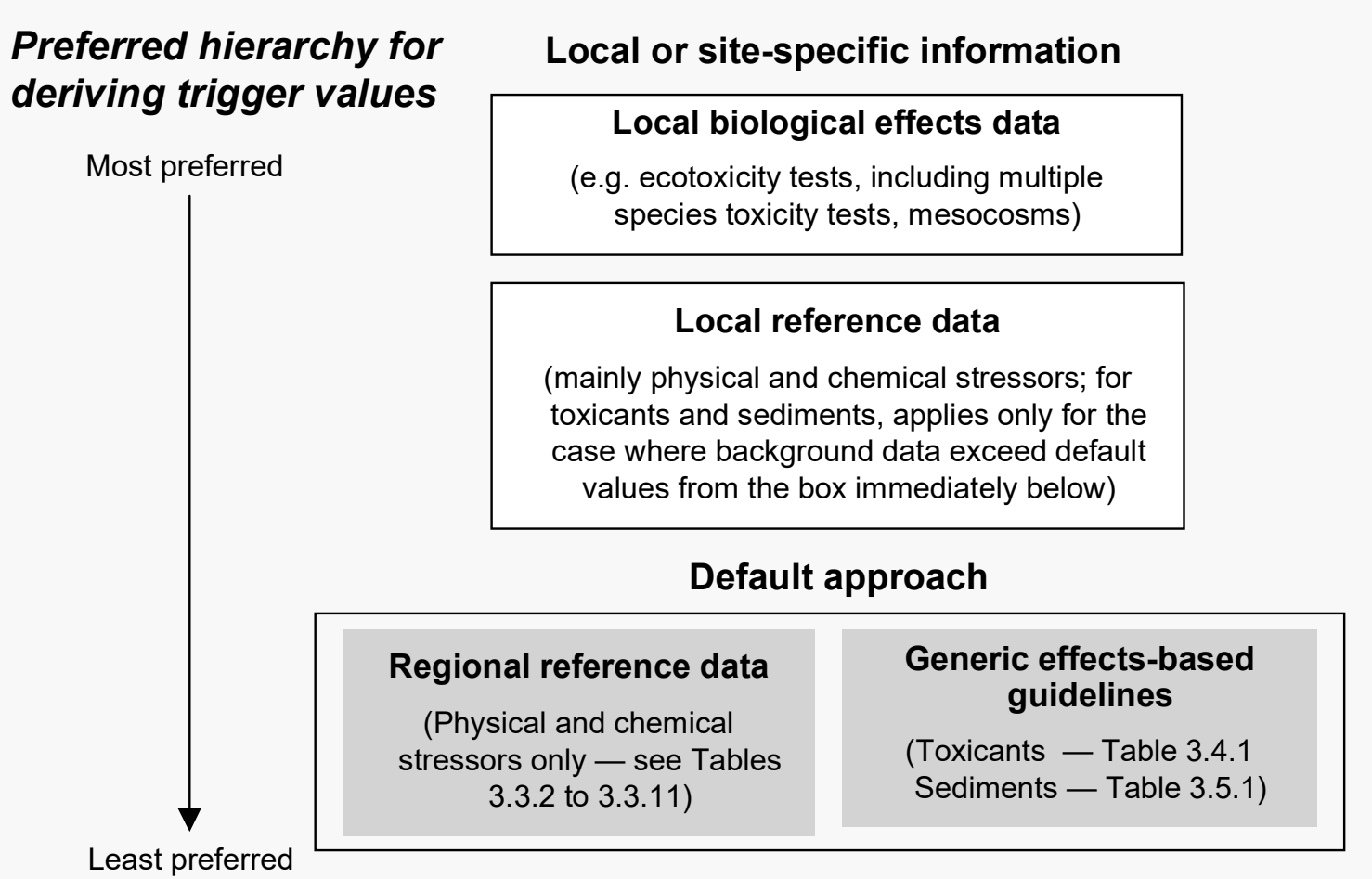
Three volumes, nine chapters, 1250 pages + CD

Aquatic Ecosystems, Stressors, Primary Industries, Recreation, Drinking Water, Monitoring, Irrigation & Aquaculture

Toxicants: Default Guideline Values (DGVs)

ecoLogical Solutions
Environmental Consultants

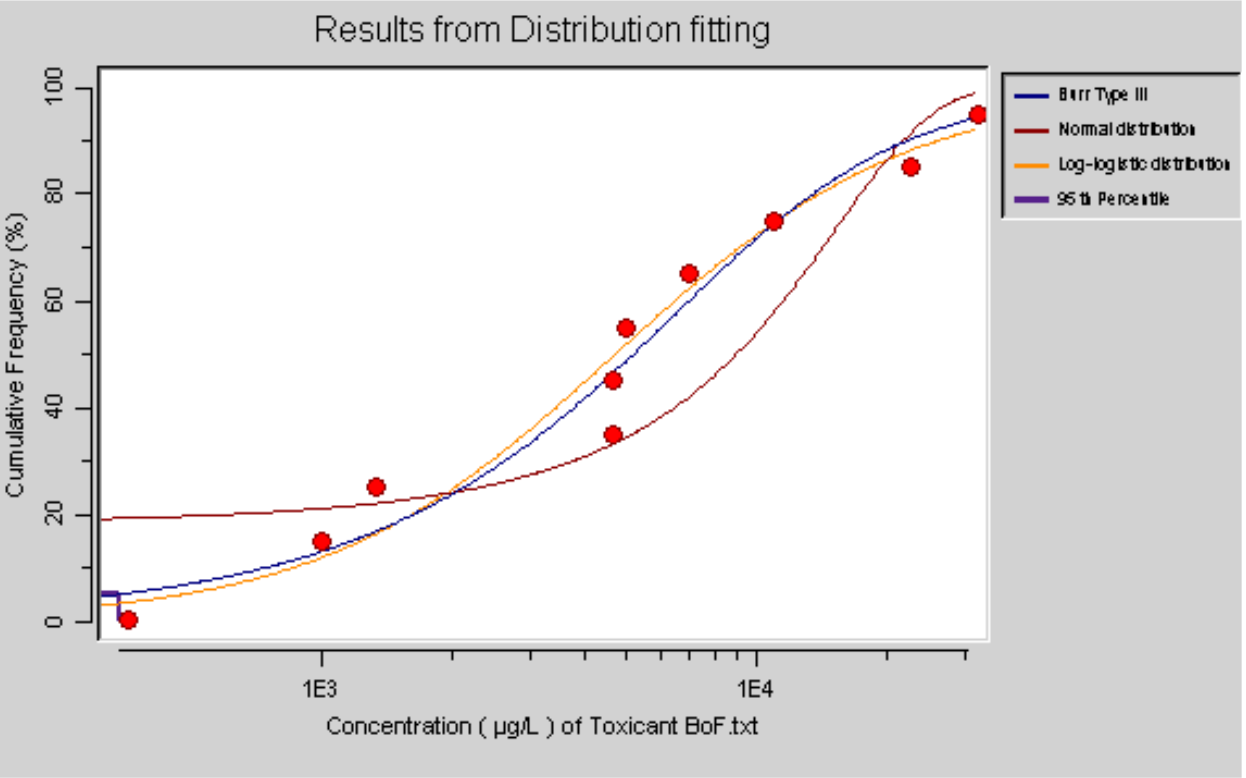
Preferred Hierarchy for Derivation



ANZECC (2000)
Vol 1, p. 3.1-6

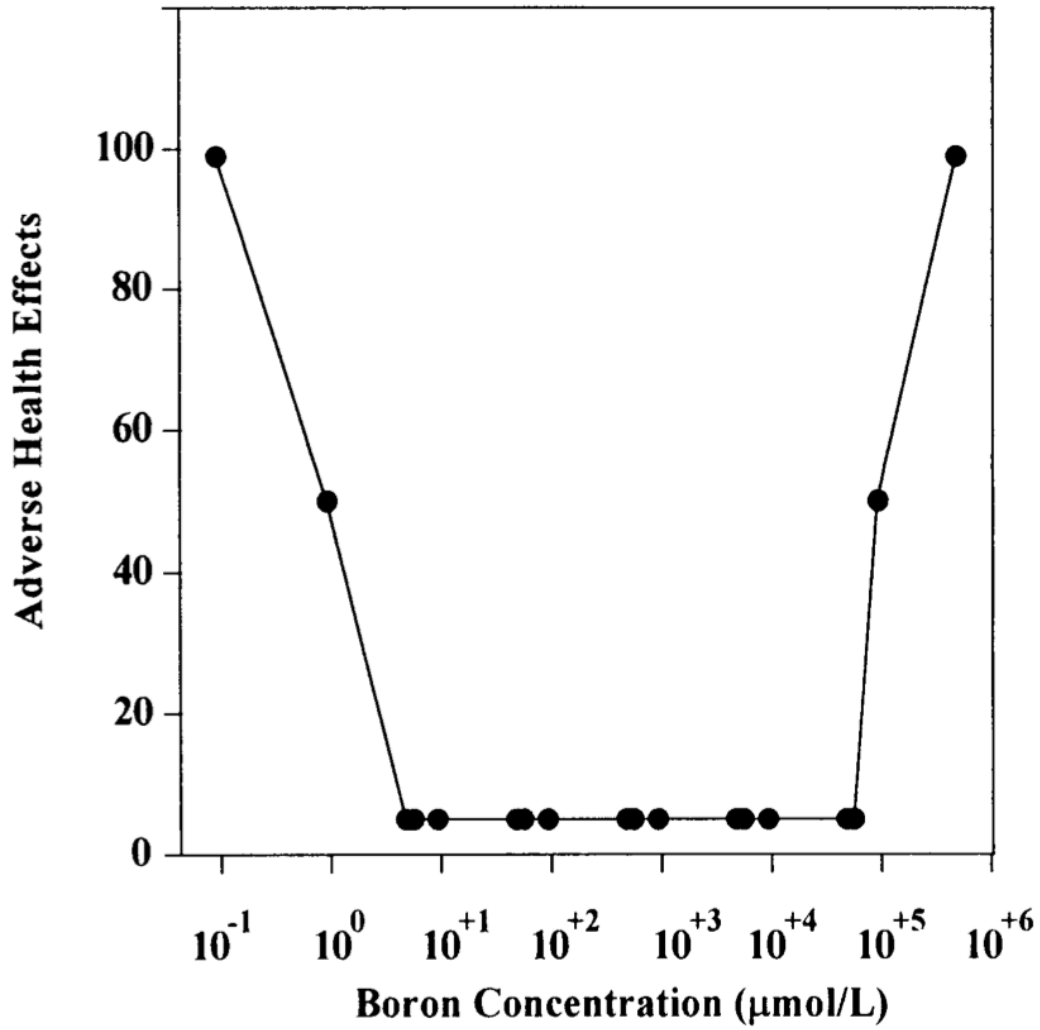
Species Sensitivity Distribution (SSD)

Boron freshwater (ANZECC 2000)



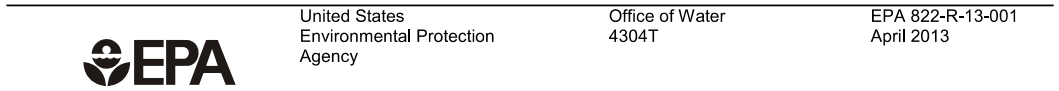
- 10 species
- Chronic NOEC data
- Log-log fit
- 95%-ile = 0.37 g/m^3
- 99%-ile = 0.090 g/m^3
- ANZECC (1992)
- 5.0 g/m^3

A Critical View



- KML (2003)
- 95%-ile = 1.97 g/m^3
- ANZECC (2018)
- 95%-ile = 0.94 g/m^3

USEPA Amm-N (2013)



AQUATIC LIFE AMBIENT WATER QUALITY CRITERIA FOR AMMONIA – FRESHWATER

- Five years to develop
- 12 major contributors
- Four years to review
- 242 pages

NPS-FM Amm-N (2020)

- MfE (Dec 2013)

NPS-FM Amm-N (2020)

- Jan 2014
- 8 page memo
- 1 contributor
- No peer review

Memorandum

To: Ms Vera Power, MfE

From: [redacted]

Copy:

Date: 20 January 2014

Our Ref: MFE13504

Subject: **Derivation of indicative ammoniacal nitrogen guidelines for the National Objectives Framework**

ANZECC DGV Updates

2023	2024	2024
Draft Copper	Draft Zinc	Draft Nickel

- Generic DGVs
- Across the entire Australia/New Zealand jurisdiction

https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/draft-dgvs#draft-default-guideline-values

Toxicity Modifying Factors (TMFs)

Hardness corrections for metals (USEPA, 1980)

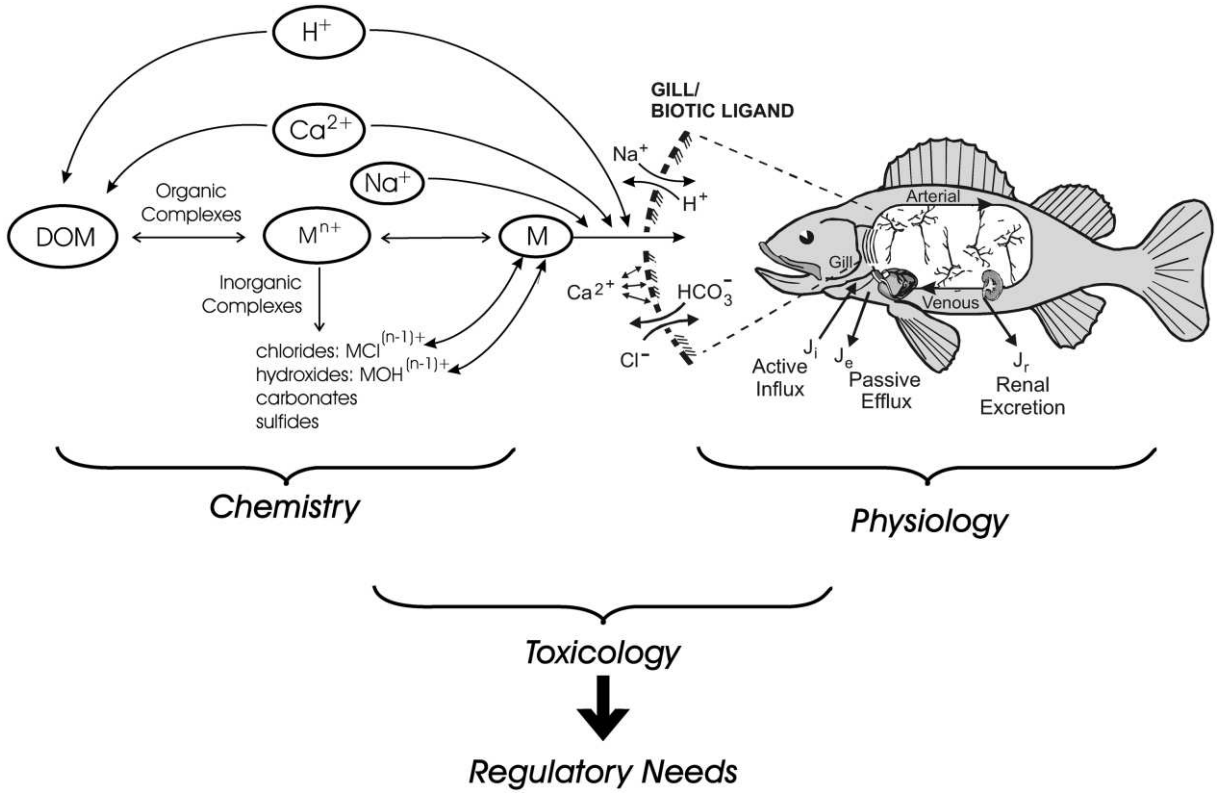
National Criteria

The procedures described in the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" indicate that, except possibly where a locally important species is very sensitive, freshwater aquatic organisms and their uses should not be affected unacceptably if the four-day average concentration (in µg/L) of copper does not exceed the numerical value given by $e^{(0.8545[\ln(\text{hardness})]-1.465)}$ more than once every three years on average.

Copper toxicity affected by:
Hardness, pH, alkalinity, 'organic compounds' (USEPA, 1976)

Biotic Ligand Model (BLM)

Consider the complexity



ELSEVIER

Comparative Biochemistry and Physiology Part C 133 (2002) 3–35

CBP

www.elsevier.com/locate/cbpc

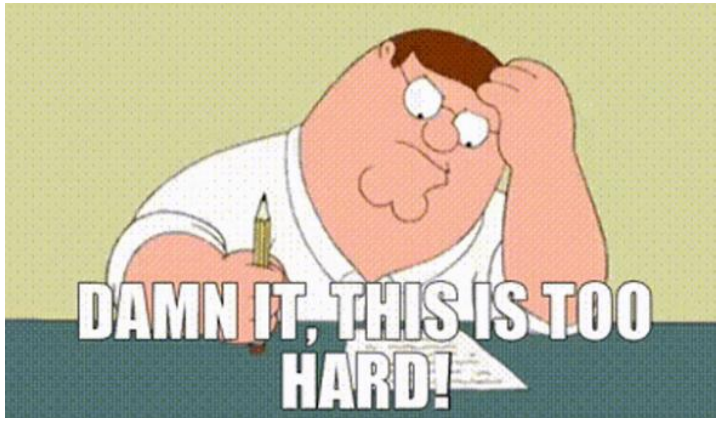
The biotic ligand model: a historical overview☆

Paul R. Paquin[a,*], Joseph W. Gorsuch[b], Simon Apte[c], Graeme E. Batley[c], Karl C. Bowles[c], Peter G.C. Campbell[d], Charles G. Delos[e], Dominic M. Di Toro[a,f], Robert L. Dwyer[g], Fernando Galvez[h], Robert W. Gensemer[i], Gregory G. Goss[j], Christer Hogstrand[k], Colin R. Janssen[l], James C. McGeer[m], Rami B. Naddy[i], Richard C. Playle[n], Robert C. Santore[o], Uwe Schneider[p], William A. Stubblefield[q], Chris M. Wood[r], Kuen Benjamin Wu[a]

Copper DVG

1

Hardness
pH
Alkalinity
DOC



2

Ignore hardness, pH, alkalinity

3

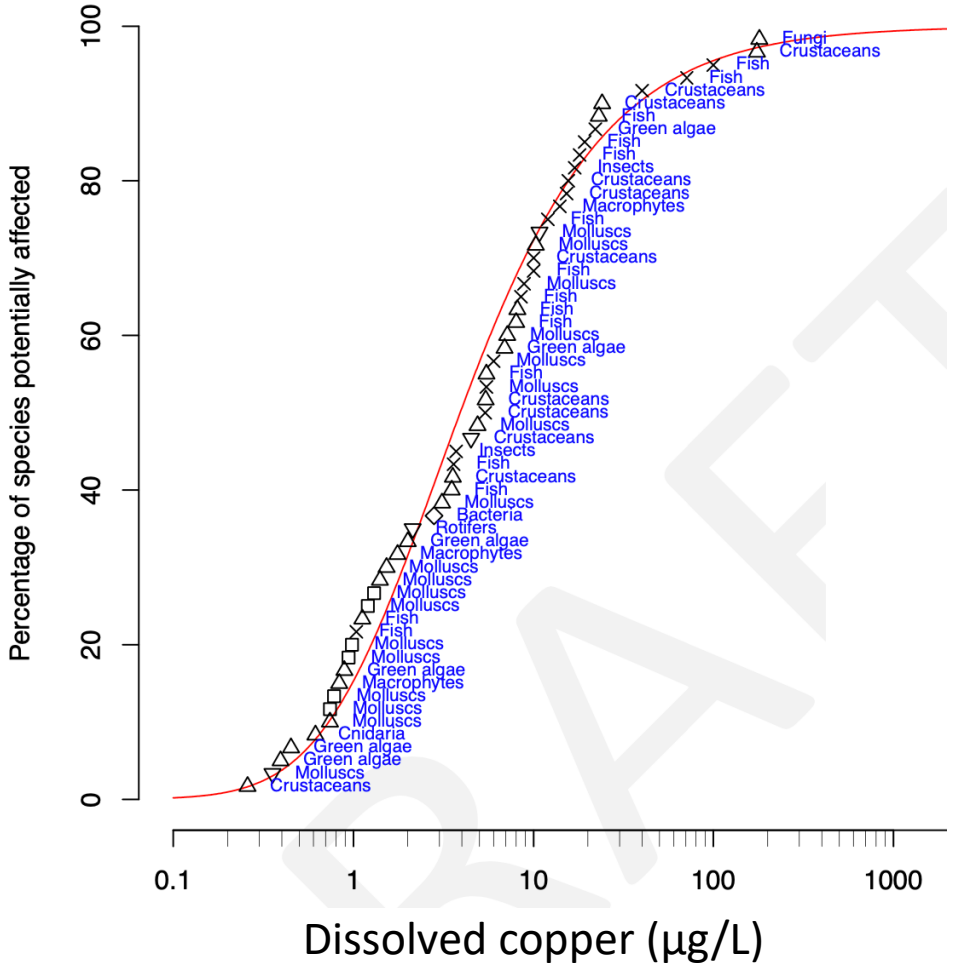
Incorporate DOC only

4

“Most influential factor”

The Approach

- Developed a BLM
- Adjusted toxicity data to 0.5 g/m^3 DOC
- Construct SSD of NOEC data
- 99%-ile DGV = 0.00020 g/m^3
- 95%-ile DGV = 0.00047 g/m^3



The Failures

1

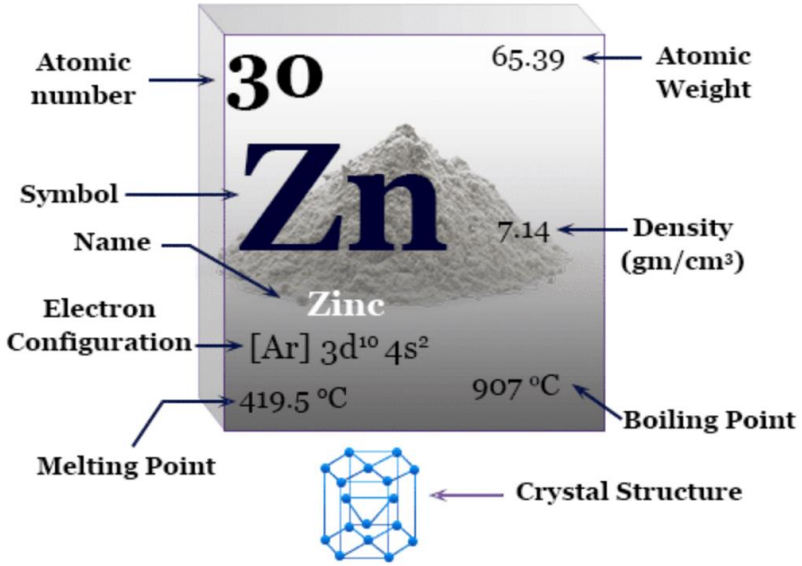
2

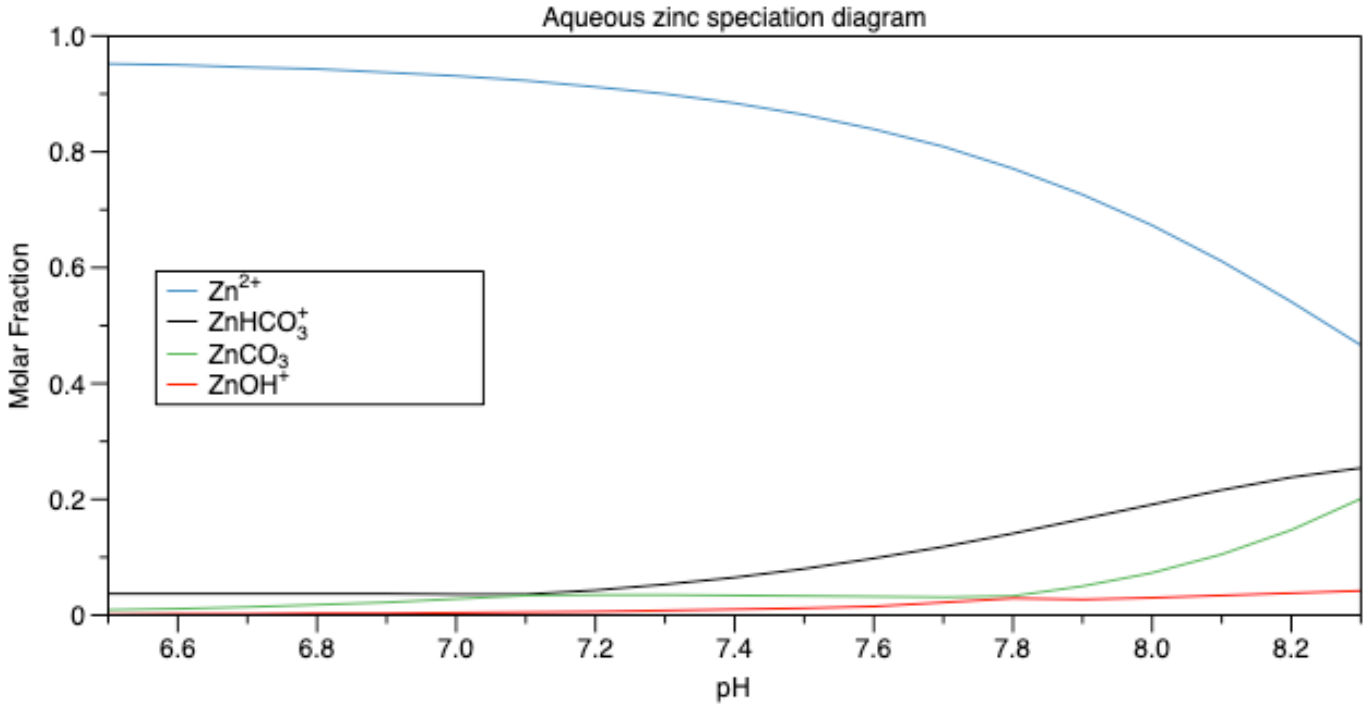
3

4

5

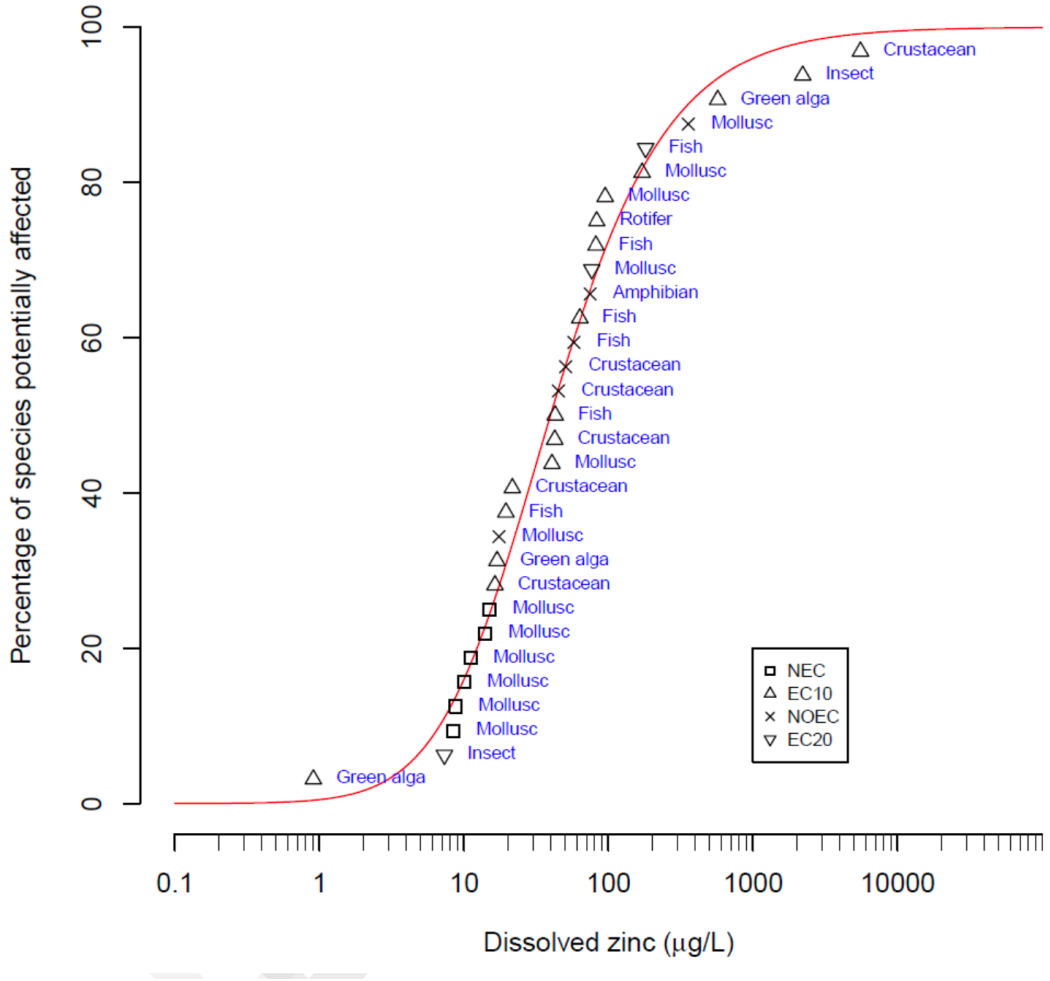
6





- Similar failings to copper
- Poor DOC data
- Ignores pH and alkalinity

Zinc SSD



- EC_{10} Chlorella *sp*. 0.00091 g/m^3
- PNG isolate
- "no clear differences between species native to New Zealand and those found elsewhere"
- Ammoniacal-N (ANZG, 2023)
- "unique high sensitivity … likely due to the very low ionic strength of the waters"

“incorporating such species results in an overly conservative toxicity assessment versus that under more typical water quality conditions”

Zinc DGV

Dress Code

Site-Specific Guidelines

Trump everything!

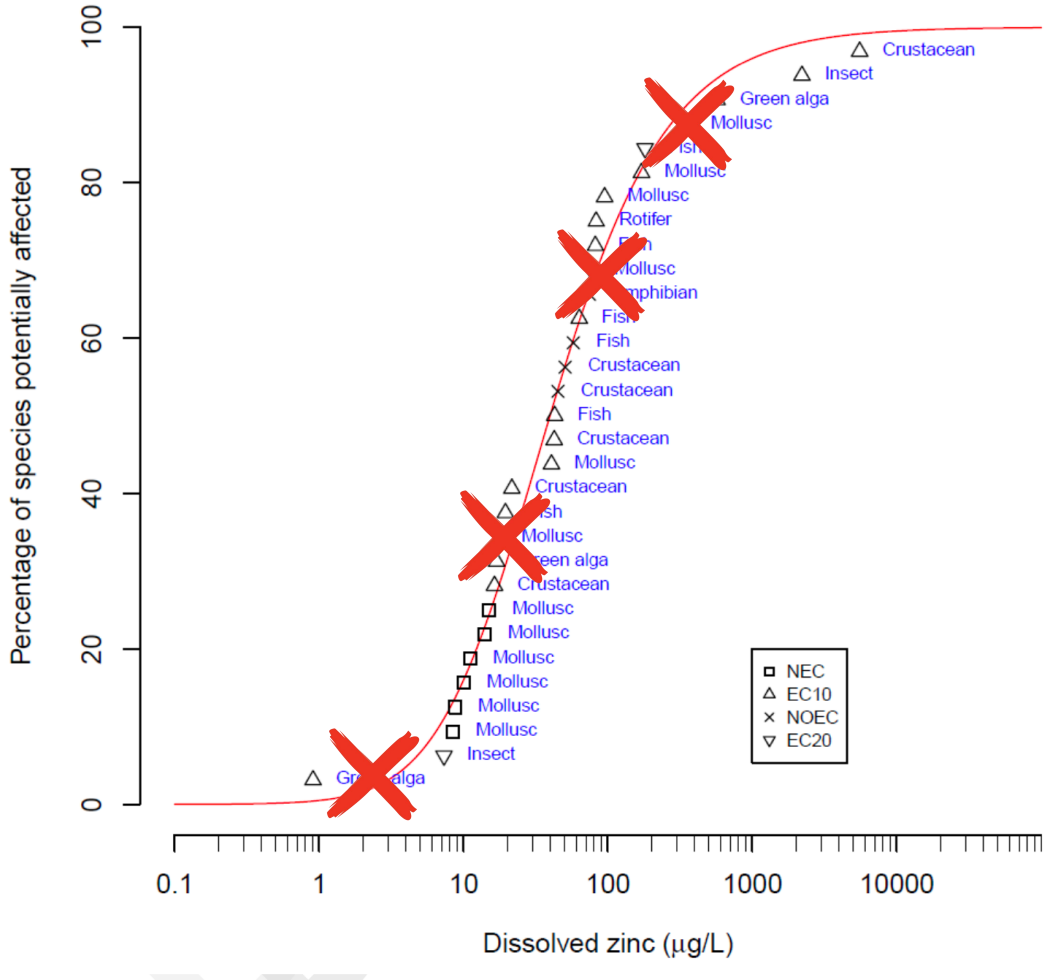
Too hard!

Too expensive!

Authoritative precedents

- Ammoniacal Nitrogen USEPA (2013)
- Freshwater mussels present or absent
- Early Life Stage (ELS) fish present or absent

Zinc SS-SSD


Percentage of species potentially affected
0
20
40
60
80
100
0.1
1
10
100
1000
10000
Dissolved zinc (µg/L)
Crustacean
Insect
Green alga
Mollusc
Mollusc
Mollusc
Rotifer
Mollusc
Fish
Fish
Crustacean
Crustacean
Fish
Crustacean
Mollusc
Crustacean
Mollusc
Crustacean
Mollusc
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Mollusc
Mollusc
Mollusc
Mollusc
Insect
NEC
EC10
NOEC
EC20

Acknowledgments

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