

Hamburg 2009

Metals Bioavailability



**Centre for
Ecology & Hydrology**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Metal toxicity to macroinvertebrates in mine-affected streams, related to chemical speciation

**E. Tipping, J.A.B. Bass, R.T. Clarke, T.A. Corbin, N.T. Kneebone,
A.J. Lawlor, S. Lofts, S.A. Thacker, C.D. Vincent**

Centre for Ecology & Hydrology, United Kingdom

Funded by

**Environment Agency of England and Wales
Scottish Environment Protection Agency**

**European Copper Institute
Rio Tinto**

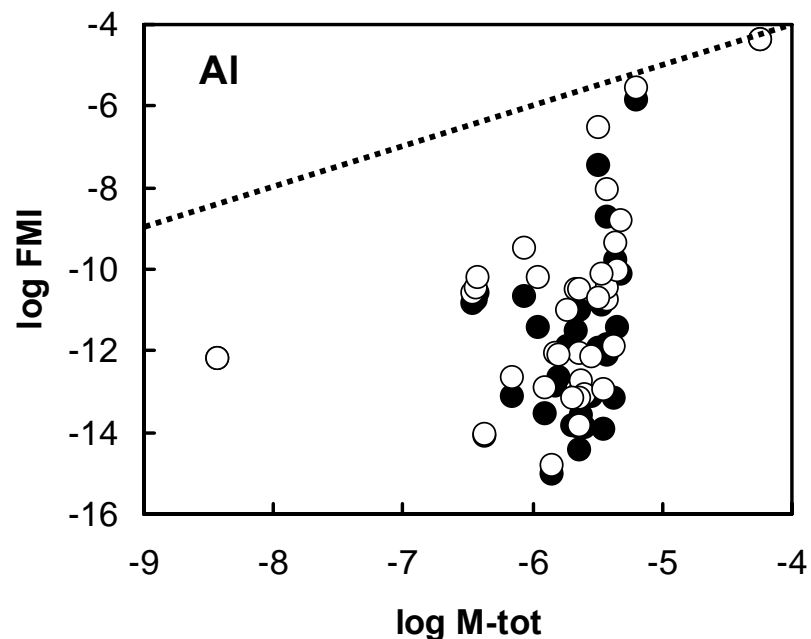
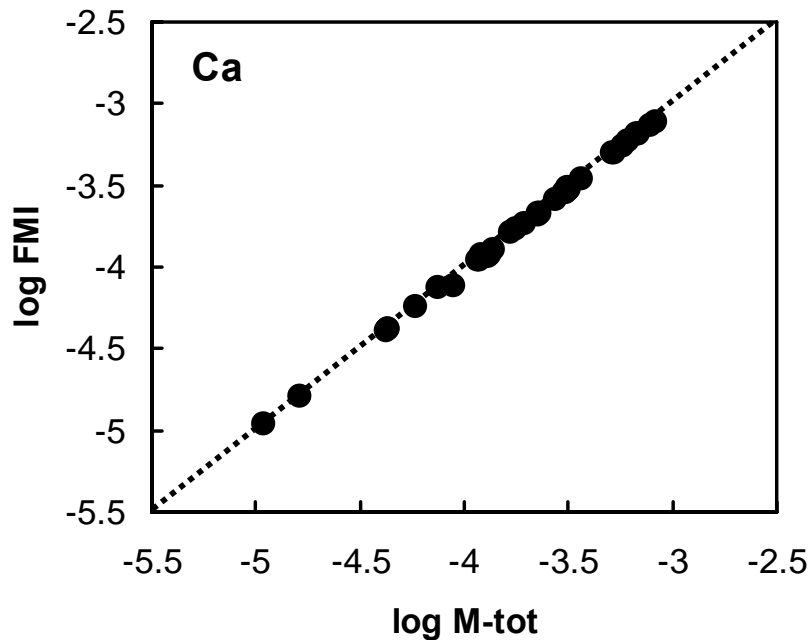
**International Cadmium Association
International Zinc Association (Europe)
European Nickel Industry Association**

33 sites used for toxicity evaluation

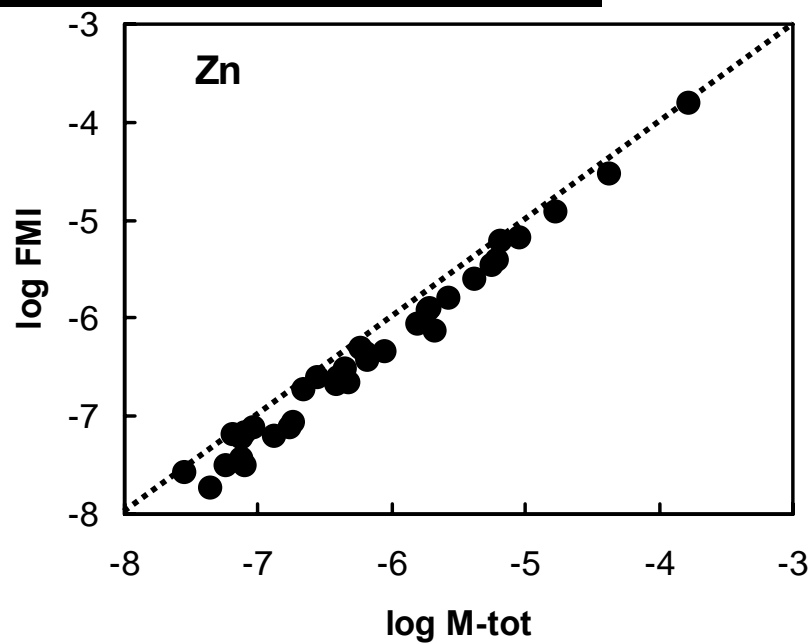
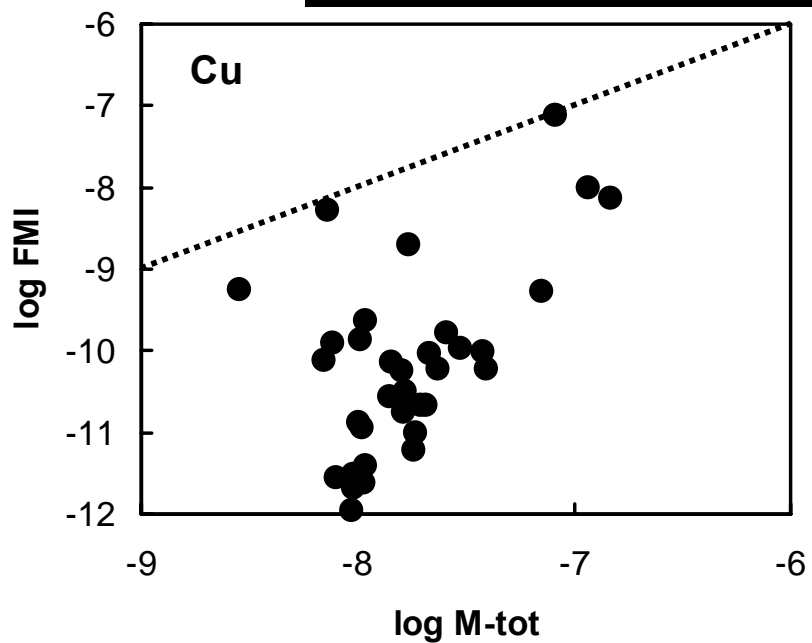
A photograph of a person in a blue jacket and hood crouching by a stream. The stream flows over a dam with multiple small waterfalls. The surrounding landscape is hilly and rocky, with some snow patches on the upper slopes. The person appears to be sampling the water or the stream bed.

Headwaters, free of contaminants other than metals

Sampled before and during spring 2006,
for full chemistry and benthic invertebrates



Metal free ion concentrations (WHAM)



Ecological variable

OE67

River Invertebrate Prediction
and Classification System
(RIVPACS)

Observed taxa

O

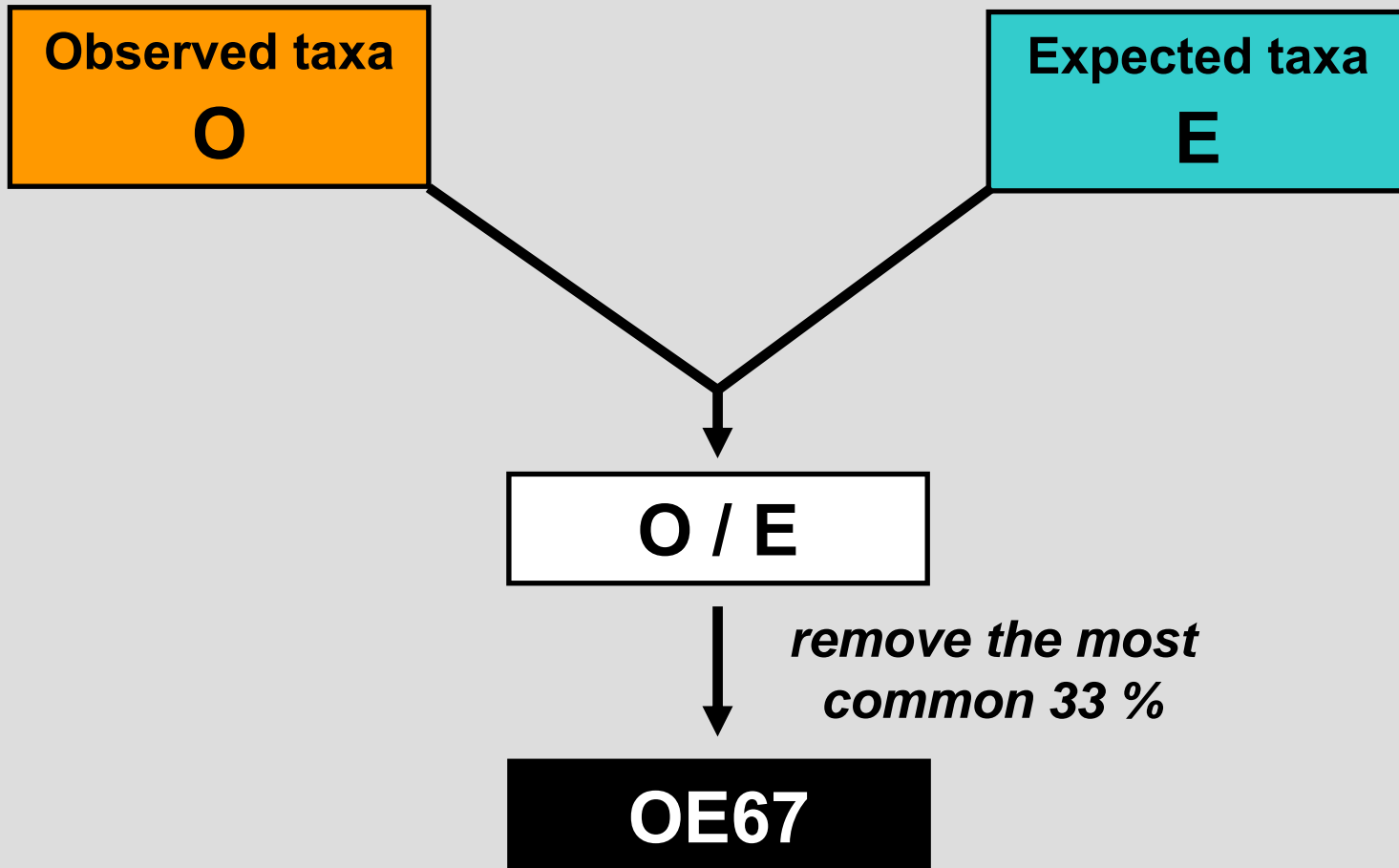
Expected taxa

E

O / E

*remove the most
common 33 %*

OE67



T oxicity

B inding

M odel

protons and metals bound
to non-specific sites on/in
the organism

estimated with WHAM

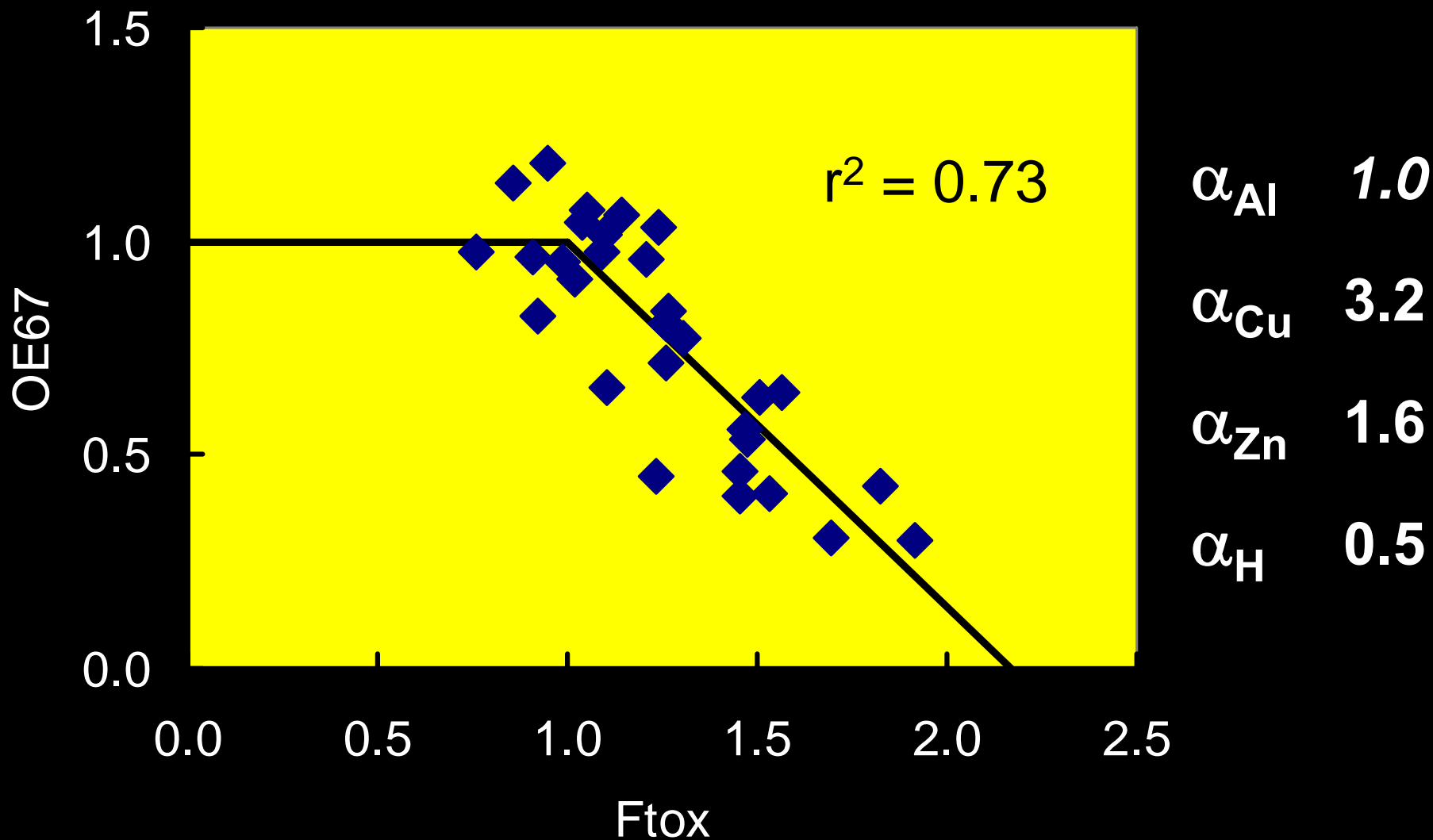
$$F_{tox} = \alpha_H v_H + \sum \alpha_M v_M$$

toxicity
function
(linear)

toxicity coefficients

fitted to the data

TBM fitted to OE67



Key conclusions

- Speciation-based metrics are superior to [total dissolved metal]
- Mixture effects operate (Al + Zn) or (Al + Cu + Zn + H)
- Dose-response relationships operate in the field