Progress on Ecological impacts

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Mine drainage framework

Manaaki Whenua Landcare Research
University of Otago
CRL Energy Ltd
UC University of Canterbury

Ecological Research

Field data

1. Large-scale survey of algal communities (52 streams)

2. Multiple benthic invertebrate studies (appox 70 streams)

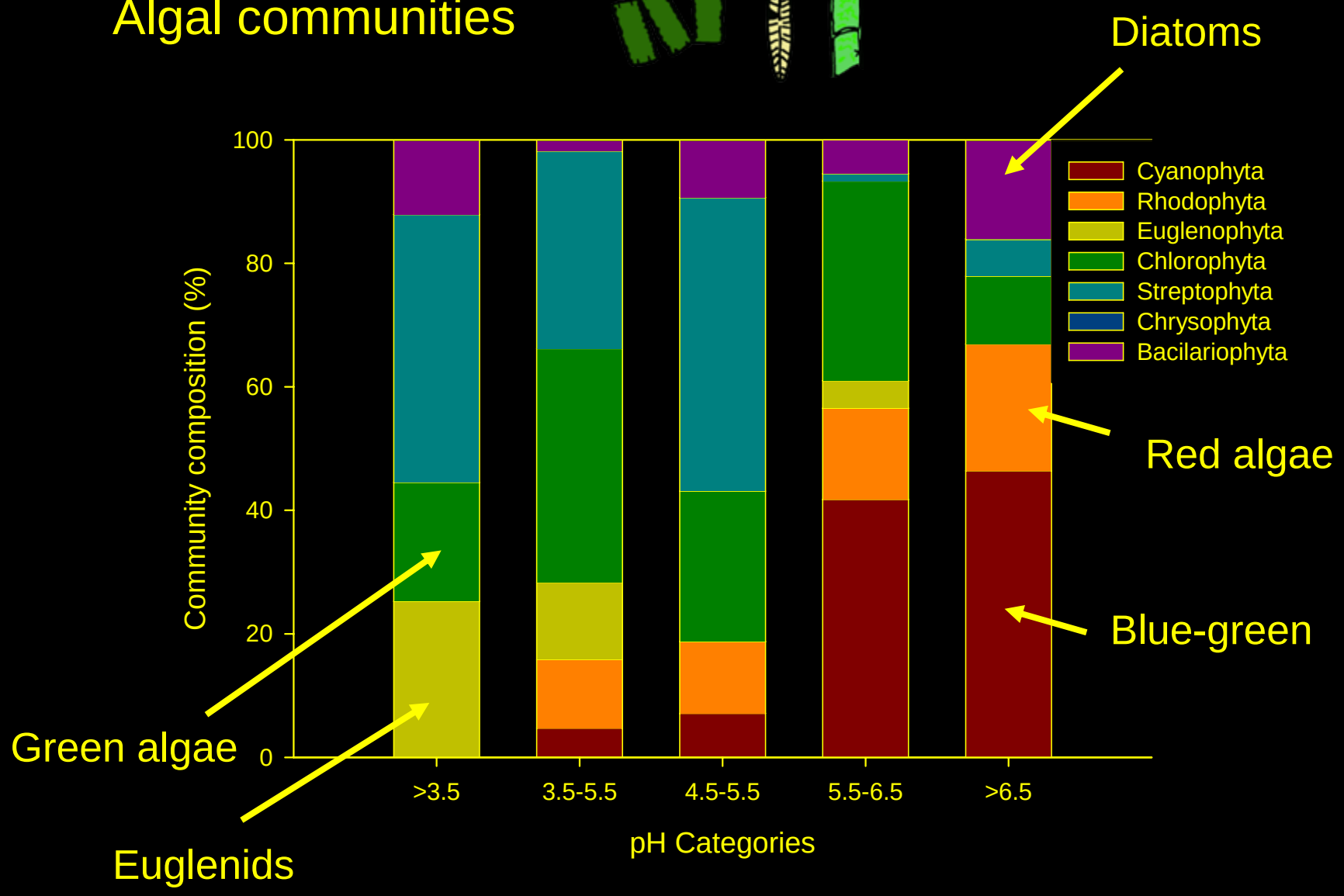
3. Decomposition study looking at bacteria & fungi (22 streams)

4. Freshwater fish survey (52 sites)

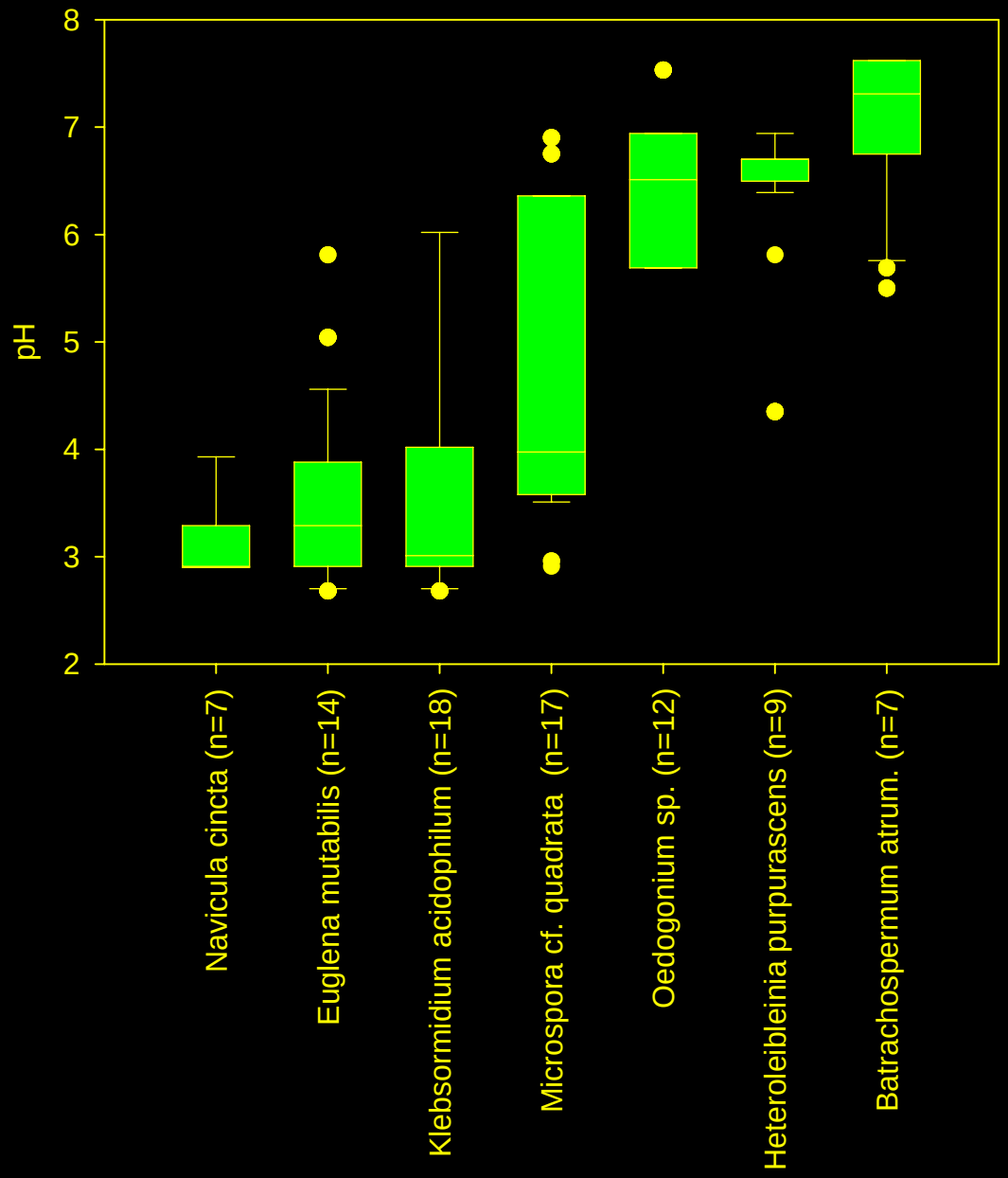
Laboratory trials

1. Series of 96hr ecotoxicological trials

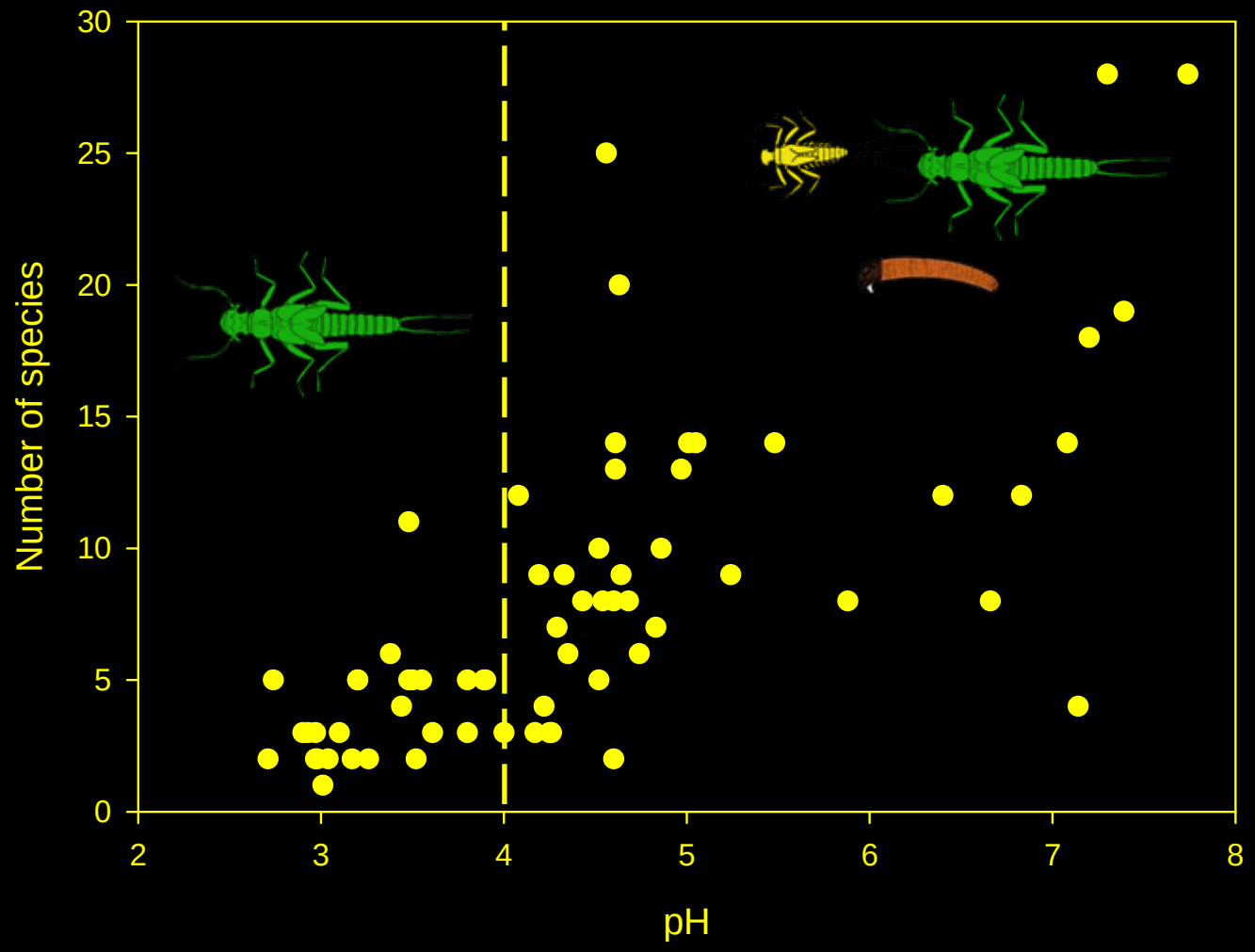
Algal communities



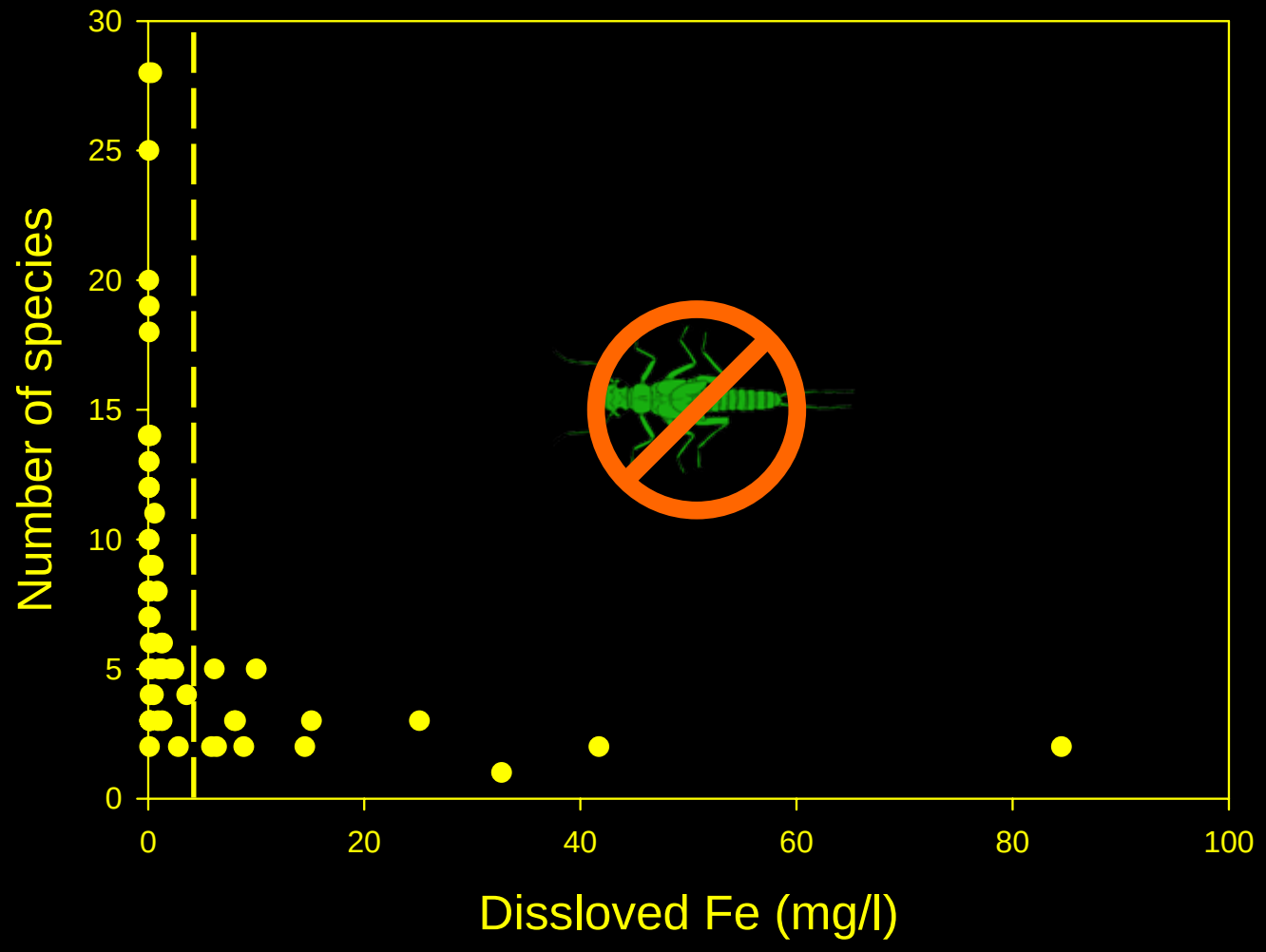
Algal communities



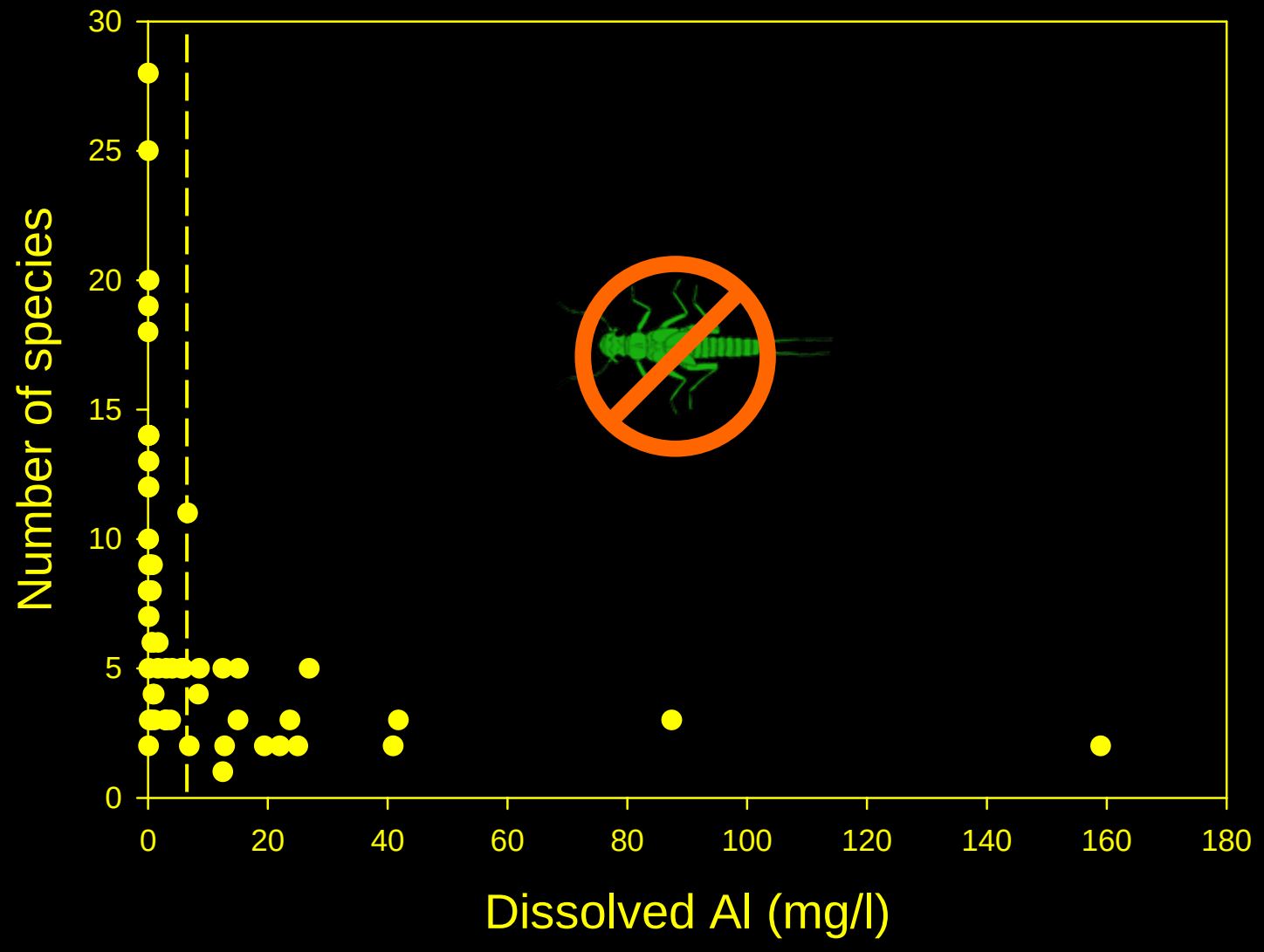
Benthic invertebrates



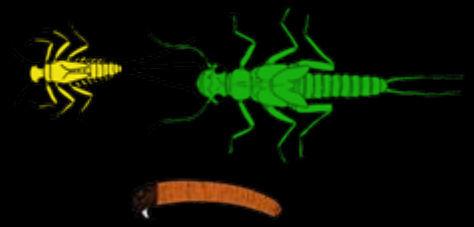
Benthic invertebrates

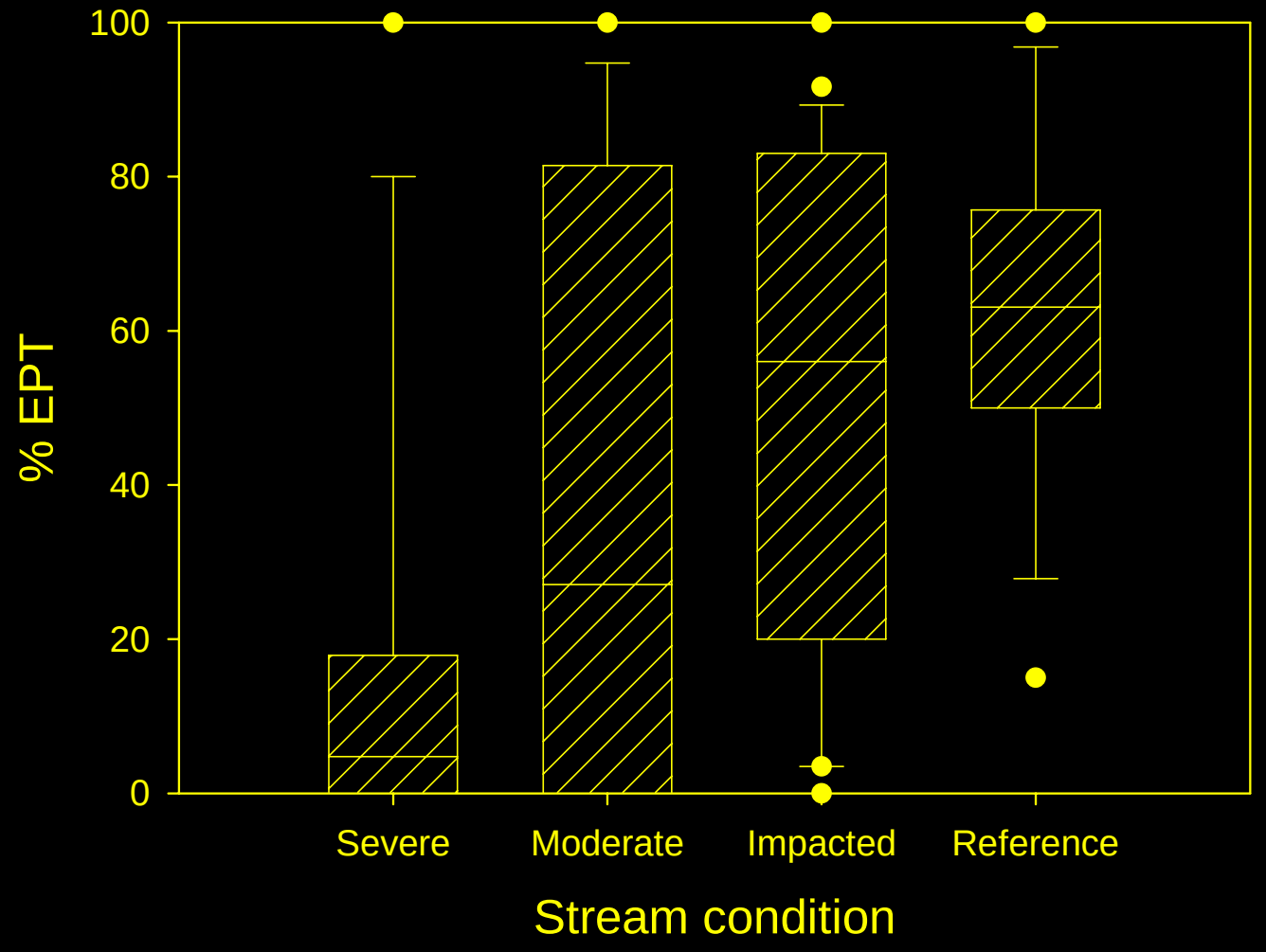


Benthic invertebrates

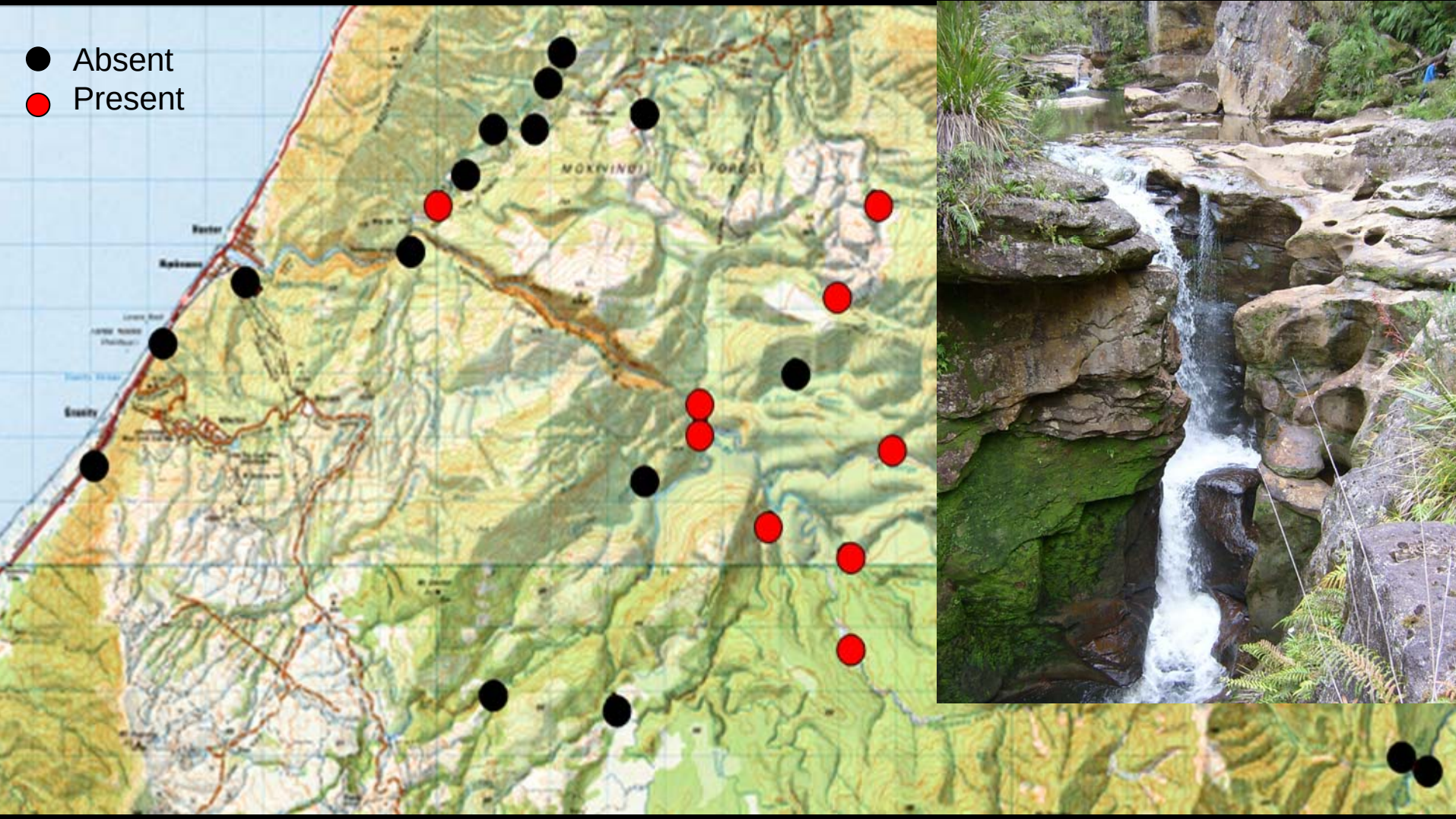


Benthic invertebrates





Response of freshwater fish



Koaro distribution in the Ngakawau River system

Ecotoxicological trials - impact assessment

- Acidified water remediation
- pH variations on several species
- Arsenic concentration

Remediation of acidified water

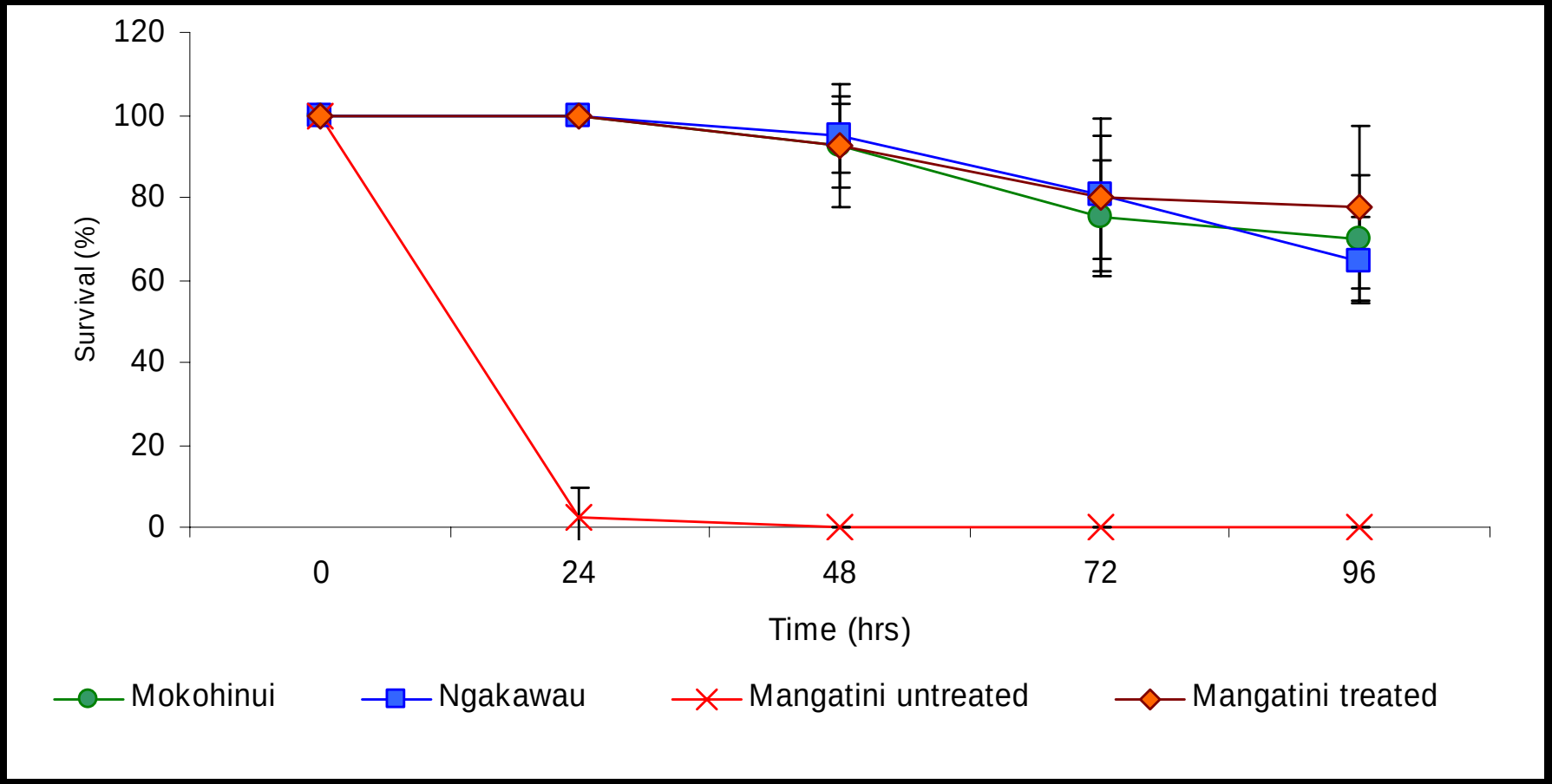
- Species

  Deleatidium sp.

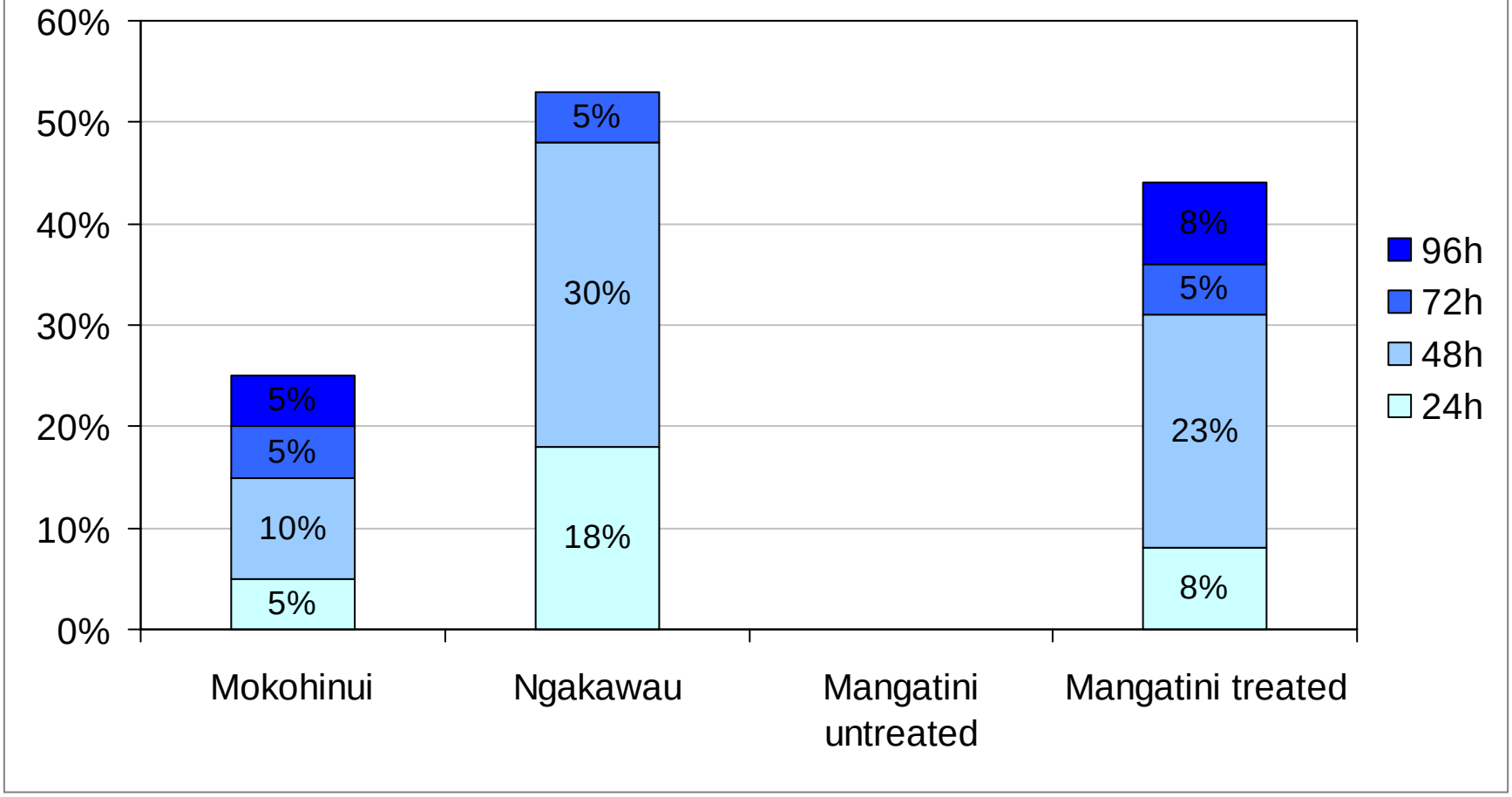
- Mokohinui river (pH 7.8)
- Ngakawau river (pH 7.2)
- Mangatini river
  - Untreated (pH 2.7)
  - Treated (pH 6.1)

- Time : 96h
- Temperature : ~ 15ºC
- Cycle : 12h day / 12h night

Remediation of Mangatini Stream



Remediation of Mangatini Stream

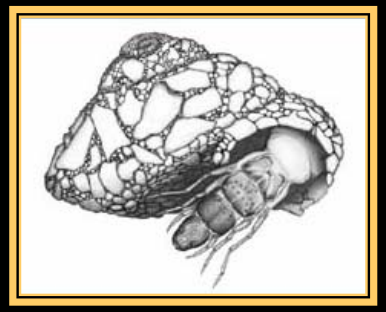


Survival of invertebrates species to water acidification

- Species
  - *Deleatidium*
  - *Zelandoperla*
  - *Zelandobius*
  - *Helicopsyche*

- Time : 96h
- Temperature : ~ 10ºC
- Cycle : 12h day / 12h night

- Animals and water collected at Carton creek



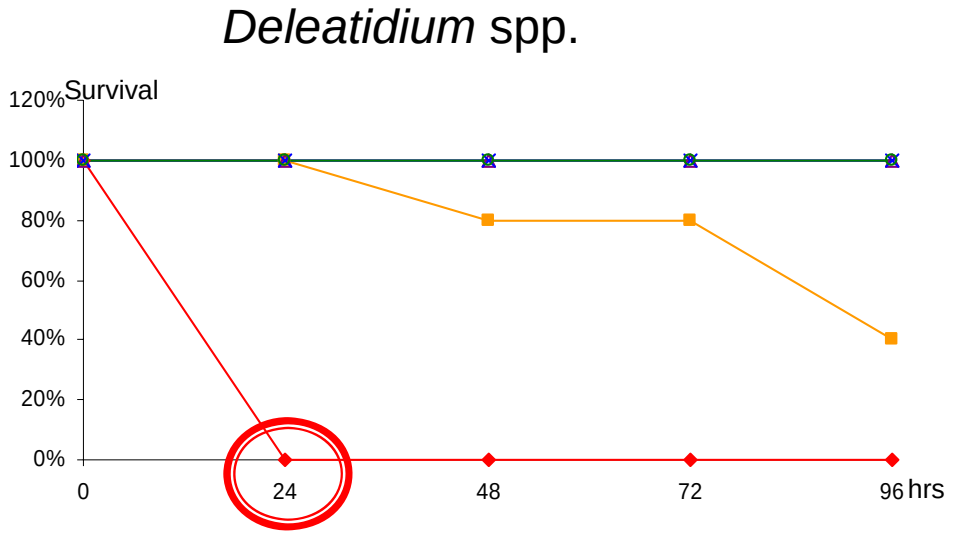
Experiment

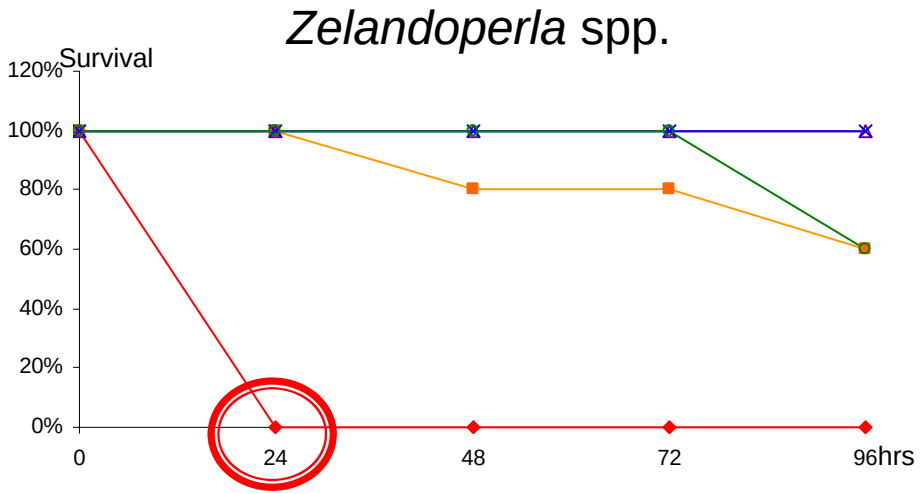
pH tested :

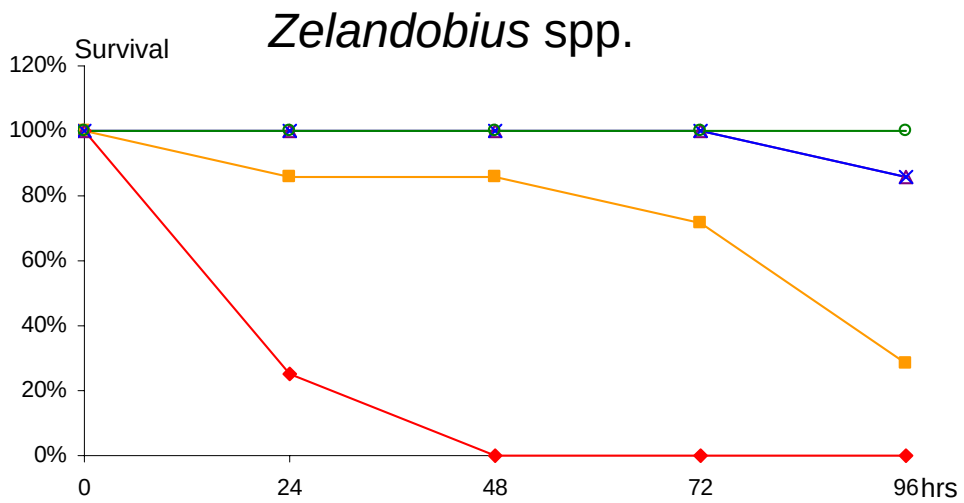
pH 2.5
pH 3.5
pH 4.5
pH 5.5
+ control pH 6.1

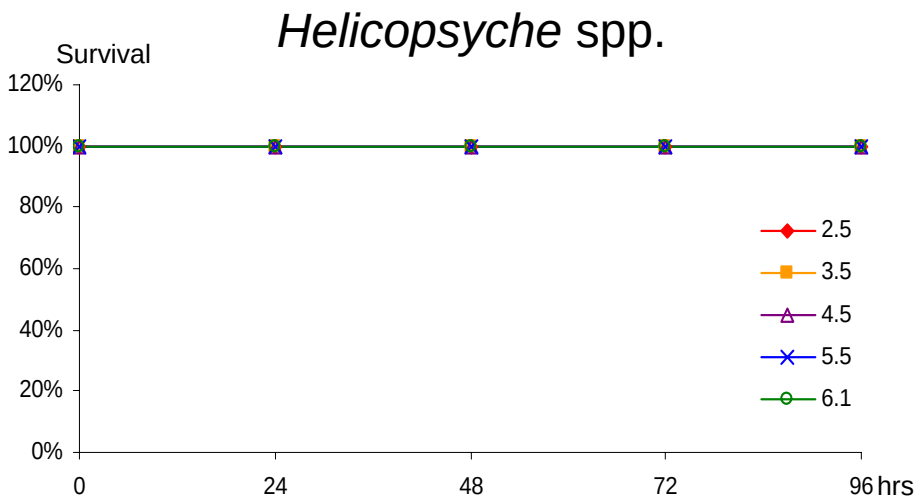
Water is acidified with sulfuric acid (H_2SO_4)

Survival of invertebrates with pH variations



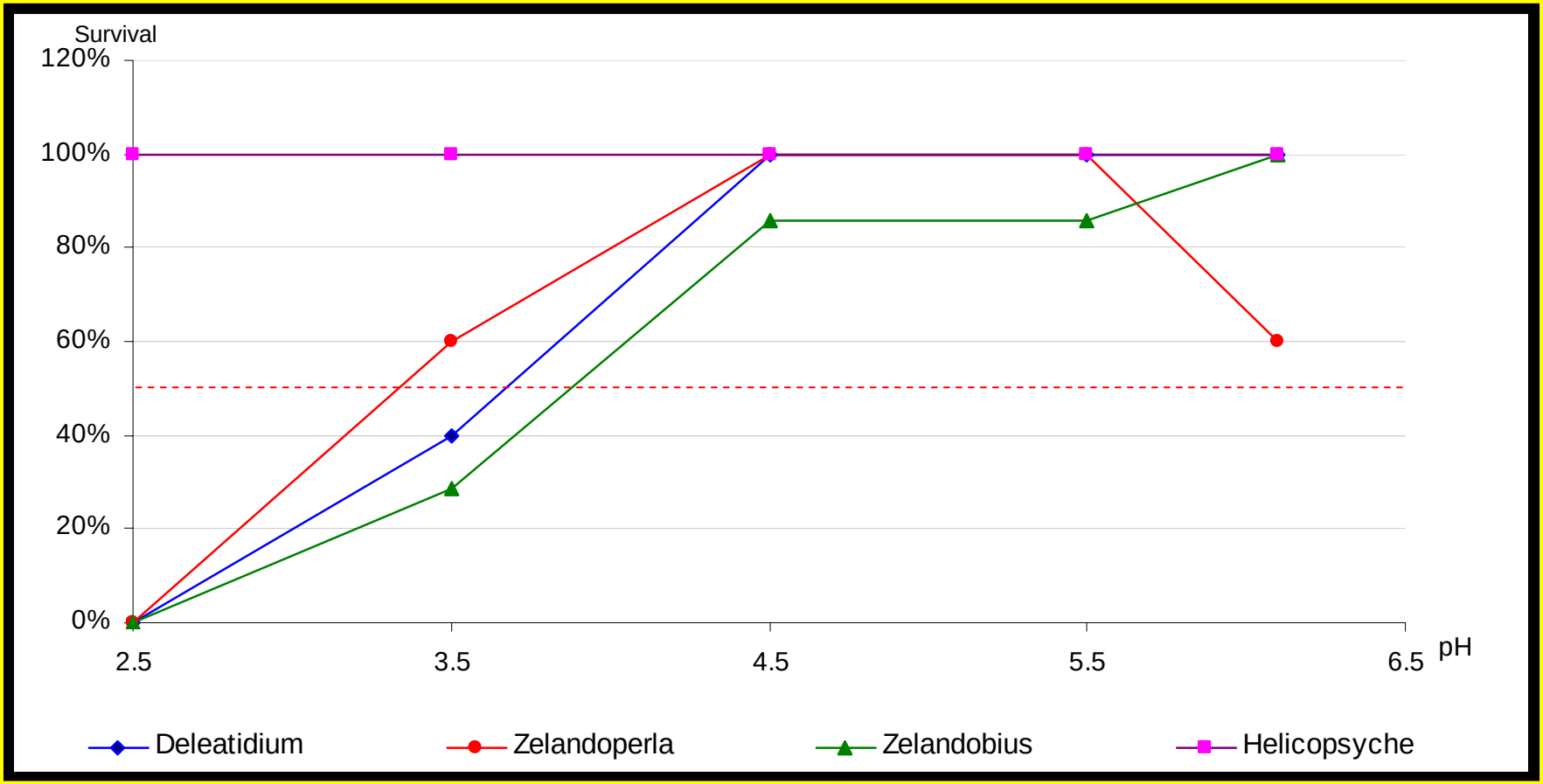






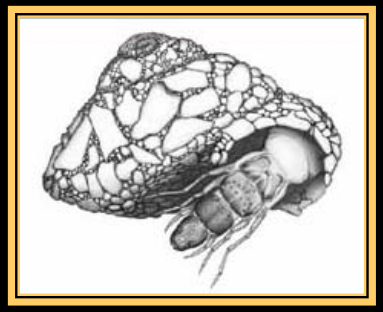
Survival of invertebrates with pH variations

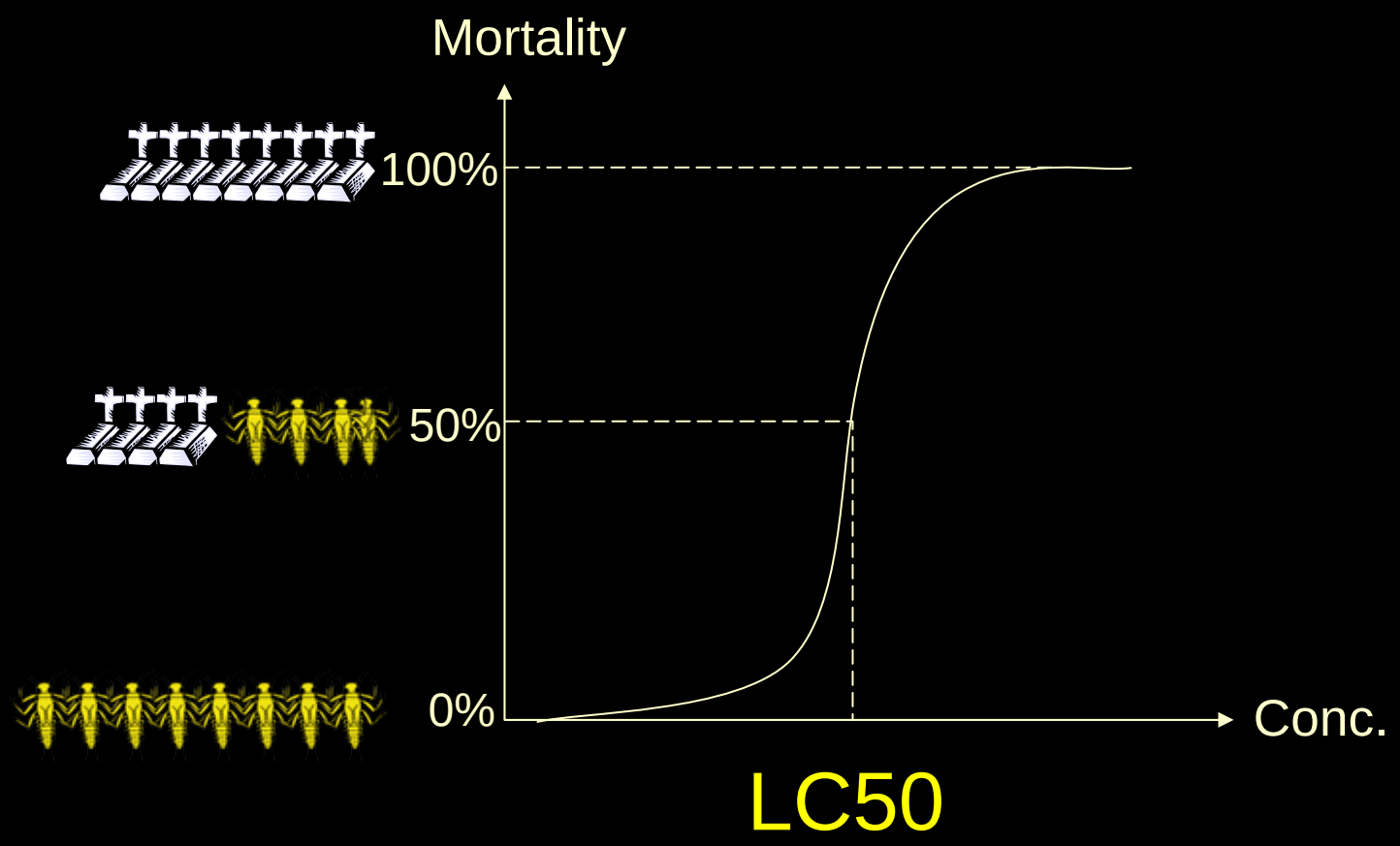
After 96hrs



Sensitivity to pH

Zelandobius > Deleatidium > Zelandoperla > Helicopsyche

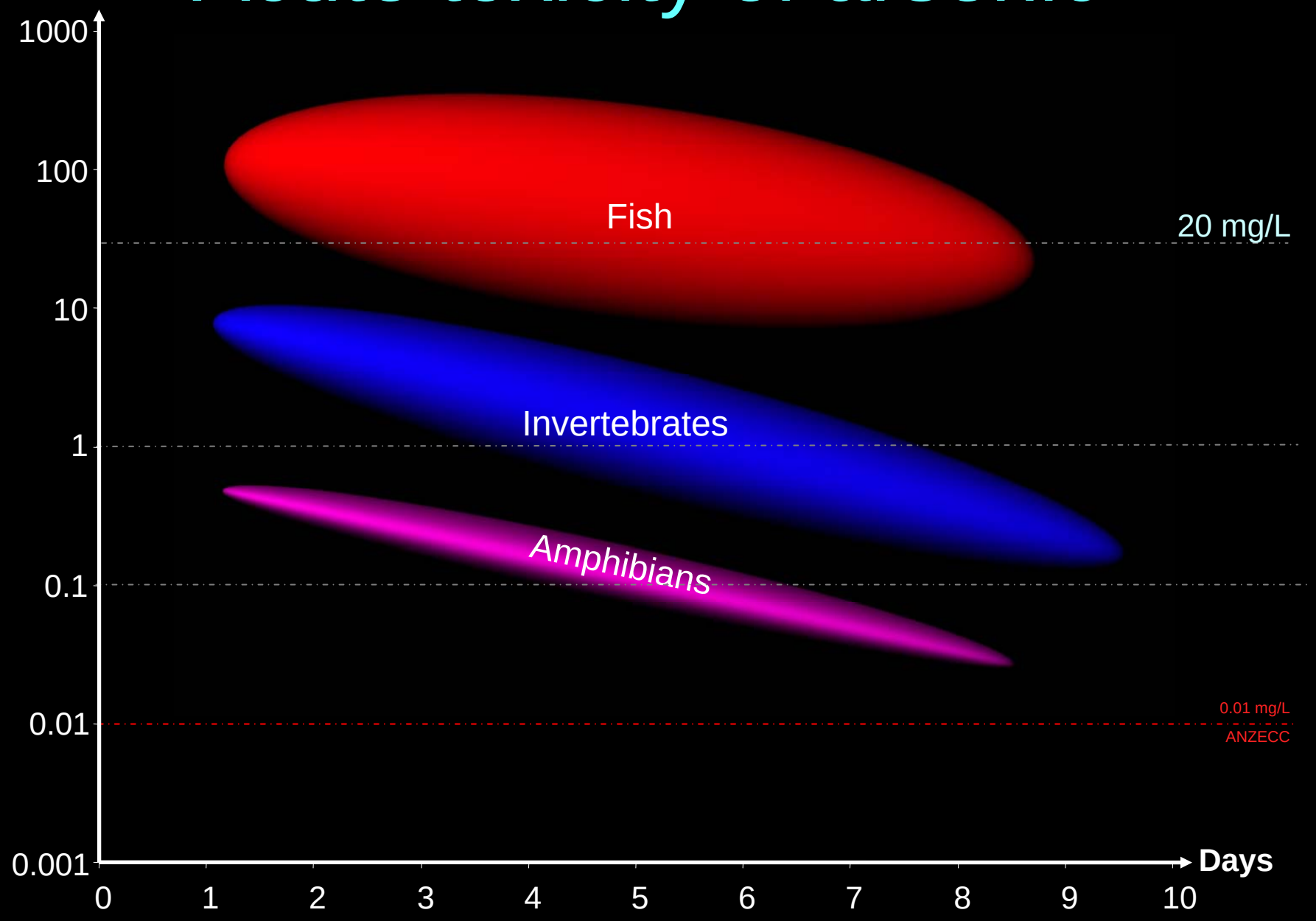




LC = lethal concentration

Amount of substance given at once on a short term which causes the death of 50% of a group of test animals

Acute toxicity of arsenic



Survival of invertebrates species to arsenic V contamination

- Species
  - *Deleatidium*
  - *Zelandoperla*
  - *Zelandobius*
  - *Helicopsyche*

- Time : 96h
- pH : 5.9
- Temperature : ~ 10ºC
- Cycle : 12h day / 12h night

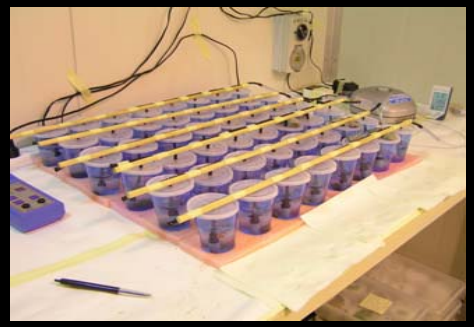
- Animals and water collected at Carton creek

Experiment

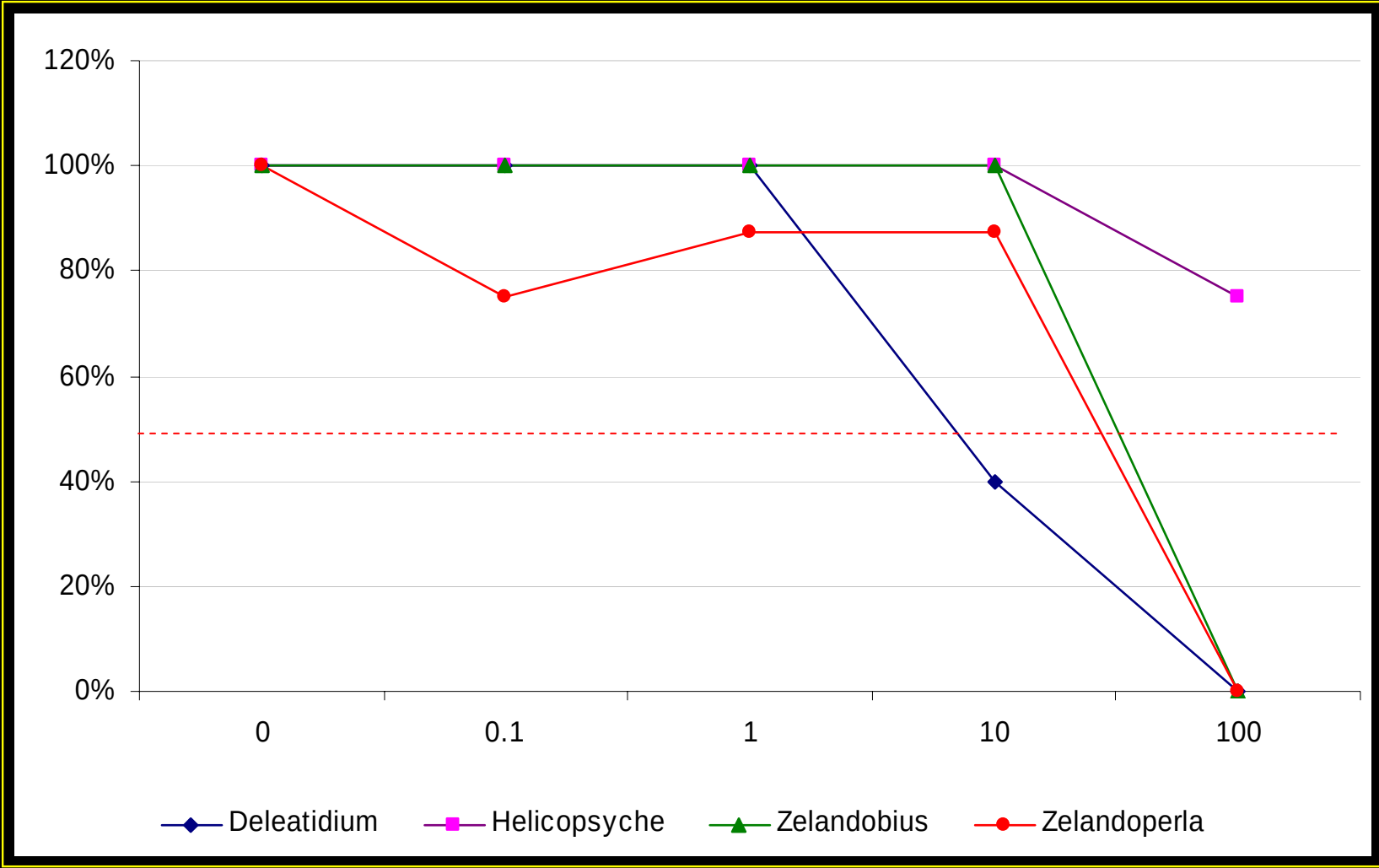
Stage 1 : Range finding test

- Concentrations of Arsenic V (arsenic pentoxide) :

0.1 mg/L
1 mg/L
10 mg/L
100 mg/L
+ Control



Stage 2 : Full scale definitive test

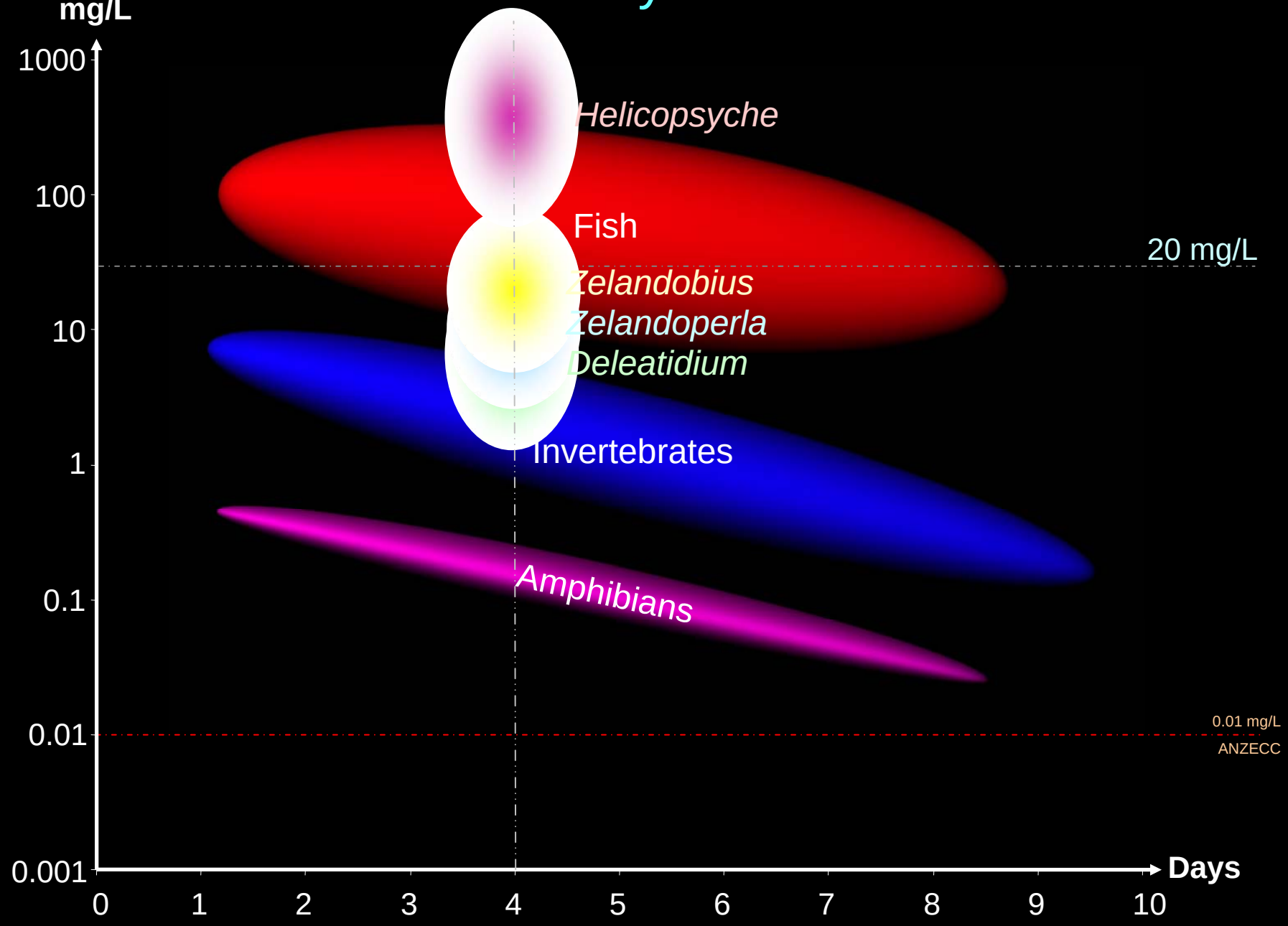


As V

LC 50

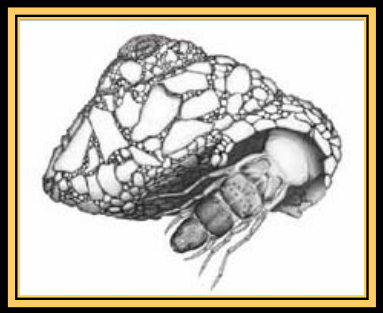
Deleatidium	: 8.9 mg/L	[7.6 ; 11.6]
Zelandoperla	: 17.6 mg/L	[9.1 ; 19.3]
Zelandobius	: 23.9 mg/L	[10.7 ; 24]
Helicopsyche	: >100 mg/L	

Acute toxicity of arsenic



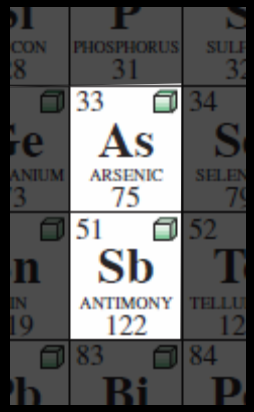
Sensitivity to As

Deleatidium - Zelandoperla > Zelandobius > Helicopsyche



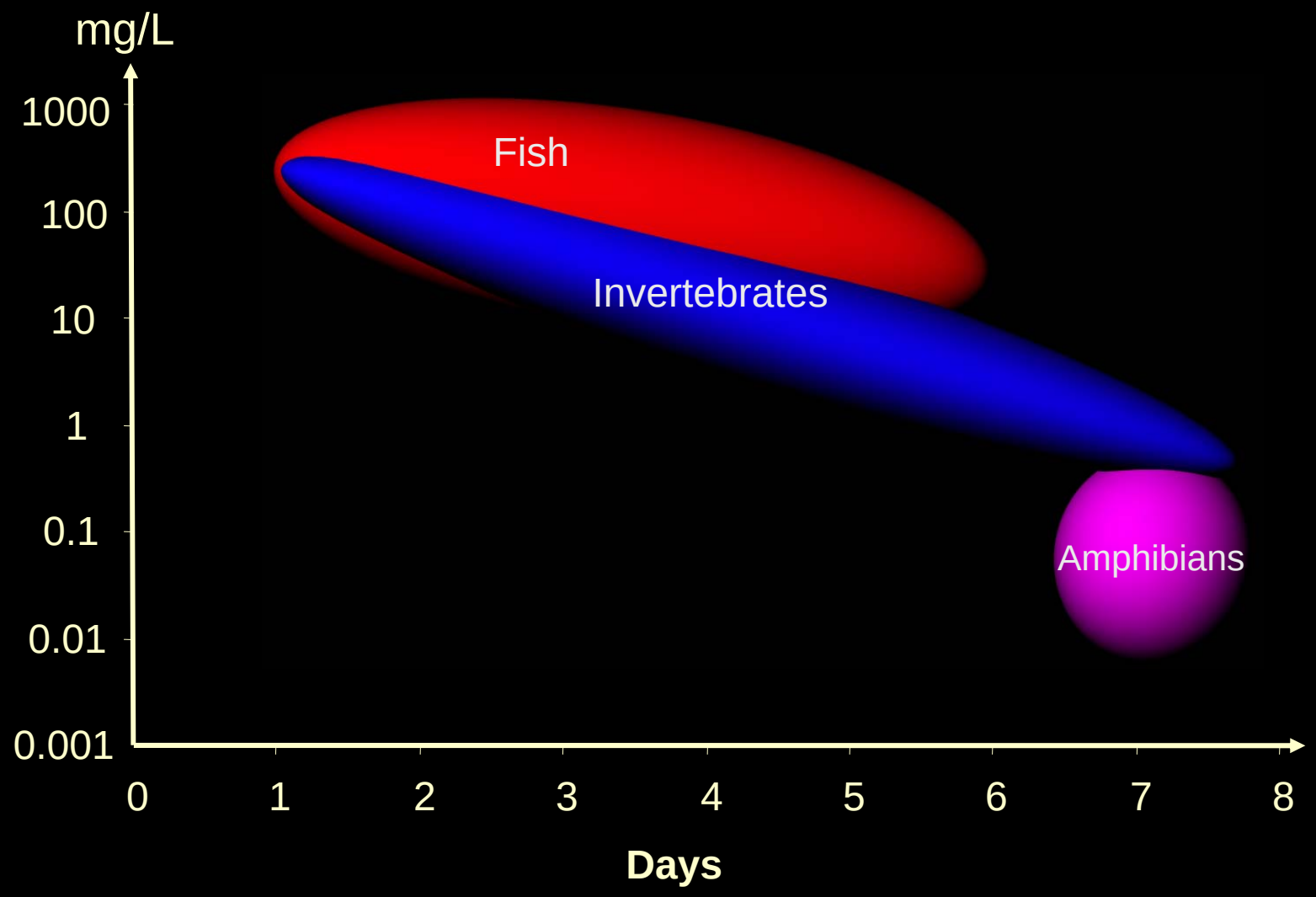
Impact of metals - Antimony

- May inhibit arsenic effects



- To few studies on biological impacts (not ecotoxicological data) organisms other than mammals

LC50 - Antimony



Future Plans

LC50 for NZ species

- Impact of metals alone :
  - arsenic III
  - antimony
  - aluminium
  - iron

- Impact of binary and tertiary mixtures