Koura
Biomonitors of lake chemistry

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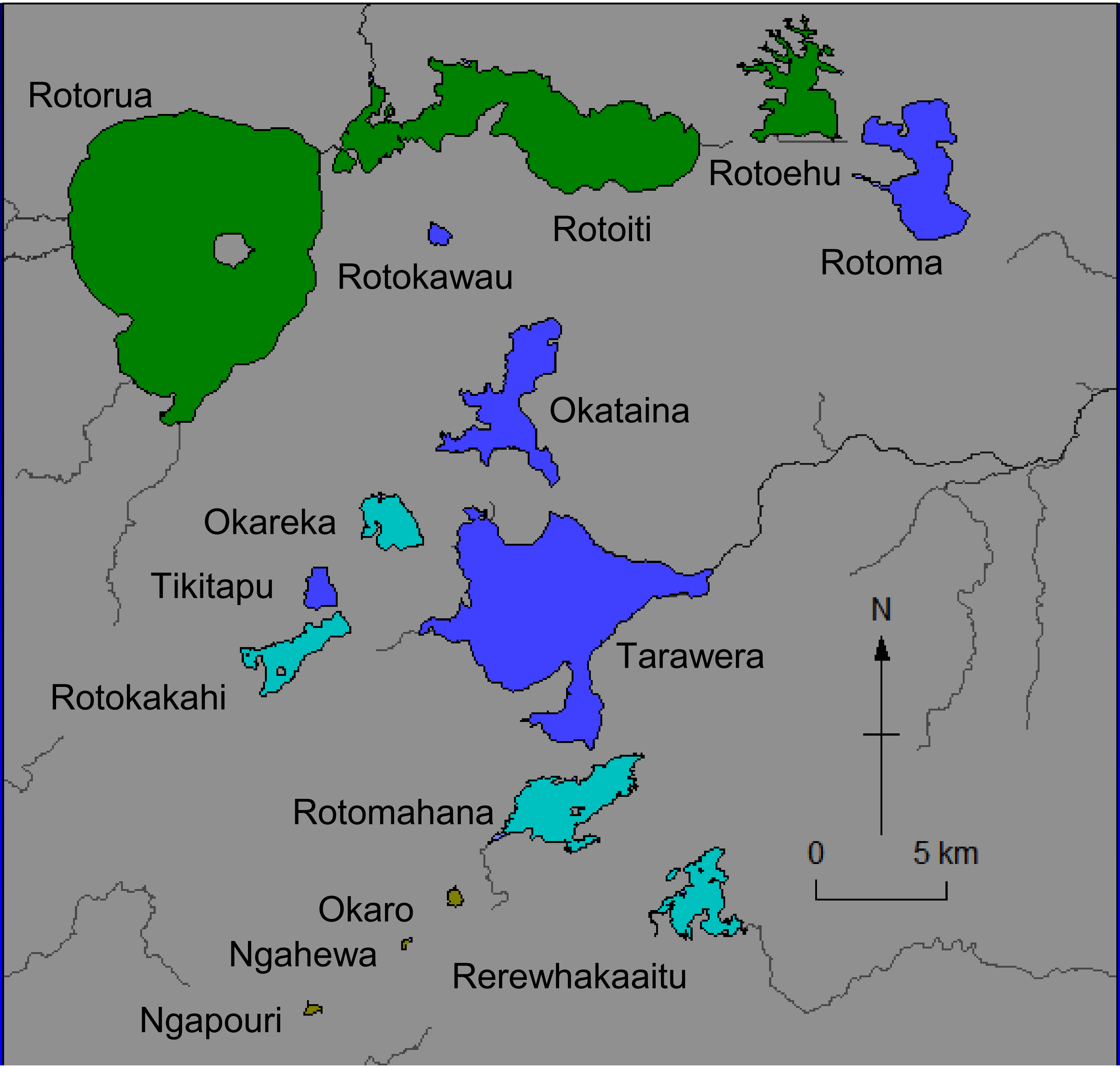
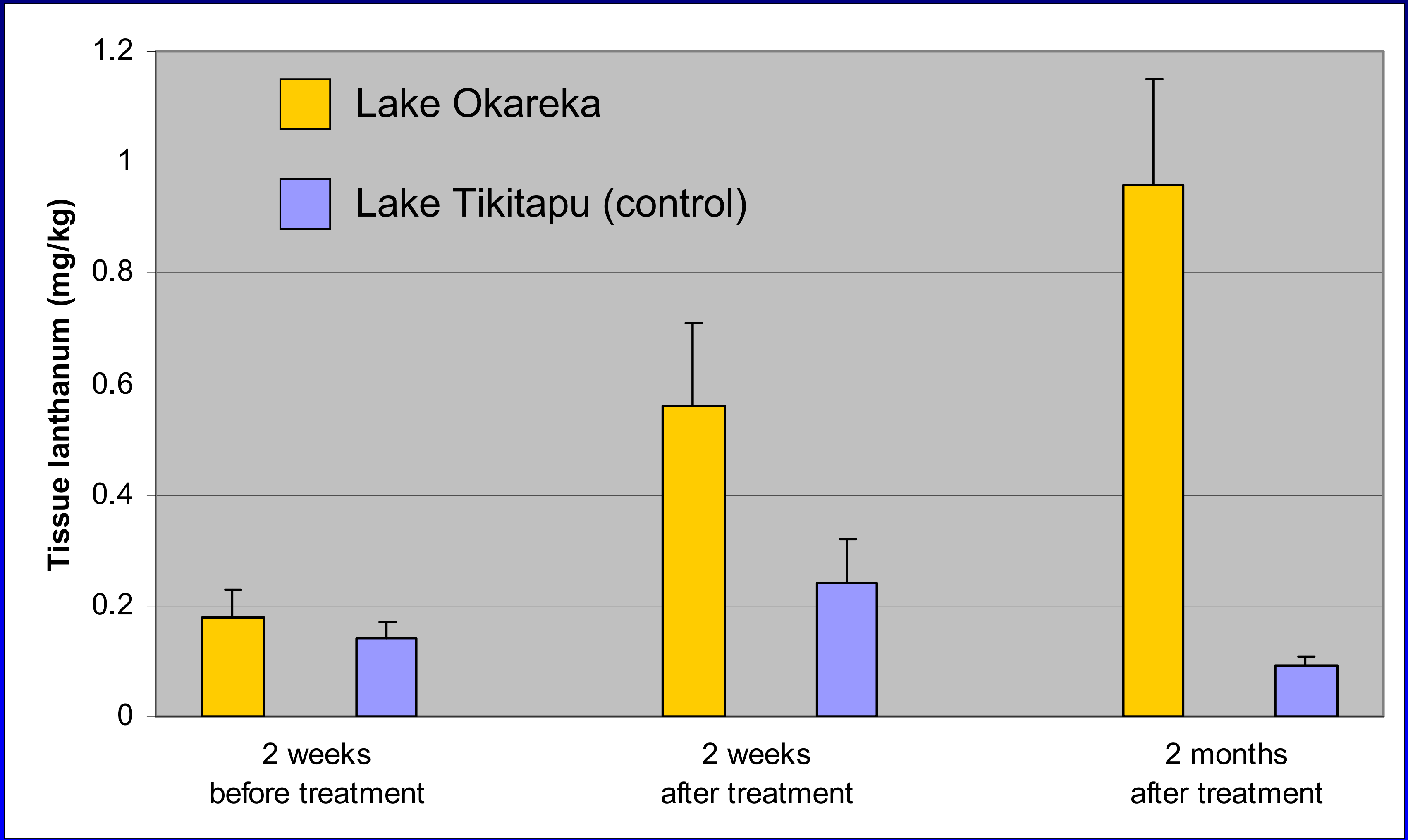
SCION


Rotorua
Rotoiti
Rotoehu
Rotoma
Rotokawau
Okataina
Okareka
Tikitapu
Rotokakahi
Tarawera
N
Rotomahana
0
5 km
Okaro
Ngahewa
Rerewhakaaitu
Ngapouri

Bioaccumulation of lanthanum in koura hepatopancreas from Lake Okareka following whole-lake Phosloc application (60 kg/ha)



Lake	Catchment (ha)	Lake Area (ha)	Mean depth (m)	Age (y)	Trophic state
Okareka	1,958	334	20	19,000	Mesotrophic
Okaro	389	30	13	800	Supertrophic
Okataina	5,982	1,173	39	7,000	Oligotrophic
Rerewhakaaitu	517	517	7	700	Mesotrophic
Rotoehu	4,916	790	8	8,500	Eutrophic
Rotoiti	12,370	3,370	32	8,500	Eutrophic
Rotokakahi	1,971	433	18	13,300	Mesotrophic
Rotoma	2,782	1,112	37	8,500	Oligotrophic
Rotomahana	8,325	902	60	111	Mesotrophic
Rotorua	52,054	8,047	11	140,000	Eutrophic
Tarawera	14,313	4,115	50	5,000	Oligotrophic
Tikitapu	622	144	18	13,300	Oligotrophic

Measuring lake chemistry – sediments or tissues

Problems with sediments

Sediment type – rock, cobble, sand, mud – grain size and pore size

Differential particle size sorting with depth

Sediment chemistry – particulate organic matter, AVS, anaerobic/aerobic

Difficult to sample in macrophyte beds

Sediment chemistry varies with seasonal stratification

Sediment chemistry provides no measure of bioavailability

Problems with tissues

Some elements are physiologically regulated, others do not bioaccumulate

Koura – *Paranephrops planifrons*

Large size – 120 g

Abundant & widespread

Sexually dimorphic

Sediment associated

Scavenging omnivores

Edible species

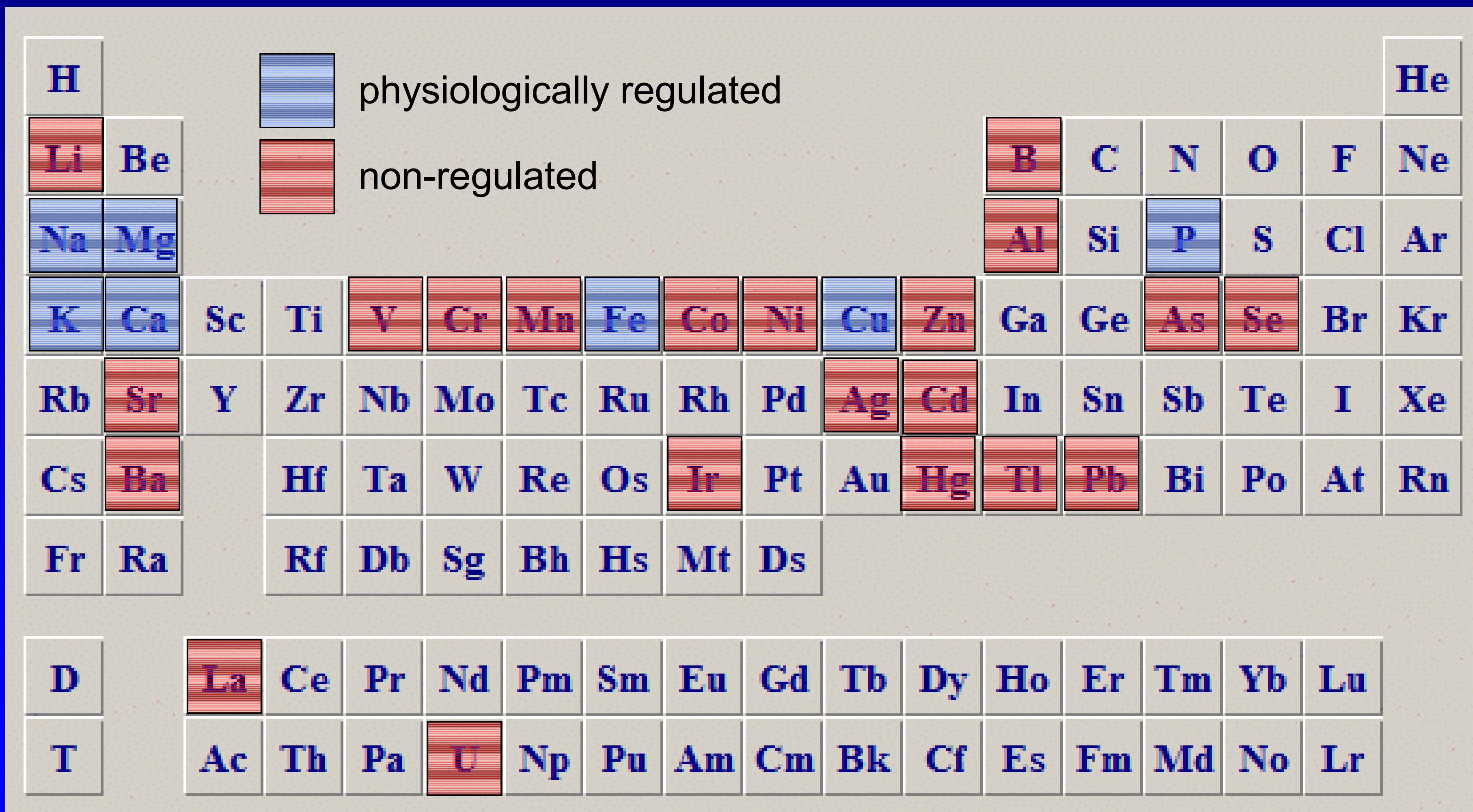
Methods

5 male & 5 female adult koura collected from 8 lakes by SCUBA

Tail flesh and hepatopancreas digested using USEPA method 200.11

28 elements measured by ICPMS

28 elements analysed by ICPMS



Relative accumulation in tissues – hepatopancreas vs tail flesh

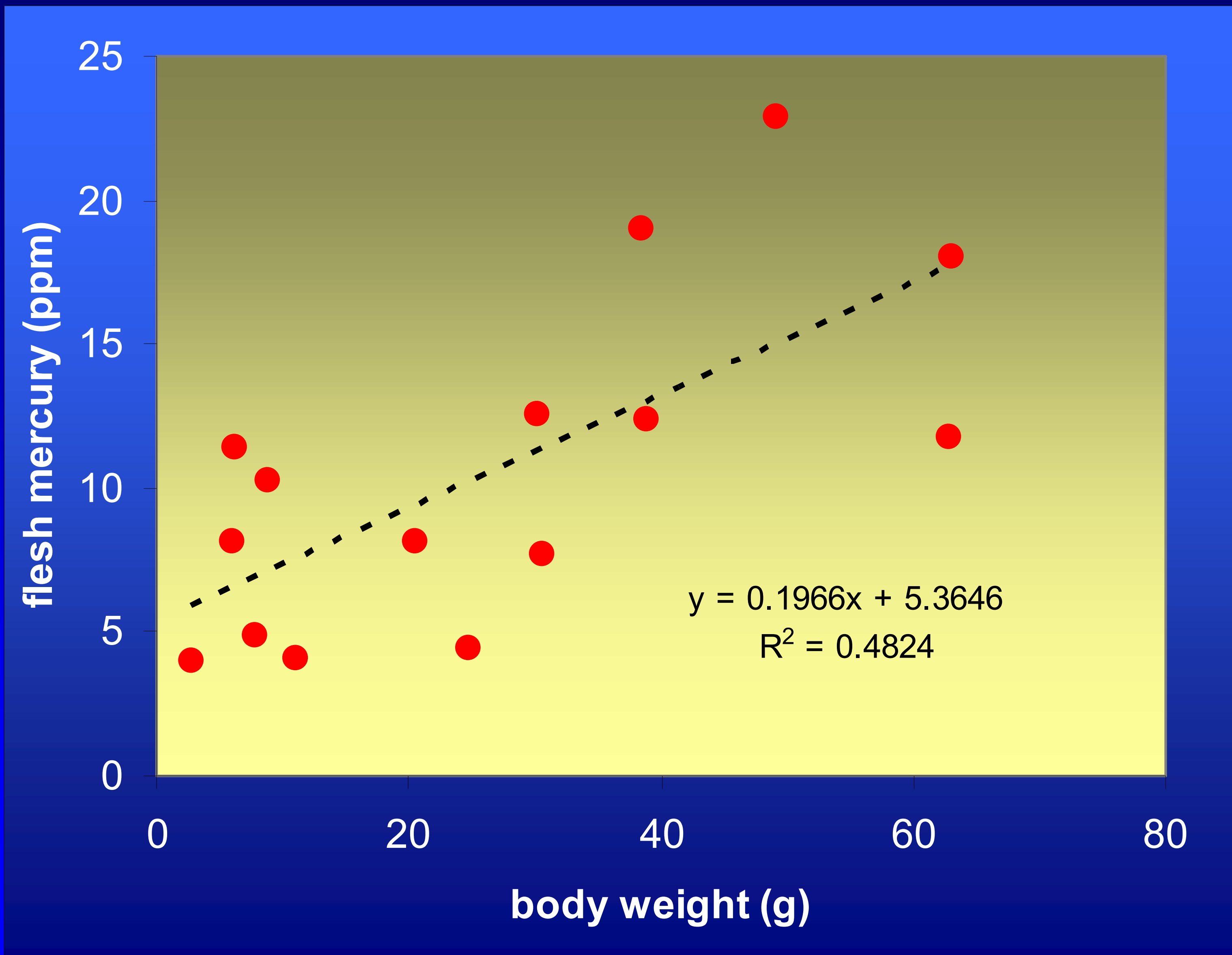
Strong (more than 10-fold)
Mn
Co
Ni
Zn
Ag
Cd
Ba
La
Tl
U

Moderate (more than 2-fold)
Li
B
Al
As
Se
Sr

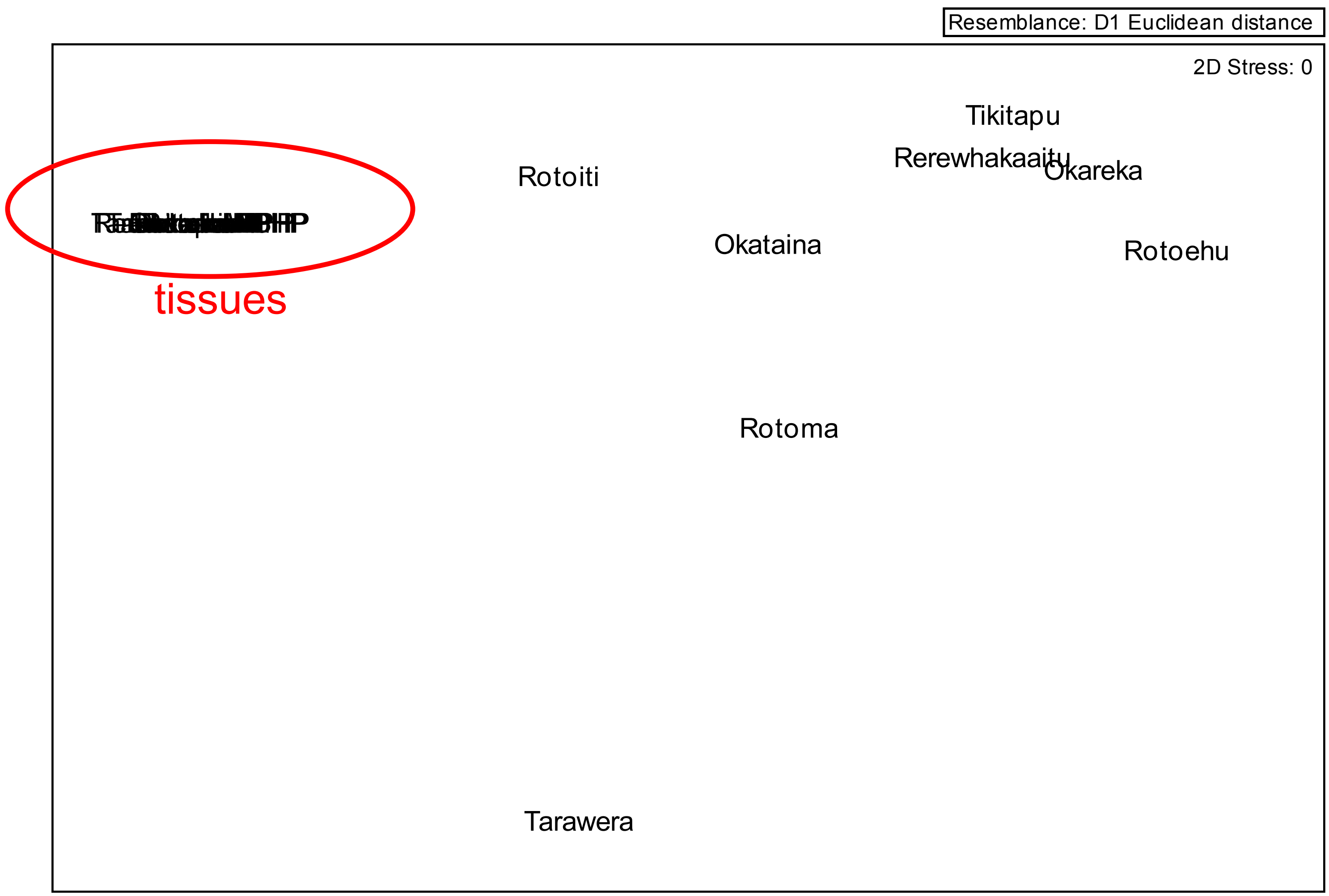
Weak (approx =)
Cr

Inverse (higher in flesh)
Hg

Mercury bioaccumulation

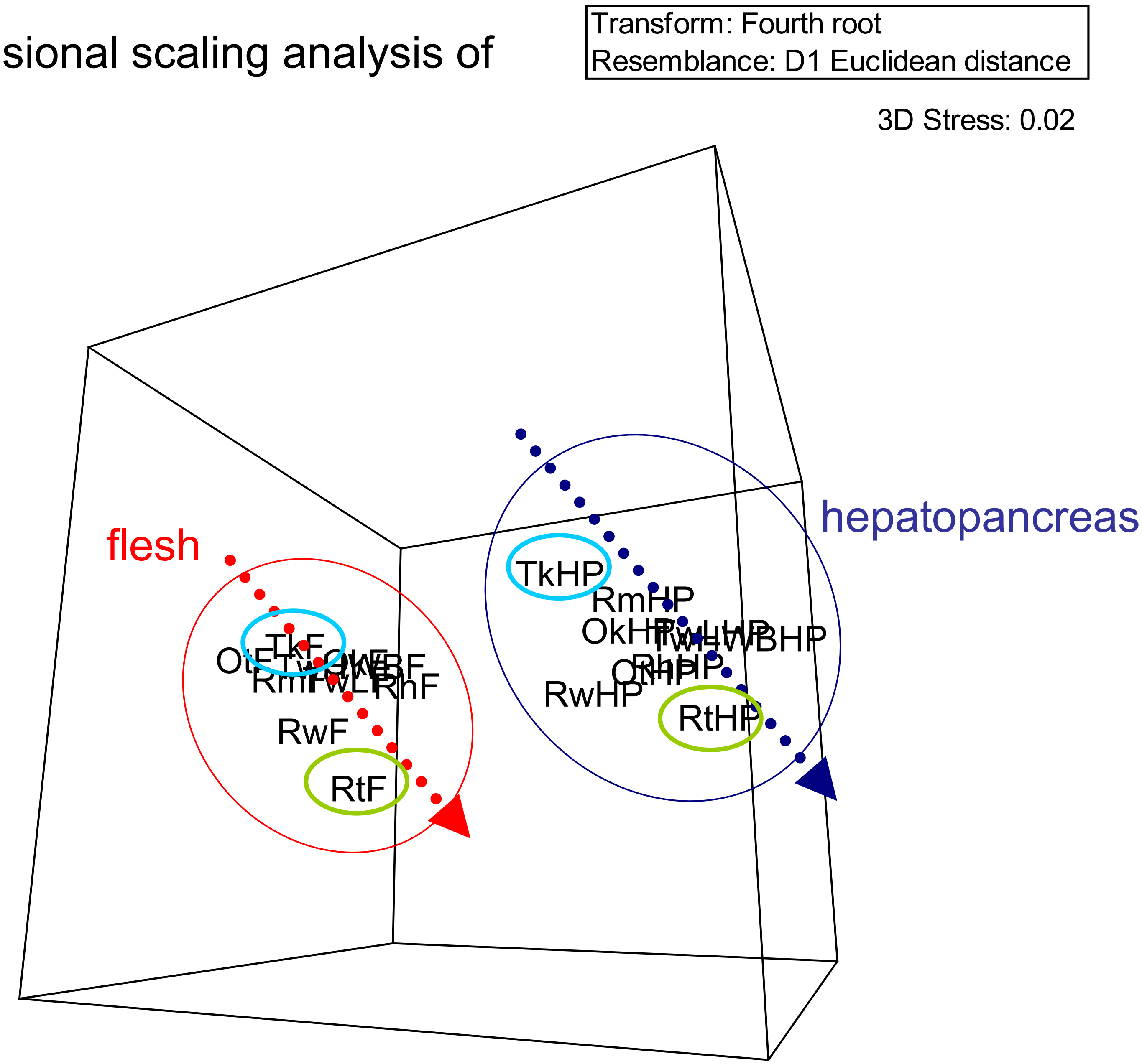


Multidimensional scaling analysis of tissue metals vs sediments

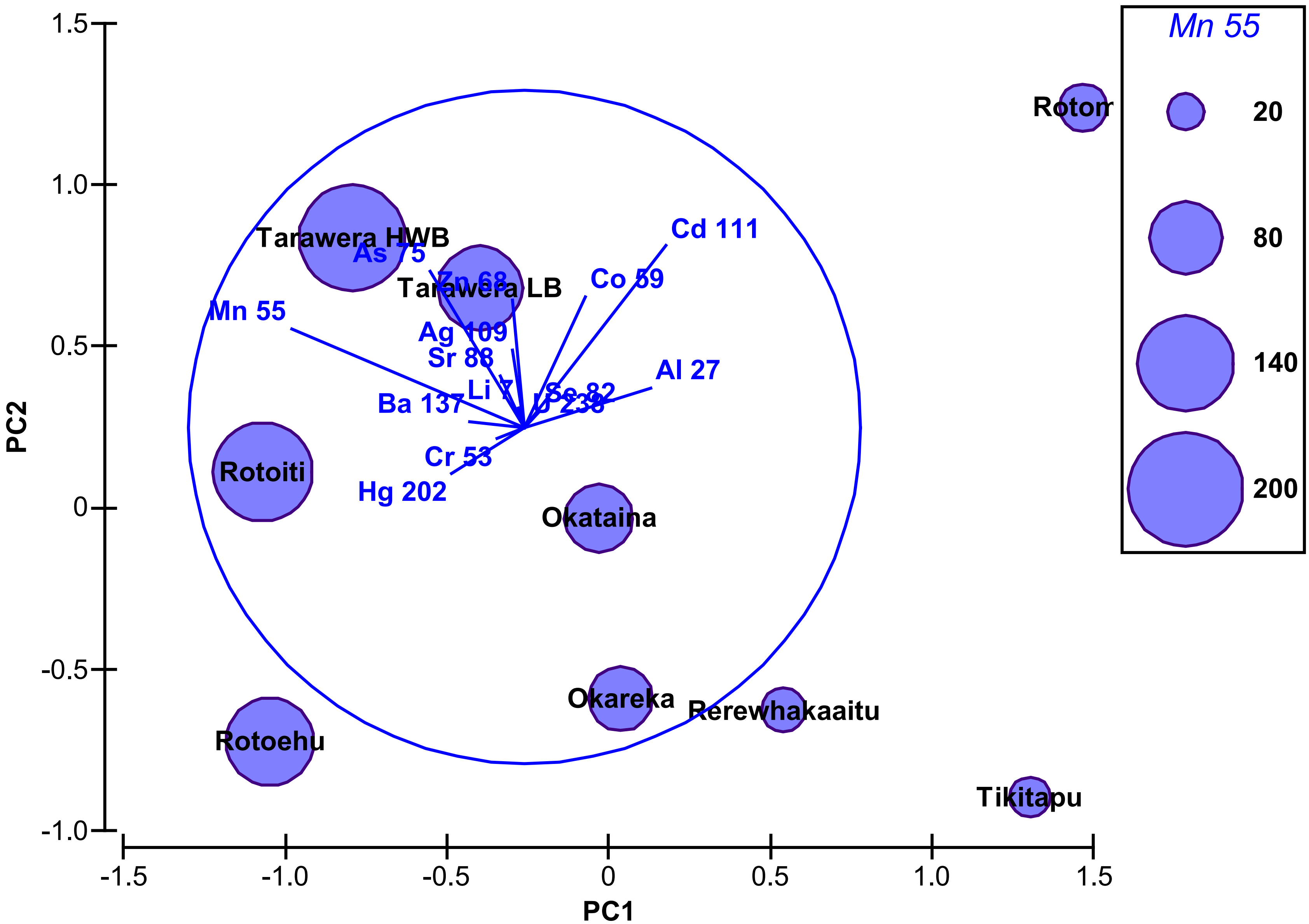


Results for sediment chemistry are highly variable

3-D mutidimensional scaling analysis of tissue metals



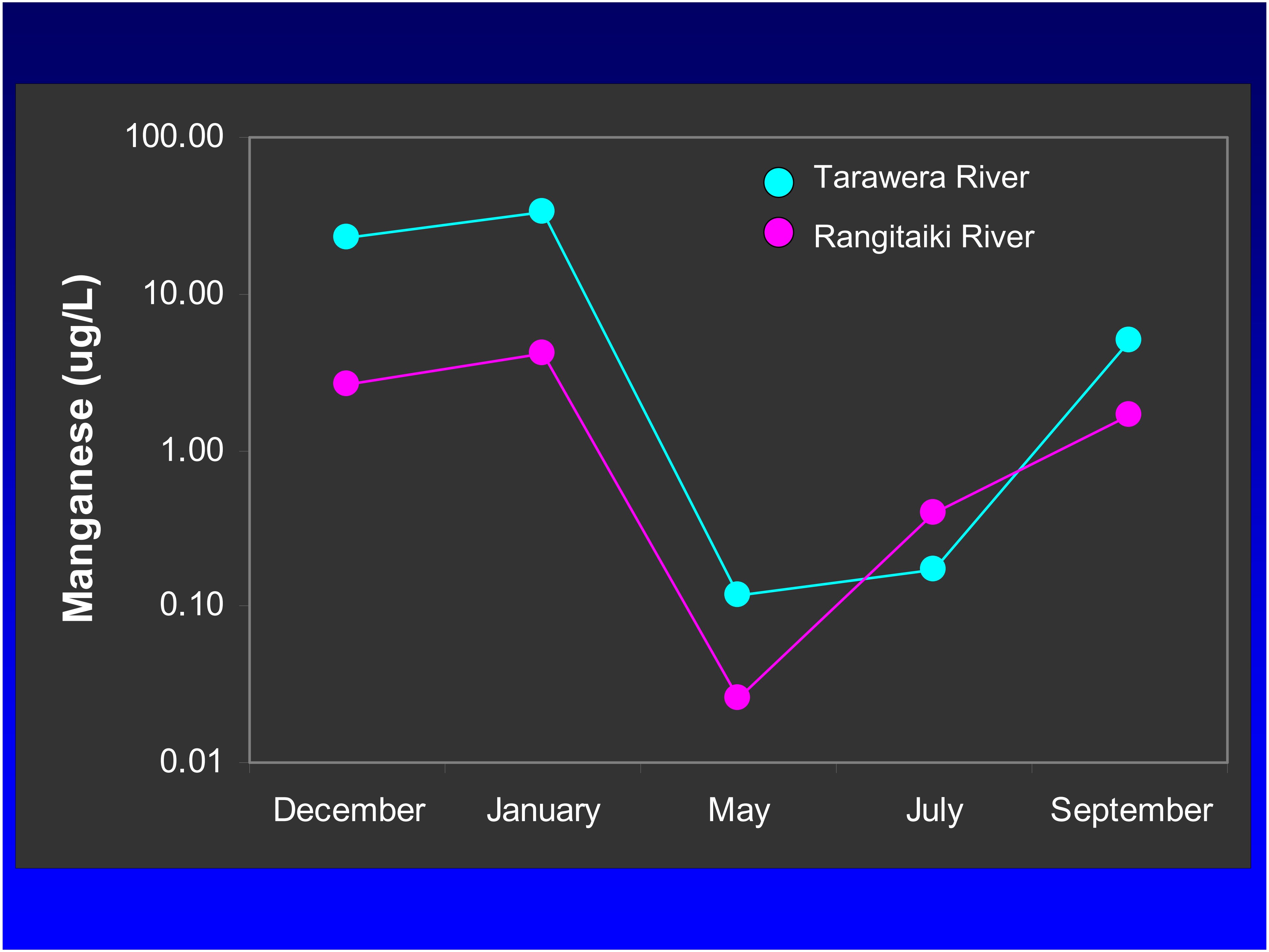
Principal components analysis – 66% of the variation is described by the first 2 axes
Manganese is the principal element associated with axis 1



Evidence of eutrophication
Rank order – manganese concentration

Sediments	Tissues
Tikitapu	Tikitapu
Okareka	Rerewhakaaitu
Rerewhakaaitu	Rotoma
Rotoiti	Okareka
Okataina	Okataina
Rotoehu	Rotoehu
Rotoma	Tarawera
Tarawera	Rotoiti

Anoxic conditions in the hypolimnion promote the release of phosphate, ammonia, sulphides, methylmercury, iron and manganese


Manganese (ug/L)
100.00
10.00
1.00
0.10
0.01
Tarawera River
Rangitaiki River
December
January
May
July
September

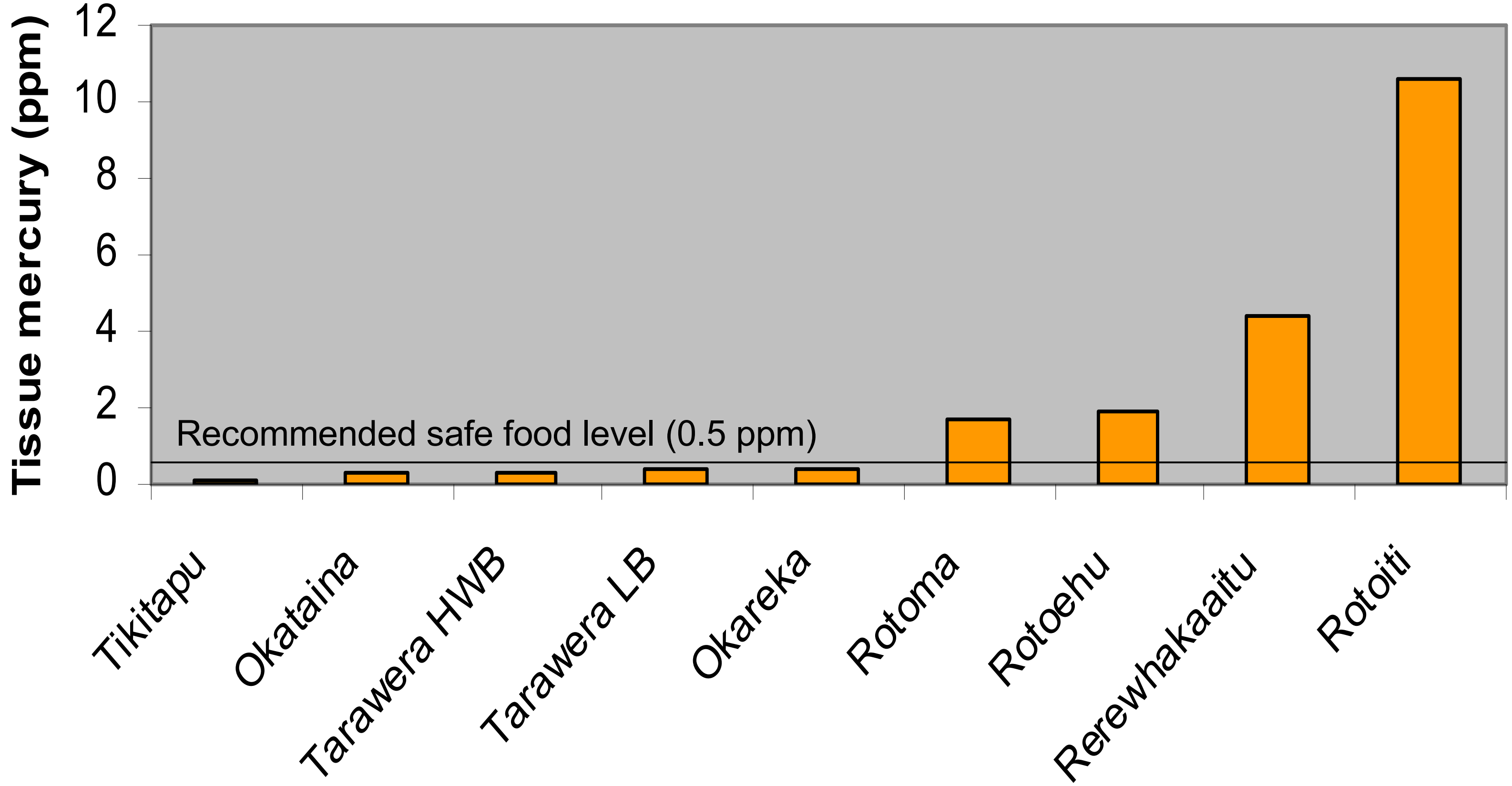
Evidence of geothermal inputs
Rank order – arsenic concentration

Sediments	Tissues
Tikitapu	Rerewhakaaitu
Okareka	Tikitapu
Rerewhakaaitu	Okareka
Rotoiti	Rotoehu
Rotoma	Rotoma
Rotoehu	Okataina
Okataina	Rotoiti
Tarawera	Tarawera

Evidence of heavy metal bioavailability
Rank order – mercury concentration

Sediments	Tissues
Okareka	Tikitapu
Tarawera	Tarawera
Rotoma	Okareka
Rotoehu	Okataina
Okataina	Rotoma
Rerewhakaaitu	Rotoehu
Tikitapu	Rerewhakaaitu
Rotoiti	Rotoiti

Possible health concerns with edible biota from the Te Arawa Lakes



Summary

Koura seem to be excellent integrating biomonitors of lake chemistry

Koura tissues provide a direct measure of bioavailable elements

Koura may be useful biomonitors of changes in elemental bioavailability in response to lake trophic status – e.g., manganese and methylmercury

Acknowledgements

Environment Bay of Plenty

Te Arawa Lakes Trust

Steve Cameron, Dudley Bell
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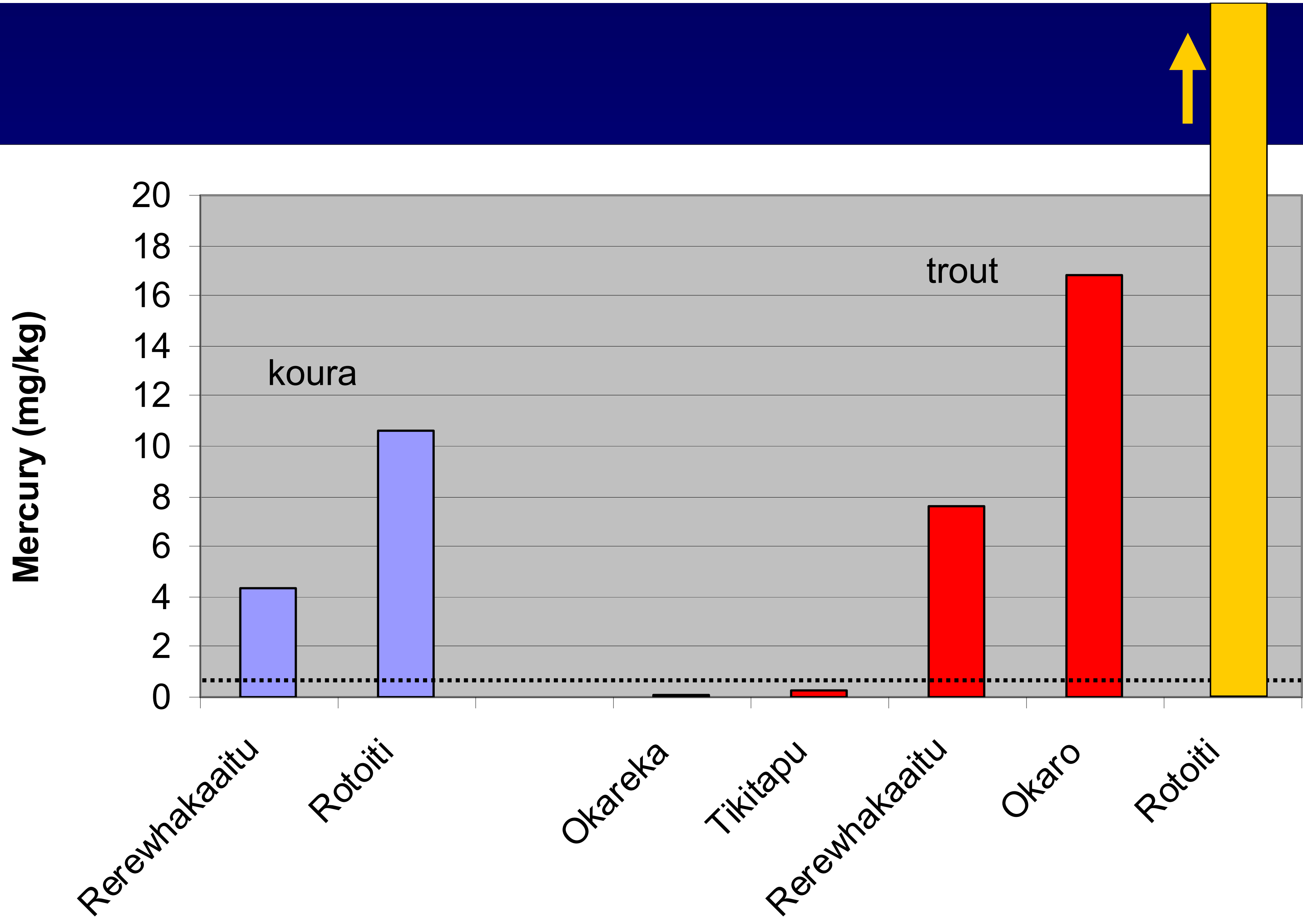
Mercury (mg/kg)
20
18
16
14
12
10
8
6
4
2
0
koura
trout
Rerewhakaaitu
Rotoiti
Okareka
Tikitapu
Rerewhakaaitu
Okaro
Rotoiti