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Enhancing the ecological significance of sediment contamination guidelines through integration with community analysis.

Number of pages: excluding cover page	11
Number of tables	1
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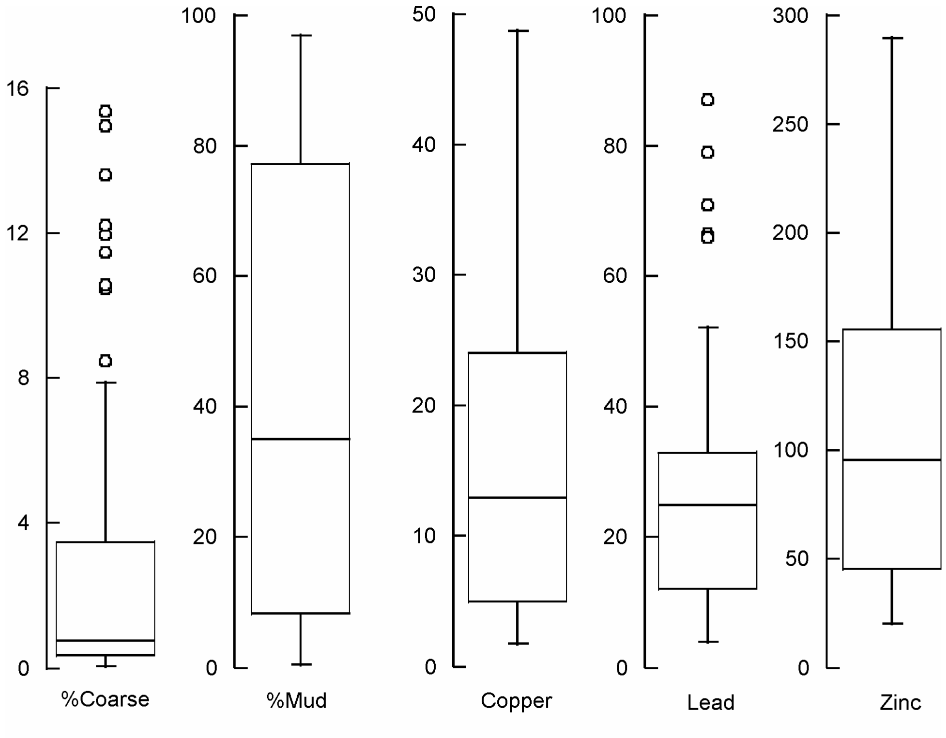
Figure S1: Location of sample sites across the Auckland region.

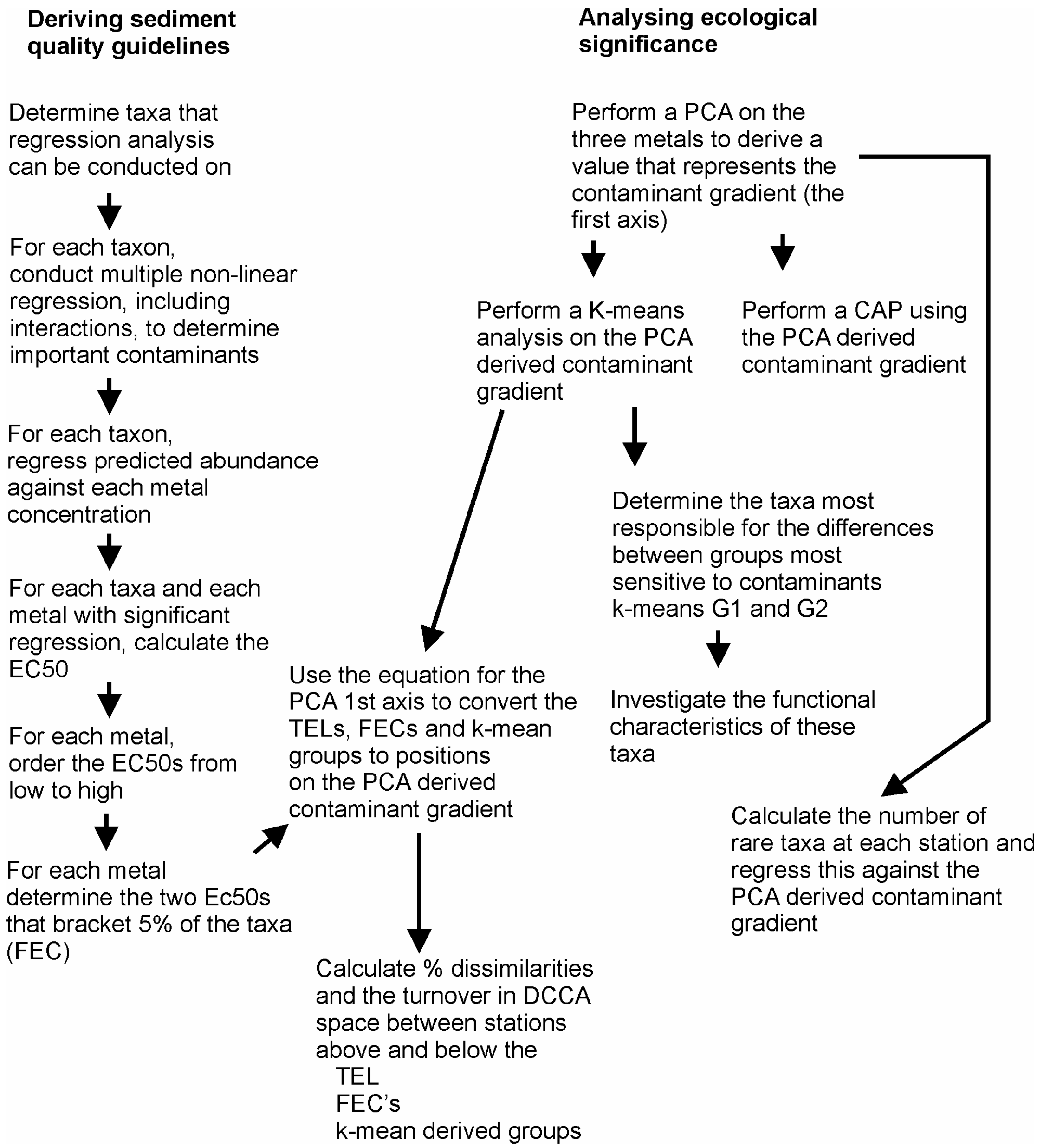
Figure S2: Distributions of sediment grain size fractions (coarse and mud) as percent weight, and copper, lead and zinc content of the sediment (in $mg.kg^{-1}$) measured across all stations.



Text S3: Taxonomic resolution of the data

As macrobenthic analysis was carried out at two laboratories, a quality control exercise concluded that some taxa would need to be amalgamated into higher-level groups (i.e., a small capitellid polychaete and a tubificid oligochaete were grouped; the polydorid polychaetes (*Polydora cornuta*, two species of *Boccardia (srytis* and *acus*) and two species of *Pseudopolydora)* were grouped; all phoxocephalid amphipods with the exception of *Waitangi brevirostris* were grouped; all corophid amphipods were grouped; and all gammarid amphipods were grouped. Three species of burrowing detritivore crabs (*Helice crassa*, *Macrophthalmus hirtipes* and *Hemigrapsus crenulatus*) were also grouped as each species was relatively rare by themselves but together there were sufficient to be analysed.

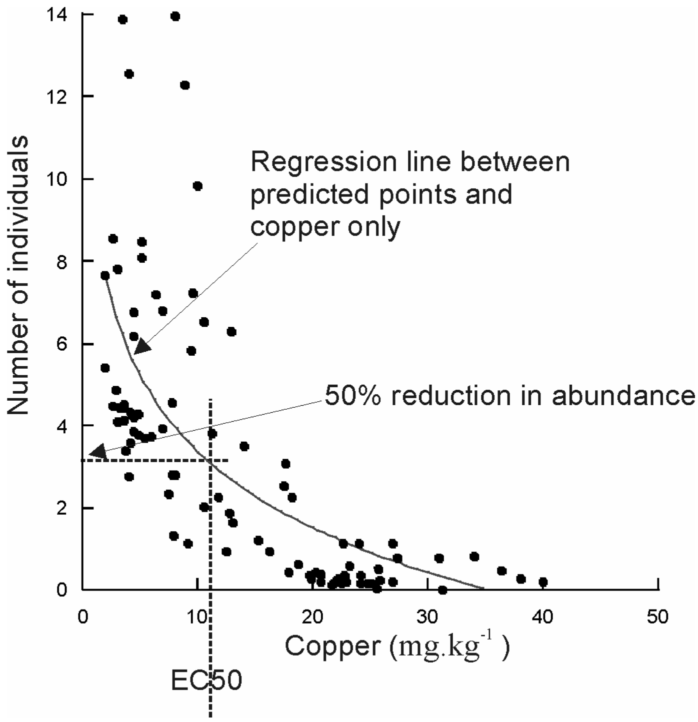
Figure S4: Schematic flow diagram of statistical methods. Note that for this study, the first two tasks under "Deriving sediment quality guidelines" are found in Thrush et al. (2008).



Text S5.

Thrush et al. [19] identified relationships between abundance and concentrations of the three metals using OLS regression on raw or log transformed data (with a 2 degree polynomial term and with sediment descriptors (%organics, % mud and % coarse) and interactions included, using either normal or Poisson-distributed errors. Where overdispersion occurred, a quasi-likelihood function was used. Backward stepwise elimination of non-significant terms was used to determine a 'best' model, based on changes in explained variance (coefficient of determination) and the Bayesian Information Criterion (BIC, [21]). While multiple regression is generally used to partition effects, predictor variables that are highly correlated can cause problems. Correlations between metals and sediment descriptors (%coarse, %mud) were assessed using Pearson's correlation coefficient. Results of the multiple regressions were assessed for colinearity, as detailed in [22]. The best model was only accepted as the end model if it was not affected by colinearity. This resulted in most taxa exhibiting a relationship with only one metal [19], though sediment particle size was often important. Some taxa exhibited unimodal responses to sediment particle size; for these taxa models were developed for both the increasing and decreasing part of the response curve.

Figure S6: Example of derivation of EC50 value using data for *Austrovenus stutchburyi*. Points in the figure are site predictions from Thrush *et al.* (2008)



Text S7: Determining the effect of sediment particle size.

Based on sediment particle size, stations fell into 2 groups. The community data were separated into these two groups and canonical correlation conducted for each group separately (see [26] for details). Briefly, the predictive power of models based on the split dataset was not as good as the combined model using all data which ignored sediment particle size. This was not unexpected, as correlations between the sediment variables and the metal concentrations were generally low (Pearson's $r < 0.5$, for all except copper and mud, Pearson's $r = 0.64$). Therefore, the need to partition the dataset by sediment particle size was dismissed.

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Text S8: Principle component analysis of copper, zinc and lead concentrations.

A non-normalised PCA done on $\log_e$ transformed data provided a single variable to represent copper, zinc and lead concentrations as the first axis represented ~94% of the variability. As the sign of a principal component axis is arbitrary, the axis was deliberately orientated such that increasing values corresponded to increasing metal concentrations, for convenience in interpretation. The eigenvector weights were 0.619 (copper), 0.536 (zinc) and 0.574 (lead), with the means that should be used to obtain centered values for each of the variables being 2.426 (copper), 4.383 (zinc) and 2.897 (lead).

Thus, the value for a site along the pollution gradient axis would be calculated as:

$$PCA = 0.619(\ln(x_{Cu}) - 2.426) + 0.536(\ln(x_{Zn}) - 4.383) + 0.574(\ln(x_{Pb}) - 2.897)$$

where x_{Cu}, x_{Zn}, x_{Pb} are concentrations of copper, zinc and lead, respectively, at the site.

Table S9-S10: EC50's of individual taxon, including information on original regression fit (R^2) from Thrush *et al.* (2008). The cumulative percent of taxa for each metal concentration is also given (E% = 100 x cumulative number of taxa divided by 103).

Metal		EC50	R^2	E%
Copper	*Anthopleura aureoradiata*	4.9	0.41	1.0
	Aonides trifides	5.0	0.61	1.9
	Macrocylmenella stewartensis	5.3	0.47	2.9
	Macomona liliana	5.3	0.43	3.8
	Exogoninae	6.5	0.36	4.8
	Scolelepis sp.	9.3	0.54	5.7
	Tanaidacea	10.6	0.24	6.7
	Austrovenus stutchburyi	11.2	0.49	7.6
	Prionospio aucklandica	13.7	0.36	8.6
	Nucula hartvigiana	17.5	0.52	9.5
	Euchone sp.	18.0	0.16	10.5
	Glycinde trifida	18.2	0.18	11.4
	Glycera spp.	19.9	0.38	12.4
	Nemerteans	21.2	0.14	13.3
	Cossura consimilis	24.5	0.28	14.3
	Theora lubrica	35.8	0.11	15.2

Metal		EC50	R^2	E%
Lead	*Magelona ?dakini*	8.1	0.59	1.0
	Eliminius modestus	8.2	0.18	1.9
	Waitangi brevirostris	10.2	0.15	2.9
	Colurostylis lemerum	10.4	0.64	3.8
	Polydorids	18.8	0.22	4.8
	Scolelepis sp.	22.2	0.54	5.7
	Zeacumantus lutulentus	25.6	0.27	6.7
	Nemerteans	30.7	0.14	7.6
	Aricidea sp.	36.6	0.18	8.6
	Heteramastus filiformis	36.8	0.43	9.5
Zinc	*Notoacmea helmsi*	50.7	0.43	1.0
	Paphies australis	52.9	0.36	1.9
	Diloma subrostrata	64.3	0.30	2.9
	Orbinidae	112.8	0.21	3.8
	Cominella glandiformis	114.7	0.18	4.8
	Euchone sp.	118.0	0.16	5.7
	Glycinde trifida	132.1	0.18	6.7
	Cossura consimilis	151.4	0.20	7.6
	Aricidea sp.	175.1	0.38	8.6