Supplementary material

Environmental Science: Processes & Impacts

Title: Integration of community structure data reveals observable effects below sediment guideline thresholds in a large estuary (EM-ART-02-2017-000073)

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Table S1 List of taxa that were analysed in the sediment samples collected in the Tauranga Harbour, New Zealand.

Abarenicola affinis	*Exosphaeroma gigas*	Nereidae
Acanthochitona zelandica	*Exosphaeroma obtusum*	Nereidae (juvenile)
Aglaophamus sp.	*Exosphaeroma planulum*	*Nicon aestuariensis*
Amphibola crenata	*Exosphaeroma* sp.	*Notoacmea helmsi*
Amphipoda indeterminata	*Exosphaeroma waitemata*	*Nucula hartvigiana*
Anthopleura aureoradiata	*Favonigobius lateralis*	*Nucula nitidula*
Anthuridea	*Felaniella zealandica*	Oedicerotidae
Aonides sp.	*Fellaster zelandiae*	Oligochaeta
Aonides trifida	Flabelligeridae	Ophiuroidea
Aricidea sp.	Gastropoda (micro snails)	*Orbinia papillosa*
Armandia maculata	Gastropoda unidentified juvenile	Orbiniidae
Arthritica bifurca	*Glycera americana*	Ostracoda indeterminata
Austrovenus stutchburyi	Glyceridae	*Owenia petersenae*
Betaeus aequimanus	*Halicarcinus cookii*	*Paphies australis*
Bivalvia unidentified (juvenile)	*Halicarcinus whitei*	Paraonidae
Boccardia knoxi	*Halopyrgus pupoides*	*Parasterope quadrata*
Boccardia sp.	*Haminoea zelandiae*	*Patiriella regularis*
Capitella capitata	*Helice crassa*	*Pectinaria australis*
Capitellethus zeylanicus	*Hemigrapsus crenulatus*	*Perinereis vallata*
Ceratonereis sp.	Hesionidae	Phoxocephalidae
Chaetognatha	*Heteromastus filiformis*	*Pisinna zosterophila*
Chiton glaucus	*Hiatula silequens*	*Platynereis australis*
Cirratulidae	*Hyboscolex longiseta*	Polynoidae
Cominella adspersa	*Isocladus armatus*	*Pontophilus australis*
Cominella glandiformis	*Lasaea hinemoa*	*Potamopyrgus estuarinus*
Copepoda	Liljeborgiidae	*Prionospio aucklandica*
Copytus novaezealandiae	*Limnoperna pulex*	*Ruditapes largillierti*
Corophiidae	Lumbrineridae	*Rutiderma* sp.
Cumacea	Lysianassidae	Sabellidae
Cyclomactra ovata	*Macomona liliana*	*Scleroconcha arcuata*
Cypridinodes concentrica	*Macrophthalmus hirtipes*	*Scolecolepides benhami*
Cypridinodes reticulata	*Magelona dakini*	*Scolelepis* sp.

Cytherella sp.	*Magelona* sp. 3	*Scoloplos cylindrifer*
Decapoda (larvae unidentified)	Maldanidae	*Solemya parkinsoni*
Diasterope grisea	*Melanochlamys cylindrica*	*Sphaeroma quoyanum*
Diloma subrostrata	*Melliteryx parva*	*Sphaerosyllis* sp.
Divalucina cumingi	*Micrelenchus huttoni*	Syllidae
Dorvilleidae	*Musculista senhousia*	Talitridae
Edwardsia tricolour	*Mysella* sp.	*Tawera spissa*
Elminius modestus	*Mysella* sp. (juvenile)	Terebellidae
Euchone pallida	Mysidacea	*Xymene plebeius*
Euphilomedes agilis	Nematoda	*Zeacumantus lutulentus*
Exosphaeroma chilensis	Nemertea	*Zeacumantus subcarinatus*

Variables contributing to variations:

Of the ten measured variables, the key variables identified by DistLM as important in explaining variation in benthic community composition were % mud, nutrients (TP, TN, Chlorophyll-α) and metals (Cu, Pb, Zn). Principal component analyses (PCAs) were performed to characterise a variable that would represent nutrients and another that would represent metals. DistLM was used to partition the variance explained by the factors by running it seven times to obtain the percentage explained in benthic community composition (R^2) by each of three factors (% mud, nutrients and metals), then each pairwise combination and finally all three groups. DistLM allows the percentage explained by different factors to be partitioned out by retaining different variables in the models. These results can then be analysed by variance partitioning methods (Anderson & Gribble 1998; Bocard et al.1982) to determine relative percentages explained by different components.

Variance partitioning identified metals (Cu, Pb, Zn) as the factor that explained the highest proportions of observed variation in community composition, followed by % mud*nutrients and % mud (Table S2). We then used a Canonical Analysis of Principal coordinates (CAP) analysis to place benthic assemblages along the metal gradient. Therefore, we are confident that changes in benthic community composition can be attributed to metals.

Table S2 Variance partitioning for a range of variables as factors that explained the highest proportions of observed variation in community composition.

Variable	Relative % variation explained
% mud	4.9
Nutrients (TN, TP, chl-α)	2.7
Metals (Cu, Pb, Zn)	7.5
% mud*nutrients	6.1
% mud*metals	0.7
Nutrients*metals	0.8
% mud*nutrients*metals	1.7

References:

M. J. Anderson and N. A. Gribble, Aust. J. Ecol., 1998, 23, 158-167.

D. P. Borcard, P. Legendre and P. Drapeau, Ecology, 1992, 73, 1045-1055.