What is MTM?

Manaaki Taha Moana (MTM) is a research programme to restore and enhance coastal ecosystems and their services of importance to iwi/hapu, through a better knowledge of these ecosystems and the degradation processes that affect them.

We utilise Western Science and Mātauranga Maori knowledge and participatory modelling tools and processes to assist iwi/hapu to evaluate and define preferred options for enhancing/restoring coastal ecosystems. This evaluation of options is assisted by innovative IT and decision support tools (e.g. digital libraries, simulation modelling, interactive mapping, 3D depiction, real-time monitoring).

Action plans are being produced for improving coastal ecosystems in each rohe.

The research team works closely with iwi/hapu in the case study regions to develop tools and approaches to facilitate the uptake of this knowledge and its practical implementation.

Mechanisms will also be put in place to facilitate uptake amongst other iwi throughout NZ.

Manaaki Taha Moana

Research Providers:

School of People Environment and Planning, Massey University

Taiao Raukawa Trust

Manaaki Te Awanui Trust

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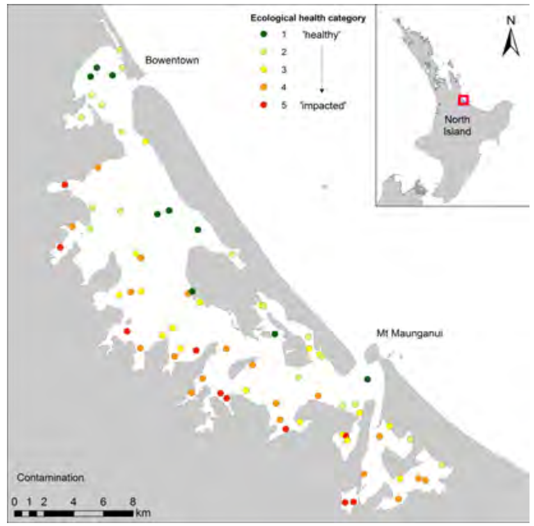
Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi

Journal article (in review)

Assessing ecological community health in coastal estuarine systems impacted by multiple stressors



Recommended citation
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Background

Increasing population pressure, urbanization of the coastal zone and nutrient and sediment run-off from agriculture and forestry has increased the number of large-scale and chronic impacts affecting coastal and estuarine systems. The need to assess cumulative impacts is a major motivation for the current desire of managers and ecologists to define ecosystem "health" and "stress". A number of univariate metrics have been proposed to monitor health, including indicator species, indicator ratios and diversity or contaminant metrics. Alternatively, multivariate methods can be used to test for changes in community structure due to stress.

Methods

In this study we developed Multivariate Models using statistical ordination techniques to identify key stressors affecting the 'health' of estuarine ecosystems. Macrofaunal and associated environmental samples were collected from Tauranga Harbour, which receives discharges from urban, industrial, agricultural and horticultural catchments.

Sampling was carried out from December 2011 to February 2012. Across the harbour, 75 sites were sampled for benthic macrofauna and associated sediment characteristics. Sites were chosen to reflect a range of habitats, including intertidal sand flats, shellfish beds, seagrass meadows and areas likely to be impacted by pesticides. At each site, ten replicates were collected, yielding 750 samples overall.

Linear modelling identified sediments, nutrients and heavy metals as key 'stressors' affecting harbor ecology . We developed three multivariate models based on the variability in community composition using canonical analysis of principal coordinates.

Results

Sediments within Tauranga Harbour were predominantly sandy (51-100% sand), with the exception of a site in the inner reaches of Te Puna Estuary, which was primarily mud (76% silt and clay). Nutrient concentrations also tended to decline with distance from the inner harbour region and associated rivers. Total nitrogen in sediments ranged from 140 to 1000 mg/kg and total phosphorous from 51 to 340 mg/kg.

The inner Te Puna Estuary site showed comparatively high nutrient levels, with nitrogen and phosphorous concentrations of 1900 and 580 mg/kg, respectively. The sites identified as most impacted, for all three models (sedimentation, nutrients and contamination), were located in the upper reaches of estuaries in some of the least exposed locations.

Sedimentation categories were based on percentage mud , with the muddiest sites (48-49% mud) ranked as '8' (impacted) and sandiest sites (<0.1-1.8% mud) as '1' (healthy). Over half (58%) of the sites were ranked in ecological health categories (EHC) less than '5', with most (23%) in EHC '2', suggesting fairly healthy communities with regard to sedimentation (see Figure 1).

Numbers of animals were lowest at the most impacted sites (EHC '7' and '8', means of 85 and 56 per core, respectively) but no clear trend was observed amongst the other EHC categories (means of 110-138 per core). In general, species richness was slightly higher at healthier sites (means of 25-30 taxa per site) than more impacted sites (means of 20-24 taxa per site).

With respect to nutrients, most of the sites (26%) were ranked in EHC '2', with very few in the most healthy ('1') and impacted ('6') categories, suggesting a relatively healthy harbour, although slightly compromised, with respect to elevated nutrients (see Figure 2). A significant community change was observed in response to this nutrient gradient.

For metal contamination, as with nutrients, the univariate biological measures in general were not as sensitive as the multivariate ordinations at detecting differences across the ecological gradient.

Conclusions

The multivariate models were found to be more sensitive to changing environmental health than simple univariate measures such as abundance or species richness. This multivariate approach can be used as a management or monitoring tool where sites are repeatedly sampled over time and tracked to determine whether the communities are moving towards a more healthy or unhealthy state. Ultimately, such models provide a tool to forecast the distribution and abundance of species associated with habitat change and should enable detection of long term degradation from multiple disturbances.

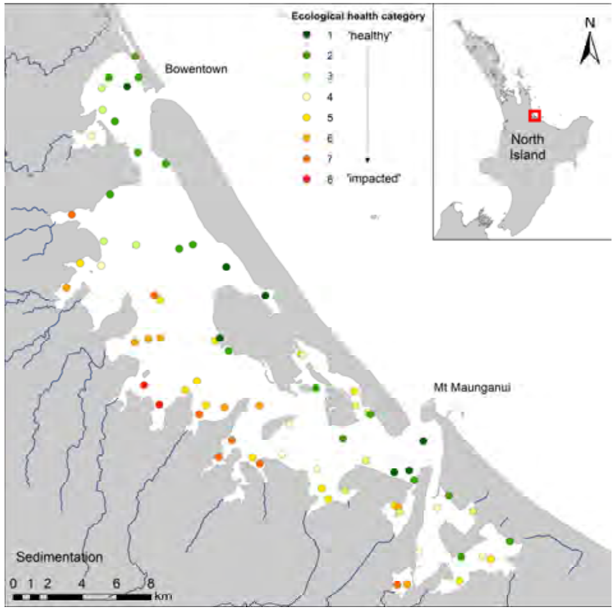

Figure 1. Categorisation of sites from healthy (1) to impacted (8) with respect to sedimentation.

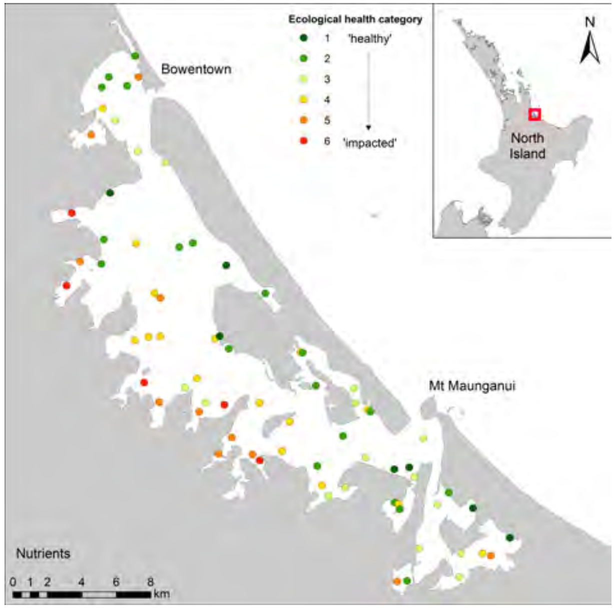

Figure 2. Categorisation of sites from healthy (1) to impacted (6) with respect to nutrient enrichment.