Is beta better? beta-diversity as an alternative indicator of restoration success

Elizabeth Graham[1], John Quinn[1]
[1]*NIWA*

Ecological restoration projects are commonly ruled a success" or failure" based on differences in univariate metrics such as species richness (α-diversity) or other biotic indices pre- and post-restoration. However, these traditional metrics often do not detect any improvements in biodiversity following restoration. Consequently, restoration assessments are increasingly focusing on community-wide changes in species identities and/or abundance, also known as β-diversity or community turnover. At the same time, advanced statistical methods have recently been developed for the analysis of β-diversity across environmental, spatial, and temporal gradients. A key advantage of this approach is the ability to distinguish between natural temporal variation and variation associated with changing physical/ environmental conditions following restoration. We used invertebrate data from a long-term (18 years) stream restoration/catchment management experiment conducted at the Whatawhata research farm near Hamilton, New Zealand to illustrate how these new techniques can be applied in a restoration context to gain insight on the mechanisms driving temporal changes in β-diversity. The experiment included three agricultural streams, each of which were restored via implementation of an integrated catchment management plan, a native forest reference site, and two pasture control sites. Comparisons of pairwise dissimilarities within and between sites indicated that community composition and turnover changed post-restoration, indicating species replacement and/or changes in abundance occurred even though there were no significant overall trends in species richness at any of the treatment sites. Community turnover in treatment sites was primarily influenced by changing environmental conditions post-restoration, whereas turnover in the reference site was largely due to temporal variation alone. The pasture control sites had no trends in dissimilarity over time and β-diversity was associated with a mixture of both environmental and temporal factors. This example demonstrates how analysis of β-diversity can be used to improve understanding and evaluation of community responses to restoration.