

Soil C, N and P dynamics on a restoration trajectory in South Island, New Zealand

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Launched in 2009, the Punakaiki Coastal Restoration Project aimed to restore the coastal sand plain forest on land that had been previously mined and farmed. More than 140,000 endemic New Zealand plants have been planted. Seven monitoring transects each comprising 3 monitoring plots (mature forest, restoration, and unplanted) were established. Soil profiles were described in 21 pits, and surface and profile soils were sampled for chemical analyses. Soil leachates were collected seasonally. We investigated the effects of ecological restoration on soil carbon, nitrogen and phosphorus dynamics. Dissolved organic carbon concentrations were significantly higher in winter. Restoration plots had significantly higher NH₄-N and NO₃-N concentrations compared to mature forest and unplanted plots, but only slightly higher dissolved organic carbon concentrations in restoration plots. Organic phosphorus started to build up in surface and top two horizon soils of the restoration plots. Through plant- and root-assisted soil weathering, changes in soil phosphorus dynamic were more apparent along older restoration gradient, as reflected in iron/aluminium- and calcium- associated phosphorus, and occluded phosphorus fractions. However, surface soil microbial biomass phosphorus fractions were higher along younger restoration gradient. Through five years of ecological restoration, the geochemistry of restoration soils had moved away from unplanted soils, but remained distant from mature forest soils, possibly due to relatively short-term restoration. This study provides increased understanding of the dynamics of soil restoration and vegetation development. Future management and onward monitoring of this site present an example of the best practice in restoration ecology.