

Auckland Research and Policy Bulletin



Reporting on research evidence and policy

Ecological status of mangrove removal sites in the Auckland region

NIWA scientists surveyed trends in sediment characteristics and benthic communities at 20 Auckland sites where mangroves were removed. All sites were checked for:

- density of seeds and seedlings
- measurements of sediment characteristics
- remaining vegetative biomass.

Macrofaunal community structure was analysed at a subset of 13 representative sites. Three positions were surveyed at each site: two in the removal area and one in neighbouring sandflat or mudflat habitat. If sites had adjacent mangrove forests remaining, sediment was also sampled inside mangroves within 100m of a clearing.

Survey results

Few sites showed recovery towards a typical sandflat over periods ranging from three months to eight years.

- At most sites, substantial vegetative biomass still remained after mangrove removal, with dense root mass often found just below or at the sediment surface.
- Removal area perimeters were generally obvious, with limited erosion of sediment, or change to sandier substrate, except at some edge positions.

- Macrofaunal community composition varied significantly between estuaries.
- Composition at sites where mangroves had been removed differed from that in unvegetated habitats less than 10m away.
- Sites where mangroves were removed by mechanical means and where mangrove cuttings were left on site showed less change toward sandier substrates and macrofaunal communities than sites with non-mechanical methods and where all cut biomass had been removed.
- Smaller sized clearings, non-mechanical removal techniques, and removal of above ground vegetation showed faster trends toward recovery.
- Seedlings were present at fewer sites than expected, though seedling removal by community groups could explain this pattern. Sites with high seedling colonisation were generally adjacent to intact mangrove forest.

The general lack of full recovery suggests that change to a sandier non-mangrove state will require at least 10 years for erosion of muddy sediment and dispersal or decomposition of remaining mangrove vegetative biomass.

In sheltered locations, change to a sandier state appears unlikely.

Survey conclusions

The survey assessed the current ecological state of areas in Auckland where mangroves had been removed.

The survey also compared community and sediment characteristics at sites to identify site characteristics and methodologies for mangrove removal that were associated with more rapid change to the desired state. A visual check of all sites showed that none have fully recovered to the desired sandier state.

Scientists also examined changes in sediment mud content, vegetative biomass, and benthic community composition as indicators of whether or not trends toward sandier substrates and associated communities were occurring, and if these trends could be associated with site characteristics or removal method.

At the sites examined with mangrove clearings from 2006 to 2013, there were consistent results across all sites, including:

- Lack of erosion of muddier sediments at muddy sites, whereas more exposed, sandier sites were more likely to show decreasing mud content.
- Lack of dispersal or decomposition of both above and below ground biomass.
- Slow trends in community change, with slightly higher rates of change for sandier communities than of muddier communities over time.

The lack of erosion of sediments is consistent with most prior surveys of mangrove removals, which showed very slow erosion of sediments and change from muddier to sandier sediments (for example, Lundquist et al. 2012, Stokes 2009).

The high densities of remaining biomass, both above and below ground were also consistent with studies of mangrove removals in other regions. Perimeters of mangrove removal zones where mulching occurred are clearly evident at numerous sites in Tauranga Harbour where removal occurred in 2010 and 2011, with some erosion evident on the edge of removal zones, but rarely penetrating further than 10m into a removal area.

Decomposition rates have been estimated at different latitudes in New Zealand (Whangarei Harbour, Pahurehure Inlet, Whangamata Harbour), suggesting that wood and root material will take decades to break down.

Changes in benthic community were also slow, with trends suggesting slightly faster changes in sediment characteristics and macrofaunal community toward sandier substrates for sandier exposed sites than for muddier sites. Initial differences between mangrove removal sites and their neighbouring unvegetated habitats in muddy systems are often far less than differences observed at sandier, exposed sites.

Univariate measures such as species richness and total number of individuals showed similarities between removal and unvegetated positions at most sites. However, species abundances and multivariate comparisons of benthic community composition suggest that colonising species are primarily disturbance-tolerant species, and that the mangrove removal zones are not trending toward unvegetated community composition at most sites. While some colonisation is occurring, the resulting community at most removal sites (both edge and centre removal positions) is formed of opportunistic species such as oligochaetes and *Capitella* sp.

Mangrove removal methods

Slow rates of recovery of similar parameters have been observed with many methods of mangrove removal, with the slowest rates of recovery associated with mechanical mulching. However, slow rates (more than 5 years) are also associated with other removal methods, including low impact manual removals. Sites with faster rates of recovery generally have sandier sediments, and have had small clearings by non-mechanical methods.

Of note, the Mangawhai site has since been fully colonised by juvenile mangroves. Novel mangrove mechanical removal methods (mechanical tracking in less than 20 per cent of the total area, and vegetative biomass removed from the site at most locations) were trialled in Whangamata Harbour at both sheltered and exposed locations. Until now, these trials have shown only minor adverse impacts, restricted to vehicle tracking disturbance and burn piles remaining in situ (Bulmer and Lundquist 2013). However, it has only been approximately 12 months since these removals, thus no long-term conclusions can yet be drawn from the trials about recovery toward sandier substrates. Scientists observed few impacts of mangrove removals outside the area of removal across the 20 sites studied in Auckland. No obvious impacts were apparent from mangrove removals in neighbouring unvegetated or seagrass habitats, with changes in community structure from disturbed removal area to unvegetated occurring abruptly within a few metres of the edge of a clearing area. However, at one location (Auckland Airport), significant negative impacts inshore of the site were apparent, where large amounts of mulch biomass had been transported; covering what was likely adjacent salt marsh habitats with depths of 30-40cm of mulch material.

Summary and recommendations

- The surveys revealed few sites recovering towards a typical sandflat after mangroves were removed, with times of removal ranging from three months to eight years in Auckland.
- For future mangrove removal consents – when evaluating if the mangrove forest will return to sandier substrates – each removal site should be assessed on exposure and sediment characteristics, as these physical aspects were correlated with recovery to the desired sandflat state.
- Minimising disturbance by the removal method and off site deposition of vegetation was also correlated with recovery to the desired sandflat state in this study.
- Continued monitoring of unrecovered sites is recommended, until sites return to a sandflat, or it becomes clear this will not occur within a reasonable time frame.

Lundquist, C J., Hailes, S F., Carter, K R and Burgess, T C (2014). *Ecological status of mangrove removal sites in the Auckland region*. Prepared by the National Institute of Water and Atmospheric Research for Auckland Council. Auckland Council technical report, TR2014/033. Available on the Auckland Council website, [technical publications and research section](#).

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ISSN 2423-0456 (Print) | ISSN 2423-0464 (Online)