



New Zealand's mangroves



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Auckland
Regional Council
TE RAUHTANGA TAIAO

Introduction

Mangroves are a conspicuous feature of northern New Zealand harbours and estuaries. In the past they were largely neglected and reclaimed to create farmland or landfills, now however they attract interest and debate.

Mangroves in different areas may require different management approaches.



Mangroves in the Firth of Thames, with newly-establishing seedlings in the foreground and aerial roots (pneumatophores) clustered around the trunk.

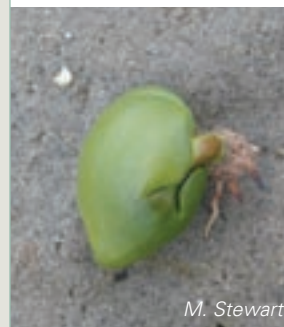
In order to manage them we need to understand how they grow, what they support and the role they play in our environment. Many of our general assumptions about New Zealand mangroves are based on information from other parts of the world, including the tropics.

This booklet summarises some of the key findings of a detailed technical review of the information we have on mangroves in New Zealand.

One main conclusion reached is that there is considerable variation in their productivity, their role in local foodwebs, the diversity of animals and plants that they support, and their response to changing conditions in the estuaries and harbours in which they live. This variation is not surprising because harbours and estuaries characteristically contain strong natural environmental gradients (such as wave exposure, salinity, and water clarity) as well as gradients in the level of human disturbance (such as pollution, sedimentation and other sources of environmental degradation). Mangroves, like most estuarine animals and plants, reflect these gradients in their distribution and growth.

Another main conclusion is that many gaps remain in our knowledge of mangroves and their ecological role in New Zealand.

Appropriate approaches to mangrove management need to be considered on a case-by-case basis because of the remaining gaps in our knowledge, and also because mangrove characteristics and their ecological roles differ from location to location. Management options also need to be reviewed as research fills the remaining knowledge gaps.



M. Stewart



D.J. Morrissey



D.J. Morrissey



M. Stewart

What are mangroves, and are they native to New Zealand?

Worldwide, mangroves are a diverse group of woody trees and shrubs that inhabit the shallow intertidal margins of sheltered coastal and estuarine environments. Growing in the zone between mean sea level and high tide, they have a variety of special adaptations that allow them to flourish in an environment too harsh for most other plant species.

Mangroves are characteristically associated with warm tropical and subtropical shorelines, but there are a few species that thrive in colder climates. New Zealand's only mangrove, *Avicennia marina* subsp. *australasica*, is one of these. Locally known as Manawa, it has the distinction of being the most southerly growing mangrove species in the world. Even so, it only grows in the North Island north of about latitude 38°S; from Kawhia Harbour on the west coast, and Ohiwa Harbour on the east coast.

Avicennia marina occurs in both northern and southern hemispheres of the globe, but the subspecies within which Manawa is included is confined to New Zealand, south-eastern Australia and Lord Howe Island. Manawa is a New Zealand native and it, or a very similar species has been part of the plant life here for approximately 19 million years.

Mangroves have been in New Zealand for around 19 million years.



Mangroves colonising a sandflat in Whangapoua Harbour, Coromandel.

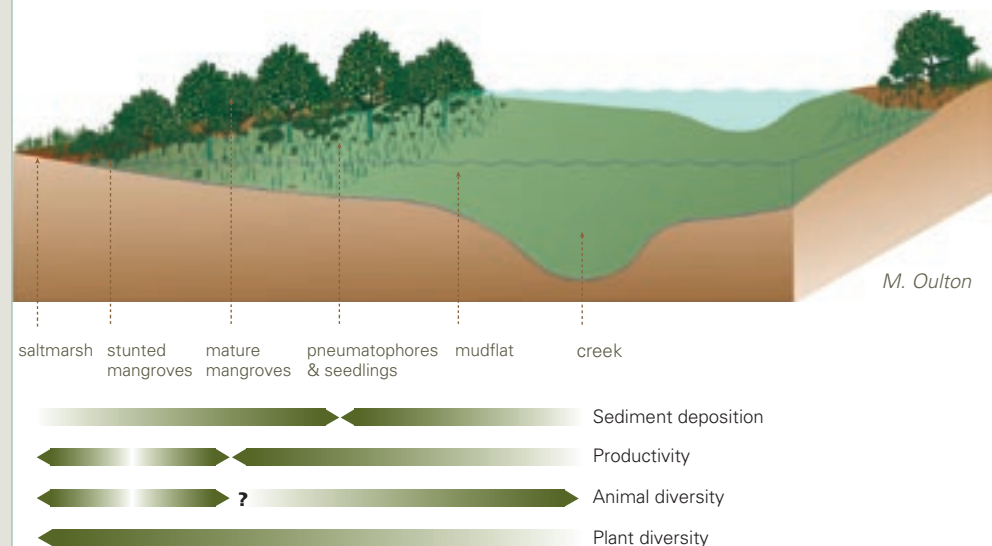
What role do mangroves play in New Zealand estuaries and harbours?

Mangrove habitat

The presence of mangrove trees creates different physical and biological conditions to those of the surrounding sand or mud flats or those provided by other estuarine plants (eg saltmarsh and seagrass). This unique mangrove habitat provides a range of environmental services and functions that are explained more in the following sections.

Erosion control and shoreline protection

The mangrove plant and its root system slow the flow of water, allowing sediment to settle and binding the surrounding mud. Mangroves also break up waves and help prevent them reaching the shore. As a result mangroves play an important role in erosion control and shoreline protection.



Cross section through a mangrove-lined creek, showing the changing importance of physical and biological processes across the shore.



Productivity

Productivity is an important measure of the amount of energy and organic matter a plant might contribute to the environment. Productivity of mangroves can be measured by the amount of leaf, twig, reproductive parts and other litter that they produce each year.

The productivity of New Zealand mangroves is similar to those growing in subtropical and temperate regions, but less than tropical mangroves. However, a more relevant measure would be to compare the productivity of New Zealand mangroves with the productivity of other New Zealand estuarine habitats such as seagrass, saltmarsh and intertidal flats. Unfortunately, due to variability in methods and a general lack of information on productivity of other New Zealand intertidal habitats, this comparison cannot easily be made. Therefore comparisons of productivity remain an important area of research for the management of coastal systems.

Food source

Mangrove material enters food webs either by direct grazing of fresh material or by the decomposition of plant litter ('detritus'). There is an assumption that mangroves provide this important source of organic material to nearby habitats within harbours and estuaries, such as intertidal sandflats, and the coast. A recent study of the Matapouri estuary in Northland confirms this for New Zealand and sheds light on how mangrove-derived material is distributed to the wider environment.

The study revealed that fresh mangrove material was present in sediment next to the mangroves, but not in a sandflat further down the estuary. This suggests that distribution of fresh mangrove organic matter is localised. Decomposing mangrove litter appeared to be more widely distributed and available to a range of animals in the surrounding estuary via the food web.

In tropical mangroves, a variety of crabs play an important role in consuming fresh mangrove material and passing the nutrients from it into the food web. New Zealand mangroves contain relatively few crab species and the abundance of the mud crab in mangroves can be patchy. In the Matapouri study it appears they consume little fresh mangrove material, in contrast to the crabs of tropical mangroves.



Support for other plants

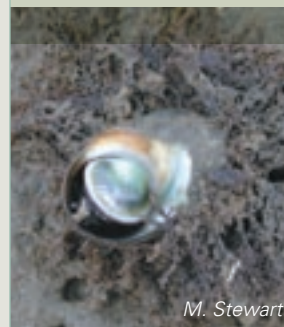
Tropical mangroves support a rich and abundant range of plants including seaweeds, seagrasses and saltmarsh plants. Although the plant life is not as diverse in New Zealand mangrove stands, in some places there are high abundances of seaweeds such as Neptune's necklace, growing on and among their trunks and pneumatophores (aerial roots).

Where mangroves occur at low densities on sandier shores, seagrass beds may occur in the gaps among the trees. Higher on the shore, saltmarsh plants may intermingle with the upper edge of the mangrove forest in some locations.

Support for animals

The range of animals living on mangrove plants and on or in the sediments of mangrove forests varies depending on the nature of the sediment and the location of the forest. The harsh conditions experienced in estuaries limits the range of animals living amongst mangroves, and in surrounding habitats, when compared to mangroves in more open environments. Limiting conditions include tidal exposure, often muddy and oxygen-starved sediments, and large changes in salinity as tidal sea water mixes with fresh water runoff from the land. In some cases, high rates of sediment deposition may be at least part of the reason for the low diversity and number of animals present. Marine animals living with or on mangroves include mud crabs, various types of worms, various mudsnails and whelks, cockles, barnacles, black mussels and Pacific oysters. Mangroves are also likely to support a wide range of terrestrial animals, such as insects and spiders, but our knowledge of these is very limited.

New Zealand has an endemic moth whose leaf-roller larvae are only found on our mangroves.



M. Stewart



M. Morrison



ARC



K. Vopel

Use of mangroves by fish

A recent survey of small fish in northern New Zealand mangrove forests has revealed how mangroves provide food and probably shelter young fish from larger predators; and how mangrove forests may have linkages to more distant habitats and ecosystems (including the open coast) through the movement of fish as they grow.

While the number of small fish in mangroves was relatively high, the number of different types of species was generally low, with the most prevalent species being yellow-eyed mullet, grey mullet, pilchards and anchovies.

Mangroves could be classified as an important nursery habitat for short-finned eels, grey mullet, and parore. Grey mullet and the short-finned eel support important customary, recreational and commercial fisheries. Parore, while not commercially valued, is an important large herbivore on coastal rocky reefs.

Juvenile and sub-adult short-finned eels were consistently present in mangrove forest edges sampled on both east and west coasts. The large total area of mangroves present suggests that the total population of short-finned eels is also large. In west-coast mangrove forests, juvenile (30-50 mm) grey mullet were relatively abundant. The only other estuarine habitat in which similar-sized grey mullet have been sampled (albeit at much lower abundances), are seagrass meadows exposed during low tides. This suggests that west-coast mangroves are important as grey mullet nursery grounds. In east coast mangrove forests, juvenile parore (20-40 mm) were also more abundant than in most other estuarine habitats (with the exception of some sub-tidal seagrass meadows, and Neptune's Necklace beds), and so east coast mangroves are probably also a relatively important nursery habitat for this species.

Other small fish species present in the mangrove forest included yellow-eyed mullet, pilchards, anchovies, and estuarine triplefins. While high numbers of these species may be present in mangrove forests, they are very common in other estuarine areas as well. This broadly agrees with findings from work on the same mangrove species in temperate Australia. However, it contrasts sharply with the role of tropical mangrove forests that can host a wide range of fish species whose reliance on the mangrove habitat can be great, and where many fisheries are considered to be highly dependent on mangrove nursery habitats.

The use of mangrove forests by larger fish is unknown, but is probably restricted to adult parore, grey mullet, yellow-eyed mullet, and to a much lesser extent, kahawai.

Recent work on the diets of small fish in New Zealand has shown that the potential benthic (seabed dwelling) food items available in mangrove forests are relatively limited, mostly consisting of small polychaete worms that appear of little value to small fish. Small grey mullet feed largely on organic debris and fine plant material, while others such as yellow-eyed mullet and anchovies also consume these items, but have a much stronger reliance on zooplankton being swept through the forests (e.g. copepods, crab and barnacle larvae).

Juvenile parore consume both passing zooplankton and small organisms attached to mangroves such as barnacles, while triplefins hunt for small crustaceans including crabs. Eels also consume such prey, but as they increase in size expand their diet to larger organisms including shrimps and small fish. Other potential predators of fish in mangrove forests are poorly known, although large adult kahawai caught along the fringes of mangrove forests had juvenile flounders in their stomachs.

Use of mangroves by birds

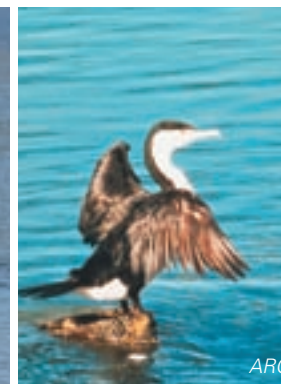
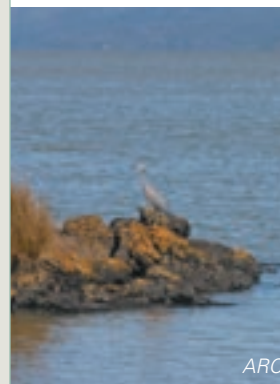
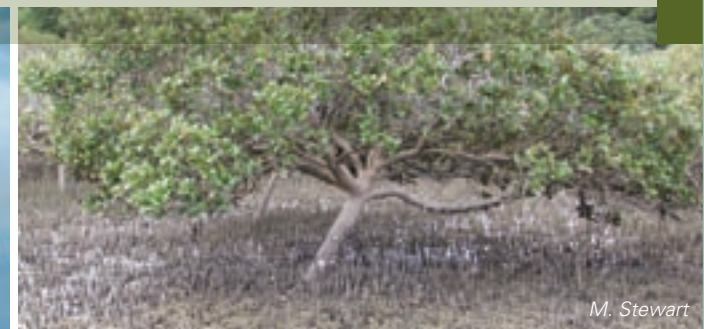
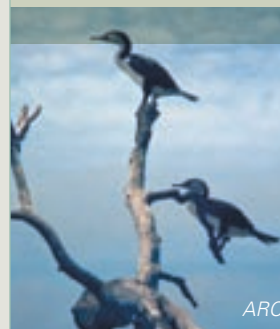
While many species make extensive use of mangroves for roosting, feeding and breeding, no bird species is totally dependant on mangroves in New Zealand.

The range of bird species that occur regularly in New Zealand mangroves includes several native species, such as banded rail, white-faced heron, harriers, kingfishers, welcome swallow and pūkeko. Other species observed include grey warblers, silvereyes, fantails, shinning cuckoos, bitterns, royal spoonbill and roosting colonies of pied and little black shags.

Mangroves provide habitat important for a range of animals and other plants.



Nets deployed in small fish surveys of mangrove habitat.



What controls the distribution of mangroves in New Zealand?

Mangroves currently occupy a natural range in New Zealand, north of around latitude 38°S. However, if transplanted further south into areas where the microclimate and habitat are suitable they can survive.

Mangroves spread by means of floating seedlings (propagules) so their presence in a region is entirely dependent on the actions of tidal and ocean currents. Local distributions, for example those within an estuary, are then decided by the specific habitat requirements of the plants and their responses to the surrounding environment.

Global distribution limits of mangroves are traditionally attributable to the lethal effects of frost but recent research on New Zealand mangroves has revealed that their range is also determined by the adverse effects of cool temperatures on their ability to function normally.

Special adaptations allow mangrove propagules to rapidly colonise new areas.



Mangrove propagules settling and taking root on the mud surface.

Are mangrove areas expanding?

Expansion of the area of mangroves has been occurring in some areas at least since aerial photographic records began (the late 1930s) but seems to have been most active since the late 1970s. However, in the first part of the 20th century there was probably a significant net reduction in the area of mangroves as coastal areas were drained and reclaimed to create farmland or filled in for urban and industrial development. Grazing of livestock in mangroves was also common practice. Infilling to create farm land was controlled by legislation in 1977, and destruction of mangroves was more restricted after that.

Why has this recent change occurred?

The relatively recent seaward expansion of mangroves in many harbours and estuaries is a response to build up of sediment and consequent raising of intertidal flats above the low-shore limit of mangrove distribution. Much of this sediment may have been carried into the estuary from the catchment, following native forest clearance, and subsequent rural and urban development. Once mangroves have colonised an area, they further increase the rate of sediment deposition by reducing water movement and causing catchment sediment and organic matter produced by the mangroves themselves to settle out.

Increased inputs of nutrients (particularly nitrogen) from catchment runoff increase the growth rate of mangroves and may also play a part in their rapid spread, although there is no evidence that nutrients are the main cause. Changes in the hydrodynamics (water movement) of an estuary, such as reduced tidal flushing due to causeway construction, can also affect the areas in which mangroves may grow. A good example of mangroves spreading upstream of a causeway is Pahurehure Inlet (Manukau Harbour), crossed by Auckland's southern motorway.

Although mangrove expansion is a wide-spread phenomenon, it is also site-specific and variable and depends on environmental factors such as temperature, salinity, wave exposure, nutrient input and sediment loading.



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M. Butt

Where mangrove expansion has been noted

Mangrove expansion seawards is evident in many small harbours or embayments such as Whangape Harbour, Puhoi, Whitianga, and Manaia estuaries, and in parts of the Kaipara, Manukau, Waitemata, and Tauranga Harbours where mangrove stands have increased rapidly (over a decade or so) to occupy large areas.

On more open coasts, such as the southern Firth of Thames, mangroves form a broad front that advances seaward as the mudflats on which they live extend (during the period 1944-1993 the seaward edge of the mangroves in the southern Firth advanced 200-250 m).

However, in many other small estuaries mangroves distribution has remained largely unchanged because expansion seaward and landward is restricted by unsuitable conditions (eg low-tide channels). In these cases the canopy may become dense over time as more trees take root and existing trees mature, but the area occupied stays roughly the same.

In some estuaries (eg Whangamata and Wharekawa) increase in mangrove spread has been limited by human influences, such as seedling removal.

The effects of mangrove expansion on the surrounding environment

Once established, mangrove stands gradually influence estuarine sediment processes, raising the height of the surrounding mudflat and altering the sediment characteristics. This in turn can lead to increases in mangrove growth and abundance. An extreme example is provided by recent studies of mangrove colonisation in the Firth of the Thames where sediment build-up has increased from 20 mm per year to as much as 100 mm per year following mangrove colonisation, leading to rapid elevation of the vegetated mudflats. Sedimentation in most estuaries is unlikely to be increased to such a degree by the presence of mangroves

Mangroves help reduce the release of urban stormwater contaminants that bind to sediments, like zinc and copper, by trapping and retaining the contaminated mud.

It is still not fully understood if mangroves ultimately cause New Zealand estuaries to become land. Whether or not they are eventually replaced by other habitats (eg other wetland plants, or land plants) as they change local conditions, or if they reach a balance where mangrove habitat continues to exist into the future are current knowledge gaps.

In some parts of New Zealand where mangroves are expanding they may colonise other habitats, such as intertidal flats or seagrass beds, however, risk of saltmarsh loss appears to be low.

There is little evidence of saltmarsh loss due to mangrove invasion as expansion of New Zealand mangroves is generally seawards and saltmarsh generally occurs higher on the shore than mangroves. Very limited invasion of the lower edge of saltmarsh has been observed in Tauranga. Healthy saltmarsh (rush) communities appear resistant to invasion. However, areas of sparse or disturbed saltmarsh (such as vehicle tracks), or where channels through the marsh allow mangrove propagules to be transported, seem to be most vulnerable.

Colonisation of intertidal flats by mangroves may deprive wading birds of feeding and roosting areas. Loss of roosting areas has been documented in parts of the inner Firth of Thames colonised by dense stands of mangroves. Use of these roosting sites by shorebirds has steadily decreased with no substantial use of the area since 1990. This change in distribution has been particularly noticeable for wrybills, golden plovers, red knots and whimbrels.

Conversely mangrove expansion is likely to benefit those birds commonly using mangroves to feed, roost and breed.

There is a long-standing debate about the significance of gain or loss of feeding and roosting habitat to wading birds at the population level. Effects probably depend on the relative quality of the affected area and whether other suitable habitats within the range of the local populations are at carrying capacity, among other factors. There is currently not sufficient information to assess population-level effects of mangrove expansion on wading birds.



Spreading mangrove in the Firth of Thames, where their seaward margin has advanced rapidly in recent decades.



The effects of mangrove expansion on people

Recent, rapid expansion of mangroves has sometimes affected human access to and use of the coast.

For example, some small but popular recreational estuarine beach areas have become inaccessible due to sedimentation and mangrove growth. Boating access in various estuaries has become restricted due to shoaling and mangrove colonisation. Vigorous mangrove growth has blocked views of previously open-water vistas and access to these waters from the shore. Sedimentation and mangrove growth has reduced efficiency of stormwater drains and drainage channels, sometimes increasing the flooding risk for developed and rural catchments.

How will climate change affect mangrove expansion?

Several aspects of climate change may affect the growth and distribution of mangroves. Increased concentrations of carbon dioxide in the atmosphere and increased average temperatures may lead to increased rates of photosynthesis and growth of many plants, including mangroves.

Rising sea level may reduce their distribution on the shoreline as lower parts of the shore are flooded by the tide more frequently or permanently submerged. This effect may be increased by erosion of the lower shore at more exposed sites, due to increased frequencies of storms associated with climate change. In areas where rates of sediment accumulation are high, however, the resulting rise in the level of the shore may keep pace with, or even exceed, the rate of sea-level rise and the net effect may just be a reduction in the rate of seaward mangrove spread. Where sediment accumulation does not keep pace, rising sea level may either reduce the width of the mangrove zone on the shore or cause them to migrate upshore, as higher levels on the shore become flooded more frequently. This migration may occur at the expense of saltmarshes behind the mangroves, unless they too are able to migrate upshore. Migration of both mangroves and saltmarshes will be restricted where coastal defences (eg cliffs, seawalls) are present – a process referred to as “coastal squeeze”.

Expansion of the geographical range of mangroves may occur as increasing average temperatures allow it to survive at higher latitudes. Whether this occurs will depend on whether mangrove propagules can actually reach suitable habitats further south, and may also be limited by periodic extremes of temperature.

Summary points

- *Avicennia marina* subsp. *australasica* is native to New Zealand and this, or a very similar species, has been here for around 19 million years.
- Mangroves play an important role in erosion control and shoreline protection by slowing the flow of water and blocking waves.
- While productivity of New Zealand mangroves is low in comparison to tropical equivalents, it is similar to the productivity of mangroves growing in sub-tropical and temperate regions.
- Mangrove organic matter does provide a nutrient source for other organisms in the surrounding environment. However the distribution of fresh mangrove material appears to be localised to near the mangrove stand while decomposing mangrove litter is more widely distributed.

- High abundances of seaweeds such as Neptune’s necklace can be found growing on and among mangrove stands in some locations.
- Mangroves support a range of marine animals, such as crabs, worms, mud snails and whelks, barnacles and shellfish. The diversity of species present depends on the location of the mangrove forest and the nature of the sediment. Mangroves are also likely to support a wide range of terrestrial animals, such as insects and spiders, but our knowledge of these is limited.
- High abundances of small fish have been found in mangroves. While most of these fish are just as common in other habitat areas, mangroves are likely to be an important nursery habitat for grey mullet, short-finned eel and parore.
- While many native bird species make extensive use of mangroves for roosting, feeding and breeding, no bird species are totally dependant on mangroves in New Zealand.
- In the early part of the 20th century there was probably a net loss of mangrove areas due to draining and reclamation.
- The relatively recent (since the 1970’s) seaward expansion of mangroves in many harbours and estuaries is a response to a build up of sediment carried into the estuary from the catchment following native forest clearance and subsequent development. Increased inputs of nutrients (particularly nitrogen) from catchment runoff increases the growth rate of mangroves and may also play a part in their rapid spread. Changes in the hydrodynamics of an estuary can also affect the areas in which mangroves may grow.
- Although mangrove expansion is a wide-spread phenomenon, it is also site-specific and variable and depends on environmental factors such as temperature, salinity, wave exposure, nutrient input and sediment loading.
- Once established, mangrove stands gradually influence estuarine sediment processes, raising the height of the surrounding mudflat and altering the sediment characteristics, which can promote mangrove growth and abundance.
- Whether mangrove expansion takes over other habitats, like seagrass, saltmarsh and intertidal habitat, and how the loss of such habitats affects birds at the population level still requires research to provide definitive answers.
- Recent, rapid expansion of mangroves has sometimes affected human access to and use of the coast.
- Several aspects of climate change may affect the growth and distribution of mangroves, some resulting in an increase in growth and distribution and other changes potentially reducing their distribution.



Information in this booklet is summarised from a detailed technical review of New Zealand mangroves.

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