

State of our Gulf 2014

Hauraki Gulf – Tīkapa Moana/ Te Moananui a Toi
State of the Environment Report 2014



Hauraki Gulf
Marine Park
Ko te Pataka kai
o Tīkapa Moana
Te Moananui a Toi



Hauraki Gulf Forum
Tīkapa Moana
Te Moananui a Toi

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The Hauraki Gulf Forum is a statutory body charged with the promotion and facilitation of integrated management and the protection and enhancement of the Hauraki Gulf. The Forum has representation on behalf of the Ministers for Conservation, Primary Industries and Māori Affairs, elected representatives from Auckland Council (including the Great Barrier and Waiheke local boards), Waikato Regional Council, and the Waikato, Hauraki, Thames Coromandel and Matamata Piako district councils, plus six representatives of the tangata whenua of the Hauraki Gulf and its islands.

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





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













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






























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2. Chairman's Foreword

This state of the environment report is the fourth prepared by the Hauraki Gulf Forum.

Our previous report in 2011 made it clear there was a significant gap between the state of the Gulf desired by our communities and its current state.

We described the type of management response likely to turn this around and we've used this to measure our progress.

This analysis shows that integrated and effective management of the Gulf environment is a tough ask.

The manner in which we attempt to resolve conflicting environment, economic and social objectives is at odds with the Hauraki Gulf Marine Park Act's requirement to sustain life supporting capacity.

A scan of the indicator sets in this report suggests the gap between current and desired states is widening.

But there are some hopeful signs too.

In the past three years the ability of tangata whenua to act as kaitiaki of Tīkapa Moana/Te Moananui a Toi has been strengthened. Farming, fishing and other marine sectors are increasingly recognising the responsibilities and opportunities that come from operating in and around the Gulf.

Central and local government, in partnership with mana whenua, are working together in the Sea Change – Tai Timu Tai Pari project, to prepare a marine spatial plan for the Gulf by the end of next year.

Tackling the issues highlighted in our assessments will be challenging but long term aspirations for having 'the world's most liveable city', vibrant rural economies and an 'enhanced mauri' within our ecosystems make it an essential task.

This 2014 assessment provides a timely reminder of what is happening, what is at stake and the work that remains to achieve success.



Mayor John Tregidga, MNZM, JP

Chair, Hauraki Gulf Forum

Photo: Jason's Nudibranch (*Jason mirabilis*) in the Mokohinau (Pokohinau) Island group, Hauraki Gulf.



Photo: A Paddle boarder on a still winters morning in the Hauraki Gulf.

3.

Executive Summary

PROTECTING WHAT WE TREASURE

*Toitū he whenua, whatungarongaro he tangata
– Land is permanent, people disappear.*

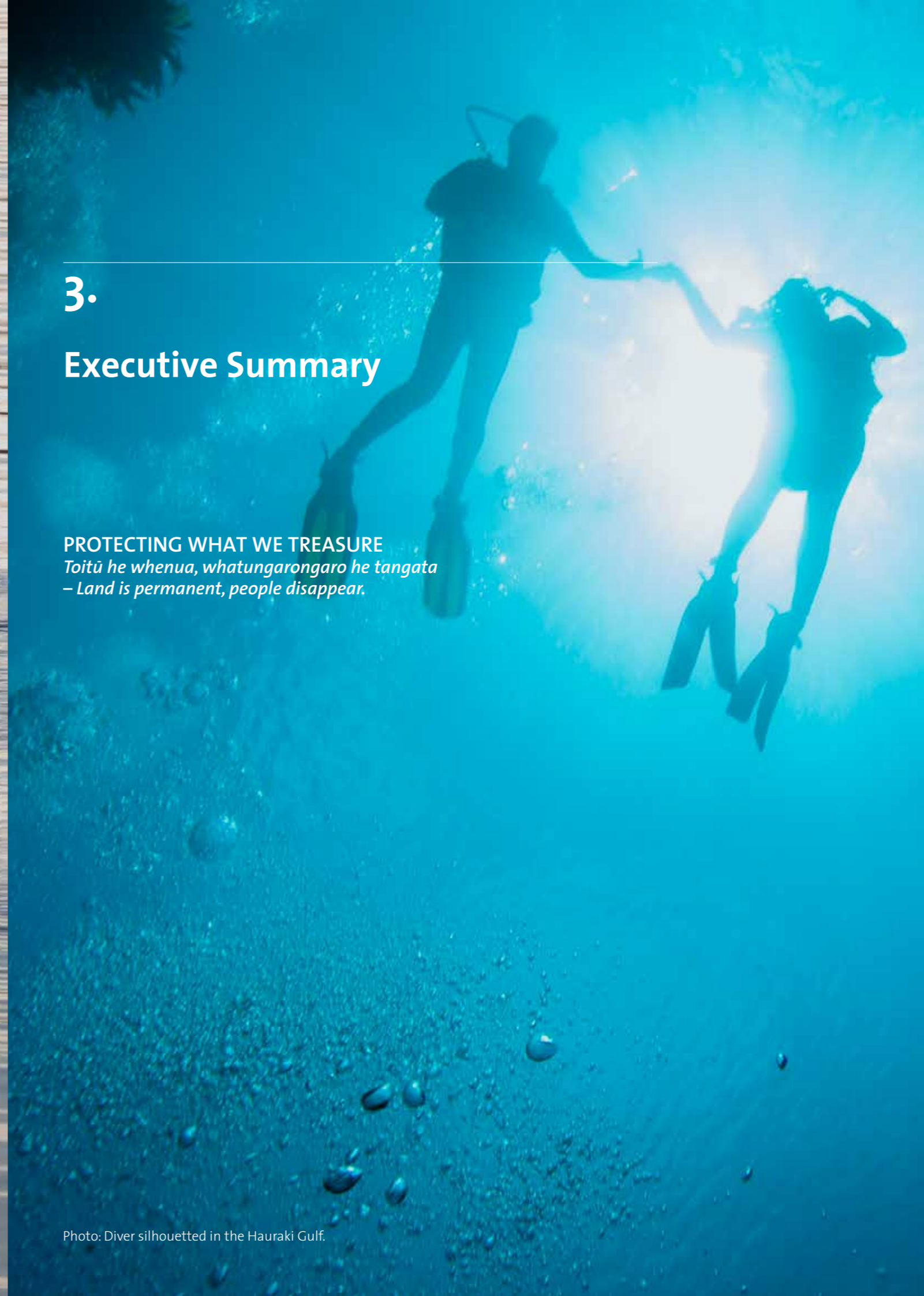


Photo: Diver silhouetted in the Hauraki Gulf.

This report is prepared in accordance with the requirements of the Hauraki Gulf Marine Park Act (2000). It follows on from the 2011 State of our Gulf Report, which highlighted the incredible transformation the Hauraki Gulf had undergone within the last two human lifespans. Over that period a number of native terrestrial species were driven to extinction, native forests and vast wetlands were cleared and replaced with pastoral land, sediment eroded from the land reduced water quality and muddied the Gulf's estuaries, ecologically important marine habitats were destroyed, populations of fished species were depleted, and urban development led to the loss, modification and contamination of the coast. Most of the indicators examined in 2011 suggested that the Gulf was continuing to experience ongoing environmental degradation, and/or that resources were continuing to be lost or suppressed at environmentally low levels.

In response, the Hauraki Gulf Forum developed a strategic framework for action and urged agencies to work collectively on making urgent progress in the following areas:

- R** A *regenerating* network of marine protected areas and island sanctuaries
- E** *Enhancement* of fisheries with improved environmental outcomes
- M** *Mana whenua* relationships reflected in resource management practice
- A** *Active* land management to minimise inputs of sediments, nutrients and contaminants
- K** *Knowledge* utilisation within an ecosystem-based management framework

This update re-examines the state of the Gulf and considers progress toward integrated management and the strategic outcomes sought by the Forum.

SITUATION UPDATE

Pressures on the Gulf remain high and are increasing. Auckland's population is growing faster than any other region in the country. This is driving the need for land development and adding pressure to its aging pipe networks, which were never designed for today's needs. Demand for holiday homes appears to be driving coastal development on the Coromandel Peninsula, where the number of houses in popular holiday spots is increasing faster than the number of usual residents. Boat ownership is already high and boat numbers are expected to increase, leading to extra demand for boat ramps, moorings and marina facilities. Thousands of tonnes of fish and shellfish are extracted from the Gulf every year by both recreational and commercial fishers. Much of the commercial catch is taken using methods that disturb the seabed. Around 12,450 bottom trawls occurred in the Hauraki Gulf between 2011 and 2013, and 27,600 commercial scallop dredge tows between 2010 and 2012. The Hauraki Plains are among the most intensively farmed areas in the country and already significant nitrogen loads from Hauraki rivers are predicted to increase out to 2020. Recent aquaculture reforms allow for an additional 1100 tonnes of nitrogen per year to be discharged into the Firth, which is close to a third of the 3716 tonnes per annum already coming from the Hauraki Plains. Applications for a further 4827 ha of spat catching space are also due to come off hold at the end of 2014, and if granted, would more than double the area currently occupied by marine farms.

Management frameworks and actions have been changing rapidly since 2011, but progress on management integration, and consistency with the Forum's strategic framework has been mixed. The past three years has seen changes to the legislation governing resource management, aquaculture, biosecurity, and ballast water discharges. Further changes to the Resource Management Act have also been signalled. The National Policy Statement for Freshwater was implemented (and has already been revised), while National Plans of Action for sharks and seabirds have been updated. Draft national inshore finfish and shellfish plans have been released, and total allowable catches for snapper, crayfish and scallops have been altered. A Snapper 1 (SNA1) Strategy

Group has also been established to develop a long term plan for the management of the SNA1 stock. The Auckland Plan was produced and the Proposed Auckland Unitary Plan was notified. Waikato Regional Council adopted by the Waikato Regional Policy Statement (which remains under appeal), and the proposed Thames Coromandel District Plan was notified. Tangata whenua outcomes were advanced through the progression and settlement of claims, improved recognition of Māori values in council plans and policies, and through greater involvement in decision making. The Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari was also initiated.

ENVIRONMENTAL UPDATE

Some environmental improvements have been detected since 2011, but many values are continuing to be degraded or suppressed.

- Fishing occurs in most parts of the Gulf and has one of the greatest influences on its marine ecosystem. The status of most of the top 15 finfish stocks relative to fisheries targets remains unknown. Available data suggests that snapper and crayfish populations have been reduced by around 70% to 80% with the greatest loss of old, large individuals. The latest stock assessment indicates that snapper biomass has increased since the late 1980s, but it remains well below its interim target and further rebuilding is required. Crayfish in the Hauraki Gulf and Bay of Plenty are considered to be 36% above the biomass required to produce the maximum sustainable yield (Bmsy), but 20% below its current management target. Snapper and crayfish predation are known to mediate the structure and productivity of reef communities, yet population levels required to restore their ecosystem functions have never been considered in management decisions. Similarly, trawling and scallop dredging occurs in areas that contain sensitive marine habitats, but impacts on seabed communities have not been addressed. Trends in cockle abundance vary among monitoring sites, but small cockles are being recruited into most sites, and are expected to grow through to harvestable size.
- Toxic chemicals, such as heavy metals, affect estuaries in Auckland with a long history of urban development, and the south-eastern Firth of Thames. Low level sediment quality guidelines are frequently exceeded for copper, lead and/or zinc in these areas. Mercury concentrations also exceed guideline values around Thames, and at sites in the upper Tamaki Inlet, Hobson Bay, and Henderson Creek. Localised contaminant hotspots are also associated with ports, marinas, landfills and industrial activity. Lead and copper concentrations are reducing in some of the worst affected estuaries in Auckland. However, copper and zinc concentrations are still increasing at some sites, with zinc concentrations increasing most rapidly in the upper Tamaki Inlet. Insufficient data is available from the Waikato Region to assess temporal trends.
- Greatest nutrient inputs to the Hauraki Gulf come from land uses associated with dairy farming on the Hauraki Plains. Waihou River is estimated to provide around 58% of the total nitrogen load to the Southern Firth of Thames, and concentrations in the river have been increasing over the past 20 years. The Waikato Regional Council does not monitor coastal nutrients, but a long-term investigation by NIWA suggests that nutrient inputs to the Firth of Thames are leading to sagging oxygen levels and coastal acidification. Coastal nutrient concentrations have generally been declining in the Auckland Region, but occasionally, environmentally significant phytoplankton blooms do occur in the upper reaches of some estuaries.
- Beach monitoring indicates that action guideline values for contact recreation are occasionally exceeded on many Auckland beaches, and that the frequency of guideline exceedance is relatively stable. Beach monitoring no longer occurs in the Waikato Region, so the recent state and trends in beach water quality cannot be determined for that region. Wastewater is a key source of microbiological contaminants. Wastewater management has vastly improved since the 1950s, but in some areas of Auckland, overflows of dilute untreated wastewater still occur on a relatively frequent basis. The construction of the Central Interceptor sewer will reduce overflows around Central Auckland, but occasional overflows will still continue in many urban areas. In the Waikato Region the discharge of untreated sewage to the coast is prohibited, but wastewater overflows do occasionally occur. New regulations will reduce the risks associated with the discharge of wastewater from boats in the Auckland Region, but these rules will not

apply in the Waikato Region, where controls default to the less stringent Resource Management (Marine Pollution) Regulations 1998.

- The Watercare Harbour Clean-up Trust continues to remove large amounts of rubbish from coastal areas around Auckland, but volumes have been declining since 2008. The decline in rubbish volumes is generally consistent with a reduction in the amount of rubbish in the coastal environment, but the effects of moving collection effort from high to low yielding areas also needs to be taken into account. Information on trends in the amount of coastal rubbish is not available for other areas.
- Sediment is a serious environmental contaminant particularly in estuaries and nearshore areas of the inner Hauraki Gulf. Modern sediment accumulation rates in the Gulf are typically greater than natural sedimentation rates. Regular monitoring is showing that sediment-related effects are occurring at sites scattered around the Gulf. Increasing trends in the proportion of fine and/or muddy sediments have been detected at sites in Mangemangeroa, Okura, Puhoi, Turanga and Waiwera estuaries, Shoal Bay (Waitemata Harbour), Mahurangi Harbour, and at some sites in the southern Firth of Thames. Changing sediment characteristics is leading to corresponding changes in benthic community composition at a number of these sites.
- Fourteen of the 19 water quality sites continually monitored by Auckland Council between 2004 and 2013, have displayed deteriorating trends in total suspended solids (TSS) concentrations. The Waikato Regional Council does not monitor coastal water quality on a routine basis, so TSS information is not available from the Firth of Thames or from other sites around Coromandel Peninsula. However, modelling suggests that sediment discharges from the Hauraki Plains dominate loads going to the Gulf, and that their footprint extends across the Firth of Thames and into Tāmaki Strait.
- Mangrove cover in five estuaries with long term data is now greater than it was prior to the 1970s (albeit very slightly for Lucas Creek), but mangrove expansion appears to be slowing. Mangrove cover has increased in only one of these estuaries since the 1990s. Similarly, mangrove cover in three estuaries with shorter-term data has been relatively stable or declined since the 1990s. Mangrove clearance is thought to be responsible for some of these declines. Mangrove forests in the southern Firth of Thames also expanded from the 1950s, but ongoing observations indicate that the subsidence of the tidal flats (caused by the consolidation of deep sediments), coupled with sea-level rise is likely to impede ongoing expansion.
- Introduced marine species pose a serious threat to the entire Hauraki Gulf. At least six non-indigenous species with the potential to cause serious harm to the marine environment have already become established in the Hauraki Gulf, with five high-risk species arriving in the past 15 years. Four new species have been reported since 2011: one of which is a high risk species capable of causing serious problems. The Port of Auckland is a key portal for invasive species. The large amount of boating, aquaculture and other marine-based activities further increases biosecurity risks in the Gulf. Controlling the spread and growth of established marine pests is extremely difficult, and to date, no successful programmes have been implemented. Management is therefore focussed on preventing their arrival and early detection. Little is known about the potential long-term impacts of high-risk non-indigenous species on native plants and animals.
- The outbreak of OsHV-1 virus is continuing to have a major effect on the oyster farming industry, but the industry is adapting. High concentrations of paralytic shellfish poisons were found in shellfish from Whangamata in 2011, and unusually high mortalities of tuatua and cockles were observed for 4–6 months in the Long Bay-Okura Marine Reserve. The latter incident is thought to be due to environmental conditions or sediment, rather than toxins. Occasional dog deaths linked to naturally-occurring toxic sea slugs have continued to be reported, and low levels of the toxin involved have been detected in kai moana from Whangapoua. However, concentrations in kai moana were too low affect people.
- The islands of the Gulf are critical sanctuaries for endangered species, and many are being restored to protect and enhance native and endemic biodiversity. At least six of the larger islands in the Gulf already have more than 80% native forest cover, and significant progress is being made in re-vegetating other large islands including Motuora, Tiritiri Matangi, Motutapu, Motuihe, and Rotorua Islands. Much of this work is community led. Mammalian pests have been

eradicated from 36 islands in the Gulf, and progress is also being made towards eradicating Argentine ants on Kawau, Aotea (Great Barrier) and Tiritiri Matangi Islands. Revegetation and pest control is allowing more vulnerable endemic birds, reptiles and insects to be translocated among islands. However, the eradication of rainbow skinks from Waiheke, Rangitoto, and Motutapu Islands is currently deemed to be unfeasible, and introduced weeds are an issue for some islands. Kauri dieback is also a serious concern. It has been present on Aotea (Great Barrier) since at least the 1970s, and has recently been detected on Coromandel Peninsula.

- The Hauraki Gulf, contains one of the few known resident populations of Bryde's whales, which are a nationally critical species, with an estimated population of less than 250 mature individuals nationwide, and around 46 whales resident in the Gulf. Since 1989, there were 44 recorded fatalities of Bryde's whales in the greater Hauraki Gulf, with four whales killed since 2011. Ship strikes account for 85% of the identified causes of whale deaths. Scientists, regulators and stakeholders are working together to reduce the impacts of ship strike. Entanglement in fishing or aquaculture equipment has also been attributed to some deaths. Habitat availability or exclusion may become an issue for Bryde's whales, if activities such as aquaculture start moving into areas they utilise.
- Since 2011 the conservation status has declined for three and improved for one of the 27 seabird taxa known to breed in the Hauraki Gulf region. There are serious concerns about the long term survival of four seabird species. The New Zealand fairy tern is still teetering on the brink of extinction, with only around 40 individuals and 12 breeding pairs estimated to remain. The NZ storm petrel was rediscovered in 2003, after being thought to be extinct for 108 years. There are also grave concerns about the long term survival of black petrel. In a risk assessment, potential fatalities of black petrel in fisheries were estimated to average 1440 each year. Modelling suggests the population is declining by 2.5% per year, although this result is very uncertain. Relatively large numbers of flesh-footed shearwater are also caught by long lines, and this has contributed to the New Zealand population declining from 50,000–100,000 pairs estimated in 1984 to less than 12,000 pairs currently.
- The Hauraki Gulf is an internationally significant area for shore birds. Counts have been made by the New Zealand Ornithological Society since 1960. Trends have varied among wader species with three endemic species and two native species increasing in number. One of these (New Zealand dotterel) is conservation dependent. New Zealand dotterel populations tend to be stable or declining when they are unmanaged, and to increase when they are managed. Counts of two migratory species have been relatively stable, while two migratory and one endemic species generally displayed declining trends. One species has displayed cyclical counts, with an increasing frequency of zero or low counts since 1990, and four species have displayed increasing counts for a number of years after 1960, followed by a decline in more recent years. Both endemic and migratory species are likely to be affected by pressures and changes in habitat quality within the Hauraki Gulf and at remote locations.

PROGRESS TOWARDS INTEGRATED MANAGEMENT AND ADDRESSING THE FORUM'S STRATEGIC PRIORITIES

Significant gains are being made in island restoration; mana whenua involvement in decision making; marine biosecurity regulation; and, expanding the knowledge needed to guide and support management responses. Conversely, little progress has been made towards enhancing fisheries or the creation of new marine protected areas (MPA). Actions taken on improving land management have varied, while pending consent applications for large-scale aquaculture development and recent zoning to provide for the aquaculture of fed species could further alter the natural and intrinsic values of the Firth of Thames. The limited extent of coastal monitoring in the Waikato Region also hampers the measurement of environmental performance in eastern parts of the Gulf.

There appears to be both legislative and institutional impediments to integrated management, and to the realisation of the strategic outcomes sought by the Hauraki Gulf Forum. For example, in relation to fisheries:

- the Fisheries Act allows for the use of integrated, ecosystem-based management, but current fisheries management practices remain largely geared towards single species;
- legislative targets that provide for the sustainable harvest of individual species, may not be suitable for the maintenance of broader ecosystem processes and intrinsic environmental values;
- the management of fishing effects at a national scale can lead to suboptimal outcomes for the Gulf;
- fisheries priorities differ from the outcomes sought by the Forum, and as a consequence, the Forum's priorities have tended to be given a lower weight than other considerations; and,
- while there is a legal requirement to consider parts of the Hauraki Gulf Marine Park Act when making fisheries management decisions, there is no requirement to give effect to the Act.

Progress is being made in relation to understanding fisheries risks to seabirds, marine mammals, non-target fish, benthic habitats, and elasmobranchs (sharks and rays). However, it is likely to take some time before those risks are managed in a fully integrated manner.

Proposed changes to the Resource Management Act would also reduce environmental protections for the Gulf, while changes to the National Policy Statement: Freshwater, have established particularly low bottom lines for freshwater quality, and there are weak links to the estuarine environment. These changes have the potential to affect environmental outcomes and impede progress towards achieving the Forum's objectives. However, proposals by Auckland Council and the Waikato Regional Council to set environmental standards for the Hauraki Gulf could assist, if they are set appropriately and are complemented with management targets aimed at maintaining or improving outcomes (rather than enabling a progressive decline toward a minimum state).

OVERALL CONCLUSIONS

The 2011 State of Our Gulf Report concluded that further loss of the Gulf's natural assets would occur unless bold, sustained, and innovative steps were taken to improve the management and utilisation of its resources, and to halt progressive environmental degradation. This update shows that while some environmental improvements have occurred over the past three years (particularly on islands), the cumulative impact of all activities is still pointing towards the suppression of environmental values at low levels or progressive environmental decline.

The Sea Change – Tai Timu Tai Pari Plan process is a bold and innovative action that has been taken to improve that situation. It provides an opportunity to take a fresh look at the management of the Gulf, and will hopefully provide a roadmap towards environmental improvement. However, addressing the combined effects of a suppressed environmental state, multiple and cumulative impacts, and high and increasing pressure will be technically and politically challenging. The ability of Sea Change – Tai Timu Tai Pari to halt and reverse environmental decline is therefore uncertain, and it is likely that other complementary actions will also be required.

A range of other management actions have occurred since 2011. Some of these are likely to reduce impacts on the Gulf, or at least, slow environmental decline. Others will increase pressure on the Gulf and potentially hasten environmental decline. This highlights the need for better integration at both the national and regional levels. However, legislative and institutional impediments hinder both integrated management, and the implementation of actions aligned to the Forum's strategic priorities framework. The Forum is unlikely to achieve the outcomes it is seeking, unless these issues are addressed.

4.

Background

To the Hauraki iwi, Polynesian hero Taramainuku stood astride far-off Hawaiki and cast his fishing net over the entire Pacific basin. The floats of his nets surfaced to form the islands of the oceanic archipelago of which the Hauraki offshore islands are a part.

To the Hauraki iwi of Tainui, Te Arawa and Tohora tradition the Gulf itself is known as Tīkapa Moana. Other names are given to the eastern Coromandel Peninsula including Te Tai Tamawahine and Nga Whakarewa Kauri, the latter referring to the kauri bearing tides of the Mercury Bay area.

In one Hauraki tradition the term Tīkapa Moana takes its name from Tīkapa (Gannet Rock) off the northeast of Waiheke Island. Tīkapa means “sound of mournful sobbing” and refers to the sound made by the tidal action entering and emerging from a particular rock structure. It was on these islets that early Māori performed specific rites – Uruuruwhenua – to claim lands. Tainui and Te Arawa canoes performed ceremonies here when they first landed in Aotearoa. In another tradition the term Tīkapa Moana refers to the way in which the inland sea gleams when sunlight is reflected off its surface.

Ngāti Whātua Ōrākei continue the tradition of hosting manuhiri to the shores of Tāmaki and the Waitematā. From Aotearoa's earliest arrival of waka, Hobson's arrival and more recently the Waka Ceremony for the opening of the 2011 Rugby World Cup and in 2013 the largest ever fleet of waka in the Waka Ama Long Distance Nationals, the Waitematā remains an integral and valued taonga to Ngāti Whātua Ōrākei.

To the Ngatiwai iwi of the northern Gulf it is known as Te Moananui a Toi. Ngatiwai tradition refers to Toitehuatahi's net being thrown from the southern Bay of Islands, and where it snagged on the shore defines the tribal rohe area of Ngatiwai. Ngatiwai refer to islands such as Hauturu as being poito of Toi's net.

Tangata whenua often refer to the Gulf as a “pataka kai” a food-basket in the literal and metaphysical sense; a place from which spiritual and physical sustenance is gained. The area was probably one of the earliest points of arrival for Polynesian voyagers and retains important reminders of Māori association.

Tangata whenua identification with the Gulf remains strong today. They remain kaitiaki of Tīkapa Moana/Te Moananui a Toi.

4.1 THE HAURAKI GULF MARINE PARK

The Hauraki Gulf Marine Park was established under the Hauraki Gulf Marine Park Act (2000). It currently includes the foreshore, seabed (excluding defense areas) and seawater on the east coast of the Auckland and Waikato regions (i.e., the Gulf), as well as Hauturu (Little Barrier Island), the Mokohinau Islands, more than half of Aotea (Great Barrier Island), Cuvier Island, Rangitoto Island, Motutapu Island, Mount Moehau, Mansion House on Kawau Island, North Head Historic Reserve, other small islands administered by the Department of Conservation (DOC), six marine reserves and the internationally recognised Ramsar wetland in the Firth of Thames. It also includes a number of reserves owned by, or previously owned by, Forest and Bird, Waitakere City Council and Rob Fenwick. Although the Hauraki Gulf Marine Park does not include the entire catchment of the Gulf (**Figure 4-1**), the Act does recognise the interrelationship between the Gulf, its islands and catchments and therefore contains objectives related to catchment management. Tangata whenua (original inhabitants) have no single name for the Gulf, but Tikapa Moana and Te Moananui a Toi are often used.

The marine environment in the Hauraki Gulf Marine Park encompasses deep oceanic waters, shallow coastal seas, bays, inlets, harbours and the broad intertidal flats. The complexity and nature of the physical environment is reflected in a diverse and highly productive marine ecosystem. The islands of the Gulf are also a critical refuge for rare plants and animals. Some of the species on the islands, which were once common, no longer naturally occur anywhere else in the world.

The Gulf has a rich history of human settlement and use. It is one of the earliest places of human settlement in New Zealand, and has sustained tangata whenua for many generations. The history of the Gulf can be traced through places like the pā (fort), kainga (village) and garden sites of antiquity on most islands, while European settlement and development is recorded in modified landscapes, driving dams, copper and gold mines, whaling stations, timber mills, industrial sites, and grand and ordinary homes.

The Gulf is economically important and most of its catchments are intensively developed and settled. Its shores contain New Zealand's largest metropolitan area and extensive tracts of productive farmland. Its coastal waters are of great importance to commerce in this country: containing the Port of Auckland, and many smaller ports and marinas. It is lived in and worked in, and used for marine commerce, commercial fishing and transport.

People also use the Gulf for recreation and the sustenance of human health, wellbeing and spirit. The intrinsic values of the Gulf provide a sense of belonging for many New Zealanders and for them it is an essential touchstone with nature and the marine environment. The Gulf, its islands and catchments have complex interrelationships that need to be understood and managed, to ensure that their values are to be maintained, protected or enhanced in perpetuity. The Gulf crosses territorial and departmental jurisdictions, land and water boundaries, and cultures. It is therefore essential that the objectives and approaches of management organisations are integrated in a way which provides for conservation, sustainable utilisation, development and enhancement.

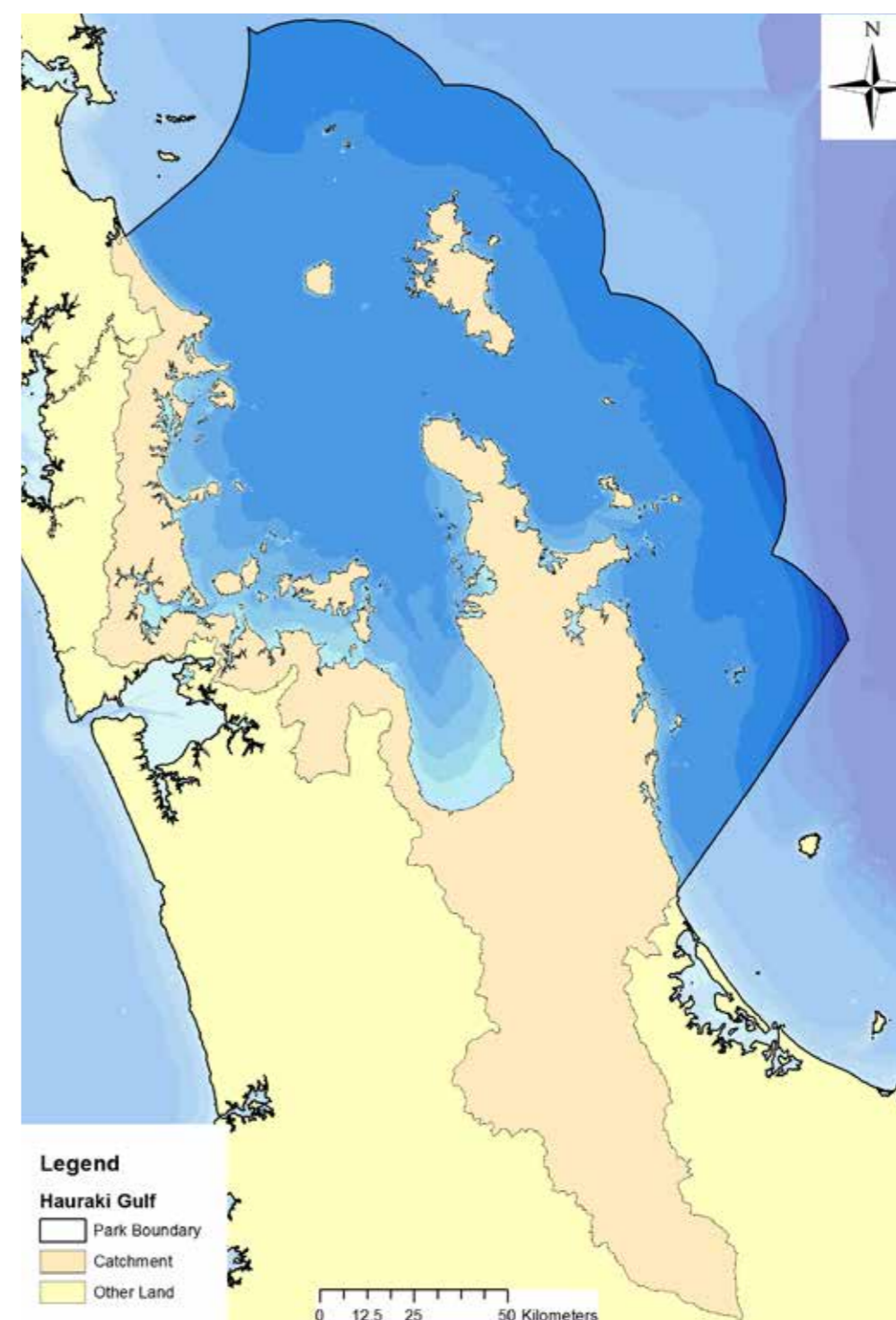


Figure 4-1: The Hauraki Gulf, Tikapa Moana/Te Moananui a Toi and its catchment.

4.2 THE HAURAKI GULF FORUM

In addition to establishing the park, the Hauraki Gulf Marine Park Act (2000) established the Hauraki Gulf Forum (subsequently referred to as the Forum). The Forum is made up of 12 representatives from local and regional councils, six tangata whenua representatives, and a representative each from Māori Affairs, the Ministry for Primary Industries (MPI (previously the Ministry of Fisheries)) and DOC. Among other things it is required to:

- promote and advocate integrated management and, where appropriate, the sustainable management of the Hauraki Gulf, its islands, and catchments;
- identify strategic issues;
- prepare and publish a report on the state of the environment in the Hauraki Gulf every three years, which includes information on progress towards integrated management, and responses to the strategic issues it has identified.

The Forum's overarching vision for the Gulf is:

Tīkapa Moana/Te Moananui a Toi, the Hauraki Gulf is 'celebrated and treasured', is 'thriving with fish and shellfish, kaimoana', has a 'rich diversity of life', supports 'sense of place, connection and identity' and a 'vibrant economy'.

"Ko Tīkapa Moana i te Te Moananui ā Toi, he wāhi 'e whakanuitia ana, e tiakina ana', he 'tini hoki te ika, te mātaītai me te kaimoana', he 'maha ngā tumomo uri o Tangaroa', ā, he wāhi hāpai 'honohonotanga ā wahi, ā tatai', hāpai 'oranga ōhanga' hoki."

However, the 2011 State of our Gulf Report (*Hauraki Gulf Forum 2011*) highlighted that while humans have lived in New Zealand for only a relatively short time, their impacts on the natural system have been profound. In the past 150 years (i.e. two human lifespans) a number of native terrestrial species have been driven to extinction. Native forests and vast wetlands on the Hauraki Plains have been cleared, drained and replaced by intensive agricultural land uses that generate nutrients, sediment and other contaminants. Accelerated sediment deposition has altered coastal habitats by infilling estuaries, reducing the diversity of seabed communities, and contributing to the spread of mangrove forests. Major marine habitats (e.g. mussel beds) have been destroyed, and the populations of fish, shellfish and lobsters have been reduced. Urbanisation has also led to the loss, modification and contamination of the coast. Overall, the natural resources of the Hauraki Gulf and its catchments have had a relatively short but unenviable history of unsustainable utilisation.

In response, the Forum adopted a strategic issues framework and urged agencies to collectively work toward urgent progress in the following areas:

- R** A **regenerating** network of marine protected areas and island sanctuaries
- E** **Enhancement** of fisheries with improved environmental outcomes
- M** **Mana whenua** relationships reflected in resource management practice
- A** **Active** land management to minimise inputs of sediments, nutrients and contaminants
- K** **Knowledge** utilisation within an ecosystem-based management framework

4.3 THIS REPORT

This report provides an update on the changing social, environmental and operational situation that affects the Hauraki Gulf. Current and changing pressures are summarised, along with changes to the management framework and key management decisions made since 2011.

Key environmental indicators are reviewed, including:

1. fishing;
2. toxic chemicals;
3. nutrients;
4. microbiological contamination (pathogens);
5. sediment;
6. introduced marine species;
7. harmful algae, pathogens and mass mortalities;
8. litter;
9. maintenance and recovery of biodiversity; and
10. coastal development.

The actual and likely outcomes of current management approaches are then considered in relation to the strategic issues identified by the Forum and the degree of integration between management agencies.

5.

Situation analysis

Combined influences and actions

He waka eke noa – A waka which we are all in, no exceptions

Photo: A pod of Bottlenose dolphins (*Tursiops truncatus*)

5.1 CURRENT AND CHANGING PRESSURES

Overview

Auckland is projected to account for around 60% of New Zealand’s population growth through to 2031, by which time it is expected to have over two million people.
New urban development and intensification will add pressure to Auckland’s aging infrastructure, much of which, was not designed to meet today’s needs.
Wastewater regularly overflows in many urban areas. The proposed Central Interceptor sewer will alleviate overflows in one of the worst affected parts of Auckland, but less frequent wastewater overflows are still likely to continue in many areas for the foreseeable future.
The Hauraki Gulf contains one of New Zealand’s largest and busiest ports. The port is largely developed on reclaimed land, and further expansion is likely to be required.
Houses are increasing faster than people on the Coromandel Peninsula. Progressive coastal development, which appears to be primarily driven by demand for holiday homes, is threatening the natural, cultural and intrinsic values of undeveloped coastlines.
The Hauraki Plains include some of the most intensively farmed dairy land in the country. Predicted nitrogen loads are already among the highest in New Zealand, and are expected to continue increasing out to 2020. Sediment loads also appear to be high.
Boat numbers are already high, and further increases are expected to place considerable pressure on existing boat ramps, moorings and marinas. Increasing demand for new facilities is expected.
Fishing pressure on a number of species in the Gulf is high. Between 2007–08 and 2011–12, commercial fishers landed catch around 4,150 to 4,620 tonnes of the top 16 fish species, 105 to 134 tonnes of kina, and 33 to 73 tonnes (meat weight) of scallops. Commercial crayfish catches fluctuated from around 104 to 115 tonnes per annum between the 2009-10 and 2013-14 fishing seasons. The total recreational catch of some species, such as snapper, is also high and has been increasing.
A high proportion of the commercial catch is taken using methods that disturb the seabed. Around 12,450 bottom trawls occurred in the Hauraki Gulf between 2011 and 2013, and 27,600 commercial scallop dredge tows between 2010 and 2012.
There are serious concerns about the number of seabirds killed by fishing activities.
Existing reserves cover approximately 0.3% of the Gulf, and apart from the conversion of Tawharanui Marine Park to a marine reserve, no new marine protected areas have been approved since 2003.
Recent aquaculture reforms and the processing of legacy consents could significantly increase the area covered by marine farms in the Firth of Thames. Nutrient inputs from proposed fish farms could compound the effects of high nutrient loads from land-runoff.
Climate change is an emerging issue that is likely to have an increasing influence on coastal communities, industries and ecosystems within the Gulf.

The 2011 State of our Gulf report described the special, but finite, natural values of the Hauraki Gulf Marine Park. It explained how many values have already been degraded or lost, and how pressure on remaining values is increasing as the population grows, and natural resources are utilised to maintain or improve economic growth and support the needs, desires and health of the community. In this section, current and changing pressures on the Gulf are considered in more detail.

5.1.1 POPULATION GROWTH AND URBAN DEVELOPMENT

The population of Auckland is growing faster than any other region in New Zealand, and is projected to account for around 60% of the country's population growth between 2011 and 2031. Auckland's population is predicted to increase by 500,000 people, to reach almost 2.0 million by 2031 (*Bascand 2014b, a*). To accommodate this growth the number of households in the Auckland region is predicted to increase from 466,000 in 2006 to 723,000 in 2031. This accounts for almost half (48 percent) of the national growth in the number of households projected over this period. By 2031, 35% of all households in New Zealand will be in the Auckland region. Demand for new dwellings will be met through a combination of urban intensification and the development of new urban areas.

New urban development and intensification will add pressure to Auckland's aging infrastructure. The central Auckland isthmus remains a particularly problematic area for wastewater discharges to the Gulf. Much of this area is serviced by older components of Watercare's wastewater network, which were originally constructed for the Orakei outfall in the earlier part of the 20th century, and are now up to 100 years old. The combined stormwater and wastewater pipe system in this area conveys wastewater to Mangere Wastewater Treatment Plant in dry weather (see **Figure 5-1**). However, when it rains, stormwater runoff enters the pipe network, which quickly reaches capacity and discharges directly or indirectly (via streams) to the Hauraki Gulf. Significant volumes of diluted wastewater are discharged into the Gulf in this manner.

For instance, there are around 122 combined sewer overflows in the catchment of the proposed Central Interceptor. The central interceptor is a \$950 million sewer initiative that is scheduled to begin construction in 2017¹. It will involve the construction of a 13 km long tunnel between Western Springs and Watercare's Mangere wastewater treatment plant. Outfalls in the Central Interceptor's catchment currently discharge around 2,200,000 m³ of diluted wastewater on an average annual basis. The interceptor has a performance target of reducing this by 80%. Other drivers for the project are to cater for Auckland's ongoing population growth and to replace the lower sections of the existing sewer system, which are showing serious signs of deterioration. A failure of that part of the network could result in the discharge of large volumes of untreated wastewater into the Manukau Harbour for an extended period of time. This would include most of the industrial trade waste treated at the Mangere (*Watercare Services Limited 2012*).

Watercare also has 478 pump stations spread over the metropolitan wastewater network and satellite townships in the Auckland Region. Of these, 98 could potentially discharge wastewater to the Hauraki Gulf during storms. Nineteen of the 31 large pump stations overflow more than twice per year during average storms, with the worst pump stations overflowing 10 to 16 times between 2011 and 2013 (**Figure 5-2**). Watercare has several projects underway to reduce the frequency of these overflows, which include large storage tanks being installed or planned in Henderson, Kohimarama, Point England, Glen Eden and Newmarket Gully. The remaining 67 pump stations tend to be small facilities, which overflow no more than twice in five years on average and discharge relatively small volumes of wastewater.

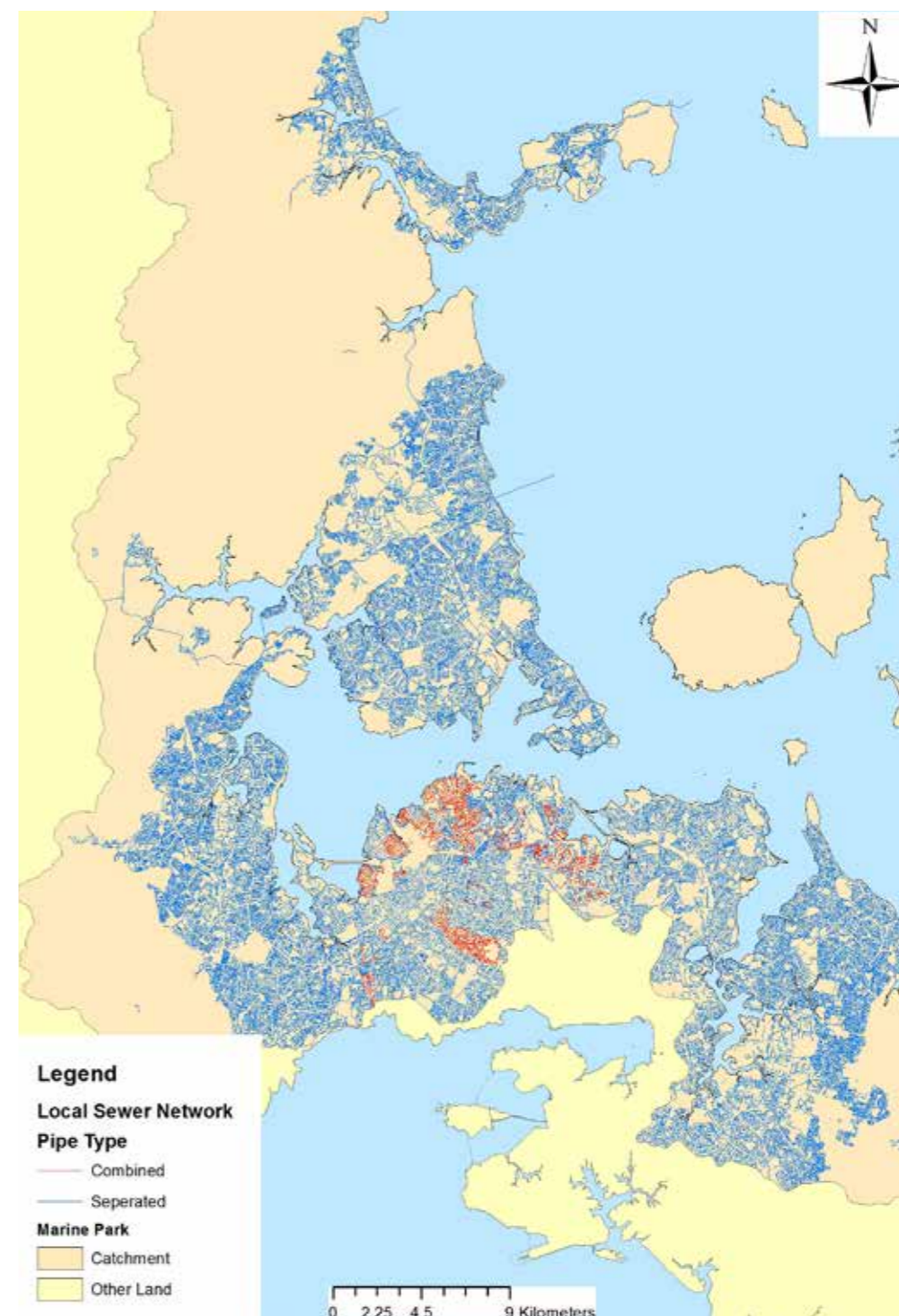


Figure 5-1: Central Auckland areas serviced by a combined wastewater and stormwater pipe network (i.e. both services are included in the same pipe (red)), and areas with separate wastewater pipes (blue).

¹. Subject to resolving a resource consent appeal

Urbanisation and development will also add pressure to Auckland's stormwater system, which in older areas, was never designed to meet today's needs. Auckland Council's Stormwater Unit operates and maintains an extensive stormwater network that is estimated to comprise 6,000 km of pipe, 10,000 km of streams, 140,000 manholes, and 370 ponds and wetlands. A fundamental challenge for the management of urban stormwater, is to minimise both flooding and stormwater effects on the environment. For much of the city's history the environmental effects of stormwater, and measures taken to manage stormwater run-off, were not widely appreciated and as a consequence, were not actively managed. Rather, the focus for stormwater management was on drainage, flood reduction and sewage disposal. The history of development is therefore reflected in the extent, characteristics and condition of the city's stormwater infrastructure and associated effects on the natural environment (Kelly 2013, Kelly 2014).

Auckland is an international gateway, and tourism is a major part of the Auckland and Waikato economies. In 2008, tourism associated with the Hauraki Gulf is estimated to have generated \$937 million (Barbera 2012), and visitor numbers arriving through Auckland Airport have steadily increased from 1.69 million per annum in 2010 to 1.97 million per annum in 2014 (years ending in April, Statistics New Zealand 2014). The Auckland Waterfront is being developed into a showcase for Auckland. It is being transformed from industrial and maritime work spaces, into mixed-use areas that combine traditional fishing, port and marine uses with residential and business areas, new public spaces and facilities. Queens Wharf was purchased by the Government and Council in 2010 for a cruise facility, hosting major events, and for use as an impressive public open space. Waterfront Auckland also plan to further develop Wynyard Quarter into a vibrant residential and business community. The downtown ferry terminal is also the central hub for ferries, Gulf cruises and associated tourist activities.

The Port of Auckland is one of New Zealand's largest and busiest ports. It provides container, conventional, and passenger shipping facilities, and handles 37% of the country's total seaport trade, and 31% of trade across all ports (including airports). Approximately \$26.4 billion of trade passes through the port each year. Port operations have been progressively expanded through land reclamation, and the consolidation of port operations to the east of the Auckland waterfront has made the Viaduct Harbour and Wynyard Quarter redevelopment possible. The need for further expansion of the port has been signalled. Auckland Council is currently undertaking a study on its future operation and development, which is likely to have implications for the extent and timing of any further expansion.

Population growth in the Waikato districts of the Hauraki Gulf catchment is predicted to be slower than Auckland's. Despite this, there is significant pressure to develop coastal land on the Coromandel Peninsula. Much of this appears to be driven by the demand for holiday homes in the Thames Coromandel District, rather than population growth. Data from Statistics New Zealand indicates that between 1996 and 2013, the usually resident population² of the Thames Coromandel District increased by only 1700 people, but 6756 consents were issued for new residential buildings over the same period. As a consequence, a relatively low proportion of dwellings are occupied when census data has been collected in popular holiday areas like Pauanui, Tairua, Whangamata and the northern parts of Coromandel Peninsula. Similar patterns are evident at popular holiday settlements in the Auckland Region, including Omaha and Kawau Island (Figure 5-3). These areas consistently have more dwellings than usual residents, whereas the opposite is apparent in major urban areas.

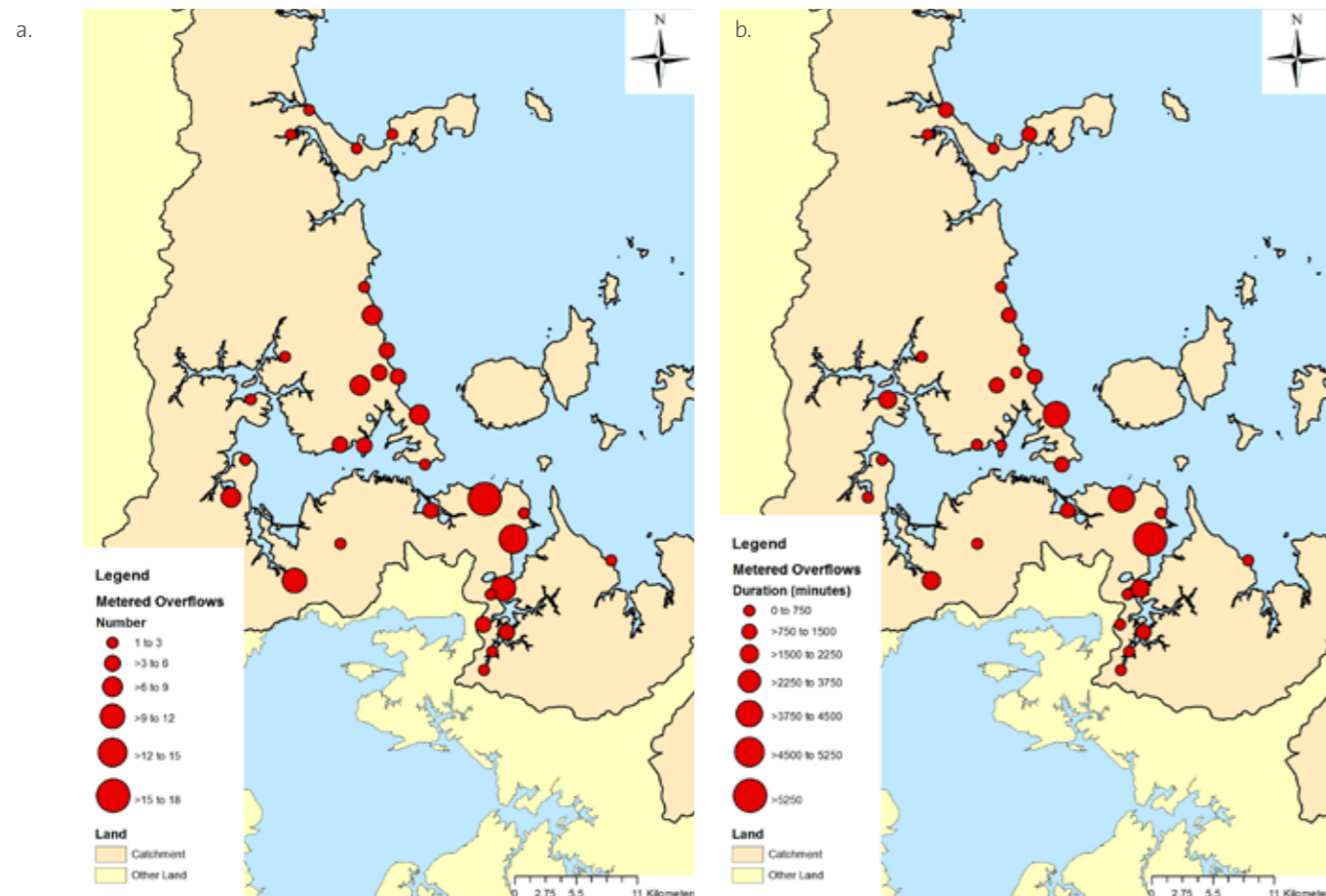


Figure 5-2: The a) number and b) total duration (in minutes) of all wastewater overflows between 2011 and 2013 from major pump stations discharging to the Hauraki Gulf.

2. The census usually resident population count is a count of all people who usually live in New Zealand (or in that area), and are present in New Zealand, on a given census night. This count excludes visitors from overseas and excludes residents who are temporarily overseas on census night. At a subnational area, this count also excludes visitors from elsewhere in New Zealand (people who do not usually live in that area), but includes residents of that area who are temporarily elsewhere in New Zealand on census night (people who usually live in that area but are absent) (Statistics New Zealand (2013) Population counts and estimates fact sheet. Available at: <http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/population-counts-estimates-factsheet.aspx> [Accessed: 10 June 2014]).

Subdivision pressures continue to threaten undeveloped Coromandel beaches, such as New Chums Beach. Since 2011, 91 consents for subdivisions near the coast have been issued in the Thames Coromandel District, with around 25 of these in low density areas (i.e. where average lot sizes are >5 ha) (see **Figure 5-4**). A number of these have been in or adjoining areas with outstanding landscape values. No consents for coastal subdivisions were sought in the Hauraki District. In Auckland, a plan change enabling the creation of 43 rural residential lots at Te Arai Point is notable.

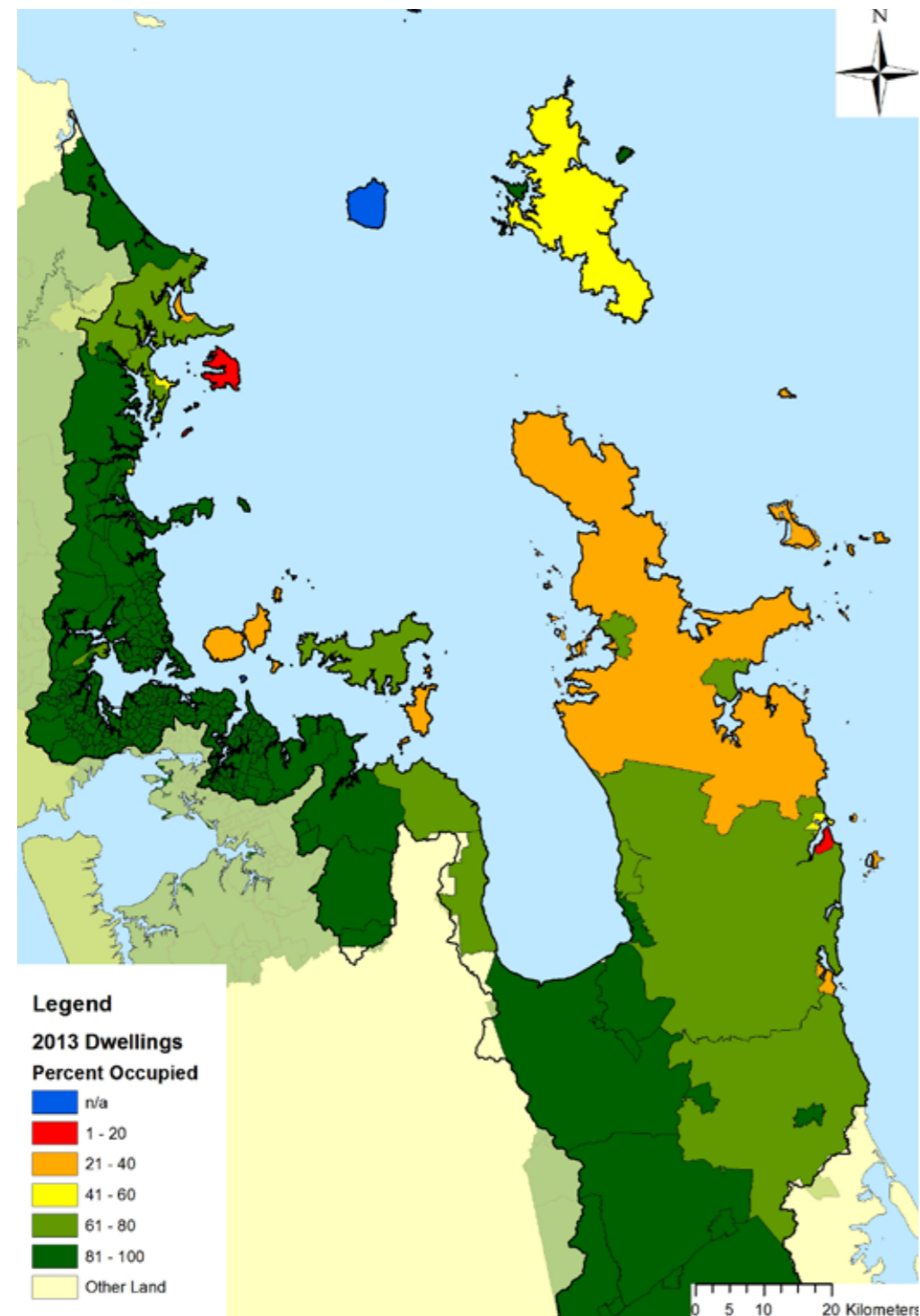


Figure 5-3: Percentage of dwellings occupied during the 2013 census.

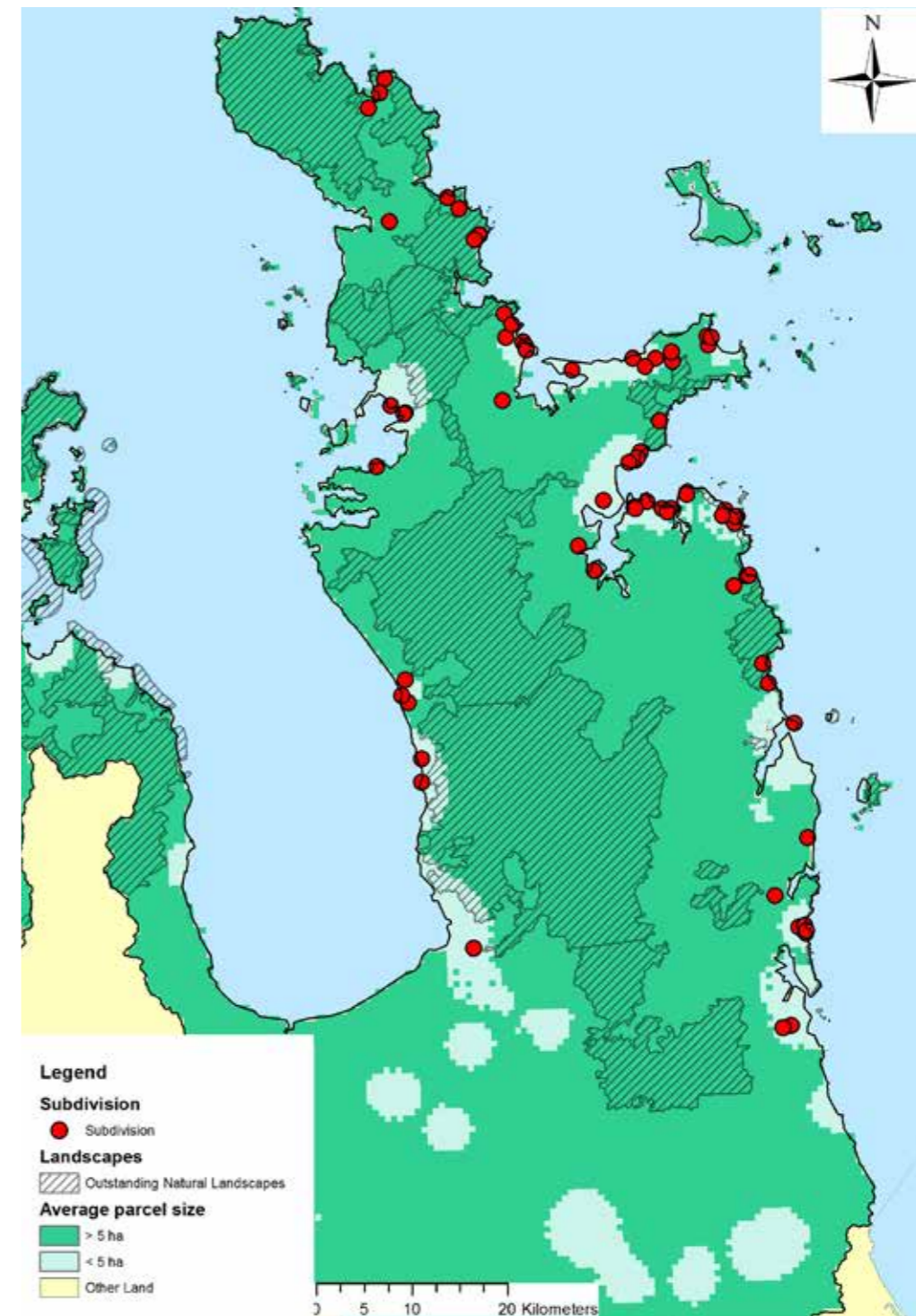


Figure 5-4: Consents granted for coastal subdivisions on Coromandel Peninsula between 2011 and 2013, together with current levels of development (average parcel size is less than or greater than 5 ha) and outstanding natural landscapes.

5.1.2 BOATING

Auckland is known as the City of Sails for good reason. The economic and social significance of recreational boating is reflected in associated economic figures, the large number of boats that use the Hauraki Gulf, and in boating-related infrastructure (see *Leersynder 2012*).

- The total estimated added value of recreational boating in the Hauraki Gulf is estimated to have been \$550 million in 2008 (*Barbera 2012*).
- In 2011, there are estimated to be around 11,000 yachts and launches, between 2,500 and 2,800 personal water craft, and around 75,000 small craft (such as dinghies, canoes, lasers, optimists and windsurfers) in the Auckland region (*Leersynder 2012*).
- Around 41% of all registered boat trailers in New Zealand in 2011, were registered in the Auckland or Waikato Regions (i.e. around 54,000 trailer boats).
- Around 49% of the 12,918 marina berths in New Zealand are in the Auckland region. There are currently 15 marinas in Auckland (including 2 dedicated dry stack facilities), which provide a combined total of 6,377 berths. Four additional marinas are located in the Waikato Region.
- There are estimated to be around 5190 swing and pile moorings in the Auckland and Waikato Regions.
- The number of yachts and launches is predicted to increase by 1600, and trailer boat numbers are predicted to increase by 52,000 in the Auckland Region, between 2011 and 2041.

Increasing boat numbers are expected to place considerable pressure on boat ramps, moorings and marinas. Growing demand has recently led to the approval of a new marina in Sandspit Estuary, and an application for a marina in Matiatia on Waiheke Island.

5.1.3 AGRICULTURE

The adverse effects of intensive agriculture are causing increasing concern, in particular, the effects of nutrient and sediment runoff. Nationally, there is a strong correlation between increasing land use for dairy farming and increasing nitrogen loads (Parliamentary Commissioner for the Environment 2013). The Hauraki Plains includes some of the most intensively farmed dairy land in the country, with particularly high numbers of cows in the Matamata-Piako and Hauraki Districts (**Figure 5-5a**). The Matamata-Piako has the highest number of cows per hectare of any district in the country, while numbers per hectare in the Hauraki District are the fourth highest in the country (**Figure 5-5b**). Cow numbers on the Hauraki Plains have increased since the late 1990s, with the greatest increase occurring in the South Waikato district where cow numbers grew by around 45% between 1999 and 2013. In the Matamata-Piako District numbers grew by around 7% between 1999 and 2007 and then stabilised. Similarly, dairy cow numbers in the Hauraki District increased by around 4% between 1999 and 2004, then stabilised (**Figure 5-6**) (see *New Zealand Dairy Statistics, Livestock Improvement Corporation* (<http://www.lic.co.nz>)). In contrast, most of the legacy districts in the Auckland Region have low numbers of dairy cows per hectare, and herds have been declining.

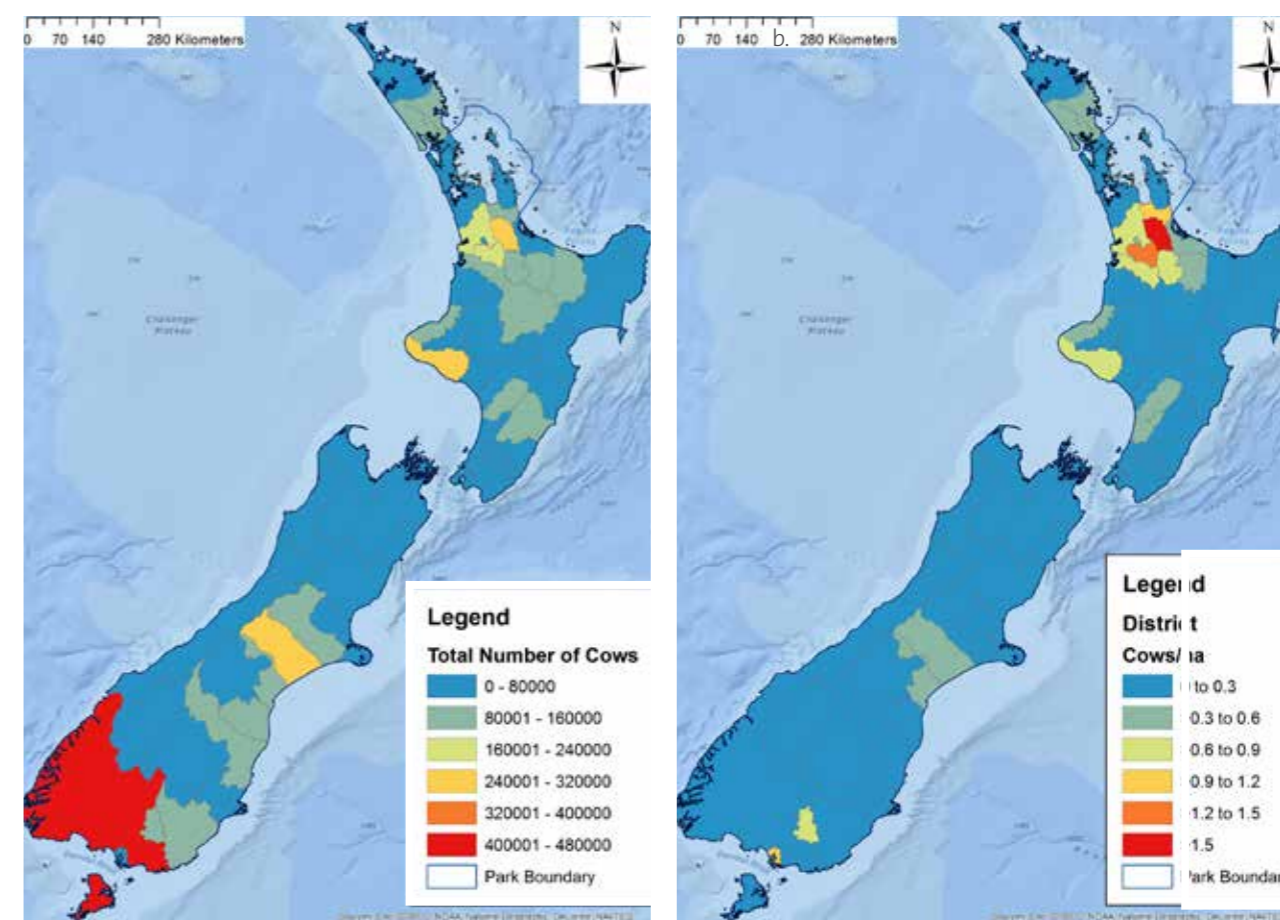


Figure 5-5: a) Total number of cows reported for local districts in 2013; and, b) the number of cows per hectare in districts throughout New Zealand (data on cow numbers obtained from LIC & Dairy NZ 2013).

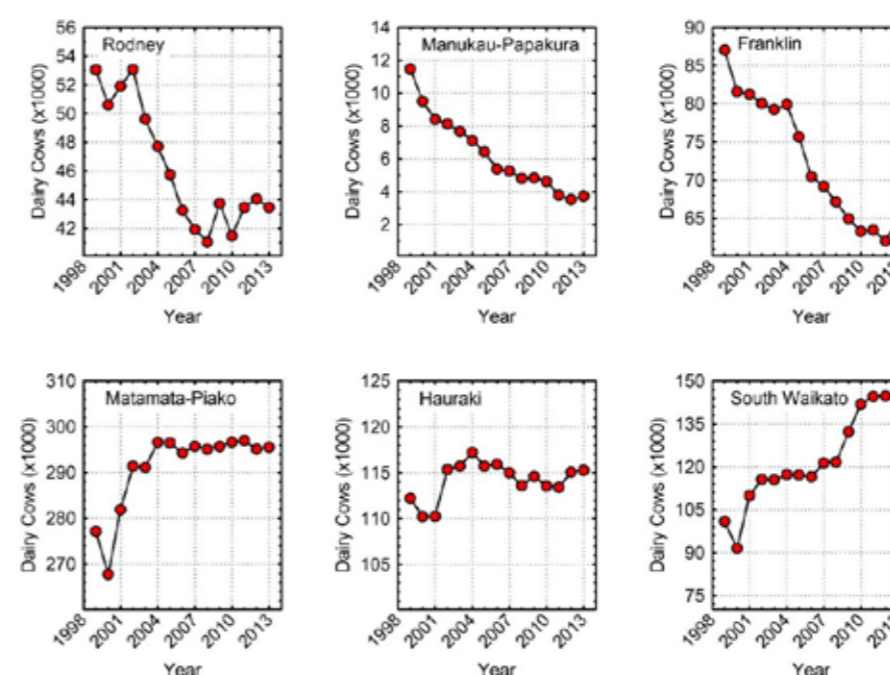


Figure 5-6: Trends in dairy cow numbers in a sub-set of districts (or previous districts) that are partially or wholly within the Hauraki Gulf Marine Park catchment. Auckland Districts are shown on top, with Waikato districts below. Data obtained from New Zealand Dairy Statistics, Livestock Improvement Corporation. Note the difference in the vertical scales.

5.1.4 FISHING

Overall, around 75 different finfish species are caught commercially in the Gulf. Of these, snapper is the main commercial species in terms of reported catch weight, and it is also the most targeted species for commercial fishers. Other important commercial species caught within the Gulf include jack mackerel, pilchard, john dory, gurnard, kahawai, flatfish, tarakihi, trevally, yellow-bellied flounder and leatherjackets (*Figure 5-7*).

Between the fishing years 2007–08 and 2011–12, the commercial landings of the top 16 fish species caught in the Hauraki Gulf ranged from 4150 to 4620 tonnes. The commercial catch of fish in the Gulf was estimated to generate around \$41 million in earnings in 2011, with most of it coming from exports (around \$36 million) (*Barbera 2012*). In addition, between the 2007–08 and 2011–12 fishing seasons, commercial fishers caught around 105 to 134 tonnes of kina and 33 to 73 tonnes (meat weight) of scallops (*data provided by MPI*), while commercial crayfish catches fluctuated from around 104 to 115 tonnes per annum between the 2009–10 and 2013–14 fishing seasons. The recreational catch of some species is also significant. For instance, estimates obtained from the Hauraki Gulf in the most recent aerial survey, indicate that the recreational catch of snapper was greater than commercial catch in the 2011–12 fishing year (*Ministry for Primary Industries 2013j*). The growing human population, constantly improving fishing technology and better access to fish (more and better boats) are likely to increase recreational fishing pressure.

Fishing occurs in most parts of the Gulf, but regulations govern how, where and when fishing can occur. For example, regulations limit where trawling can occur, the size of vessels that can be used for trawling and/or the time when trawling can occur (*Figure 5-8*). Consequently, trawling is confined to central and outer parts of the Gulf, whereas commercial long-lining is more widespread (*Figure 5-9*). Recreational fishing is mainly concentrated along the coast, with the heaviest concentrations of effort in Kawau Bay, Rangitoto Channel, Motuihe Channel, Wilsons Bay, around Pakatoa and Tiritiri Matangi islands, and in the Motukahaua and Motuoruhi island groups north of Coromandel Harbour (*Figure 5-9*).

The commercial catch of finfish is mainly obtained through bottom trawling, Danish seining and bottom long-lining, which together provided around 85–90% of the combined catch of snapper, gurnard, tarakihi, kahawai, rig, trevally and John dory (*Hauraki Gulf Forum 2011*). A smaller proportion of the fish catch is obtained by set netting, which is mainly used to target parore, flatfish and mullet.

Bottom trawling and scallop dredging have a significant impact on the seabed (*Thrush & Dayton 2002; Handley et al. 2014*). Around 12,450 bottom or mid-water trawls occurred in the Hauraki Gulf during the three year period from 1 January 2011 to 01 January 2014 (*unpublished data Ministry for Primary Industries*). In addition, roughly 27,600 commercial scallop dredge tows were carried out between the 2010 to 2012 fishing seasons (*unpublished data Ministry for Primary Industries*). There are also major concerns about the impacts of long lining on seabirds.

There are currently six marine reserves in the Hauraki Gulf, which only cover around 0.3% of the entire Hauraki Gulf Marine Park. All forms of fishing (apart from research fishing) are also prohibited in cable protection zones (*Figure 5-8*). These cover a much larger area (around 4.9% of the Gulf), but public knowledge of, and compliance with the fishing prohibition is an issue (*Mike McGrath, Telecom, pers. comm, Figure 5-9*). Apart from the conversion of Tawharanui Marine Park to a marine reserve, the last marine protected area to be approved was Te Matuku in 2003.

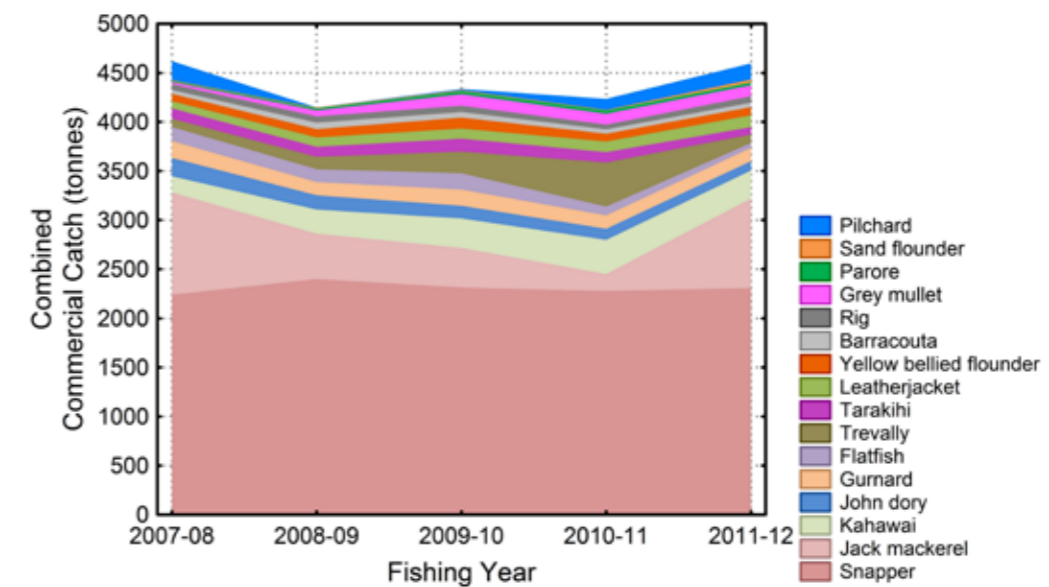


Figure 5-7: Commercial catch (tonnes) of the top 16 fish species caught in the Hauraki Gulf between the 200–08 and 2011–12 fishing seasons (*combined data from statistical reporting areas, 005, 006, 007 and 008*). Note that deepwater species are not included in this figure.

5.1.5 AQUACULTURE

The Hauraki Gulf is one of the first areas in New Zealand to develop commercial aquaculture, and Māori have been involved since the beginning. Aquaculture aligns with traditional use and concepts such as pātaka kai, and development began in earnest in the 1970s and has grown into a significant industry within the Gulf. In 2009–10, the total national economic contribution of aquaculture in the Auckland and Waikato Regions was estimated to be \$98.6 million, with around two-thirds originating from Waikato and one-third from Auckland (*Barbera 2012*). Aquaculture has been identified as a priority industry for the Government, which is committed to enabling the industry to achieve its goal of \$1 billion in annual sales by 2025 (*Ministry for Primary Industries 2012c*). Actions taken by the Government have included a range of reforms which, among other things, established a new 300 ha zone for finfish aquaculture west of Coromandel, and a 90 ha zone in Wilsons Bay (*Ministry of Fisheries 2011a*). Māori are entitled to 20% of all new Aquaculture Management Areas. More details on the history of aquaculture development and the pressures emerging from this activity are provided in the Aquaculture Case Study (*see Section 5.1.7*).

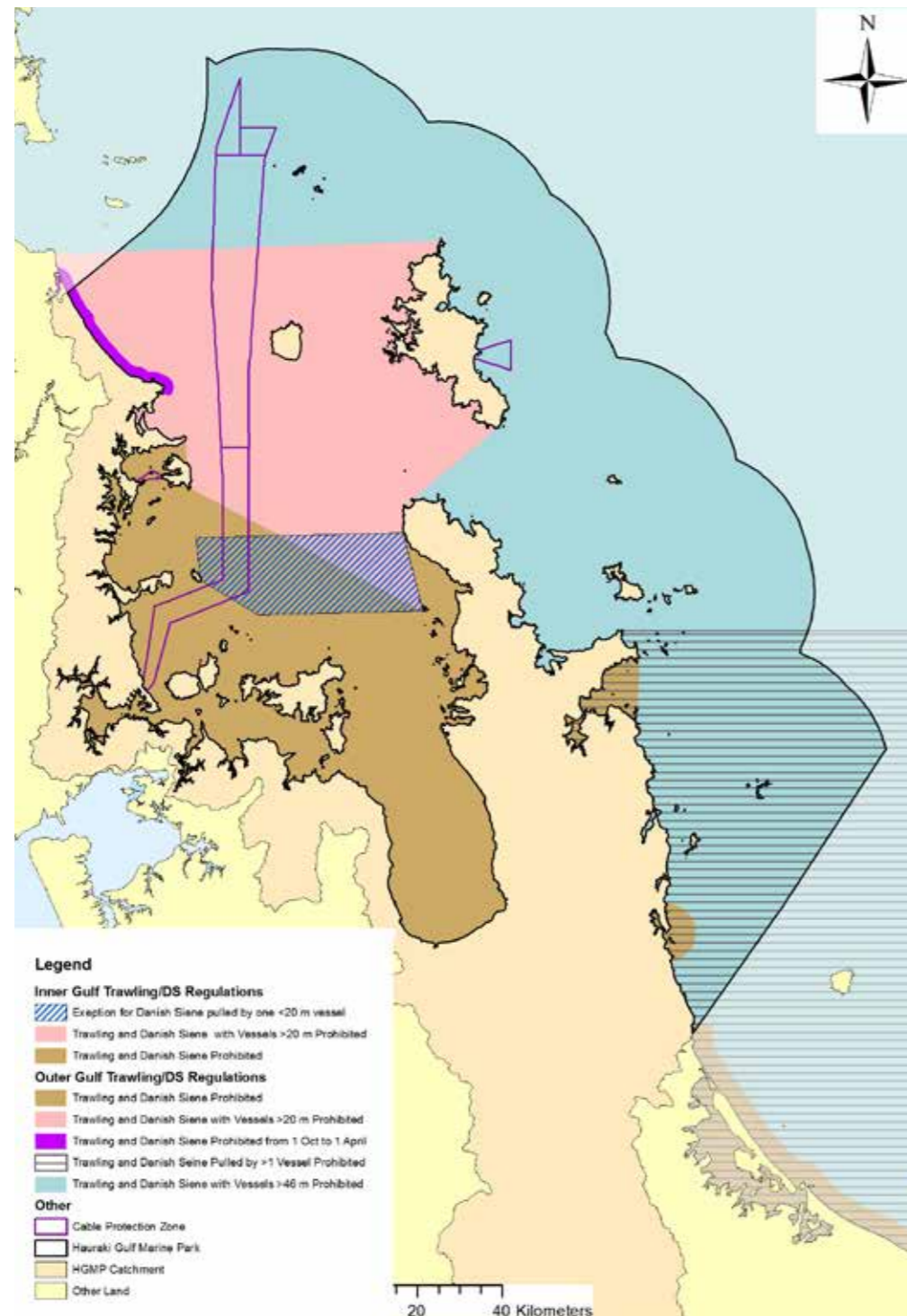


Figure 5-8: Areas where trawling and Danish seining is either prohibited or limits apply to the size of vessel, or times when trawling and Danish seining can occur.

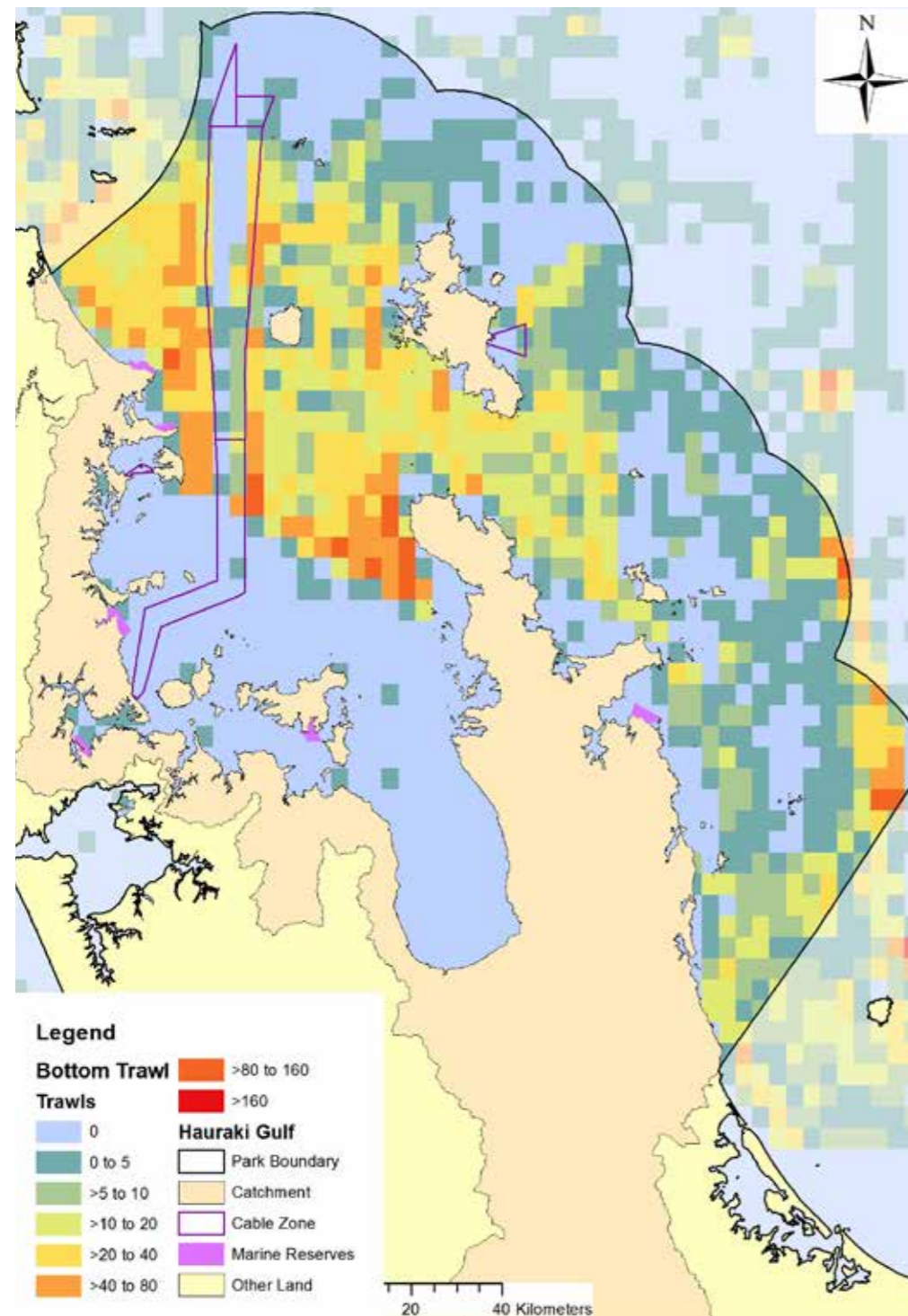
5.1.6 CLIMATE CHANGE

Climate change is a gradually emerging issue that is likely to have an increasing influence on coastal communities, industries and ecosystems. The combination of sea-level rise, and larger and more frequent storm events are expected to increase coastal erosion and inundation. The extent of coastal development in the Hauraki Gulf means that managing the risk of coastal erosion and inundation is likely to present an escalating challenge. National-scale sensitivity mapping suggests the Hauraki Plains are highly sensitive to coastal inundation, and much of the mainland coast around the southern and eastern Firth of Thames, and from Tāmaki Strait through to Omaha is sensitive to coastal erosion (*Goodhue et al. 2012*).

Despite limited evidence to date, the fifth assessment report of the Intergovernmental Panel on Climate Change has high confidence that climate change will have a negative impact on some coastal habitats. For instance, it anticipates that sea level rise will drive mangroves landward: potentially at the expense of saltmarsh. The secondary effects of changing temperature, rainfall, and sea level rise may also lead to the loss of habitat for nesting birds. Increasing ocean acidification is expected to affect many taxa, but confidence around the scale and magnitude of effects is less certain (i.e. moderate confidence). Strengthening of the East Auckland Current is also expected to promote establishment of tropical or sub-tropical species that currently occur as vagrants along the north-east New Zealand coast (*Intergovernmental Panel on Climate Change 2014*).



a.



b.

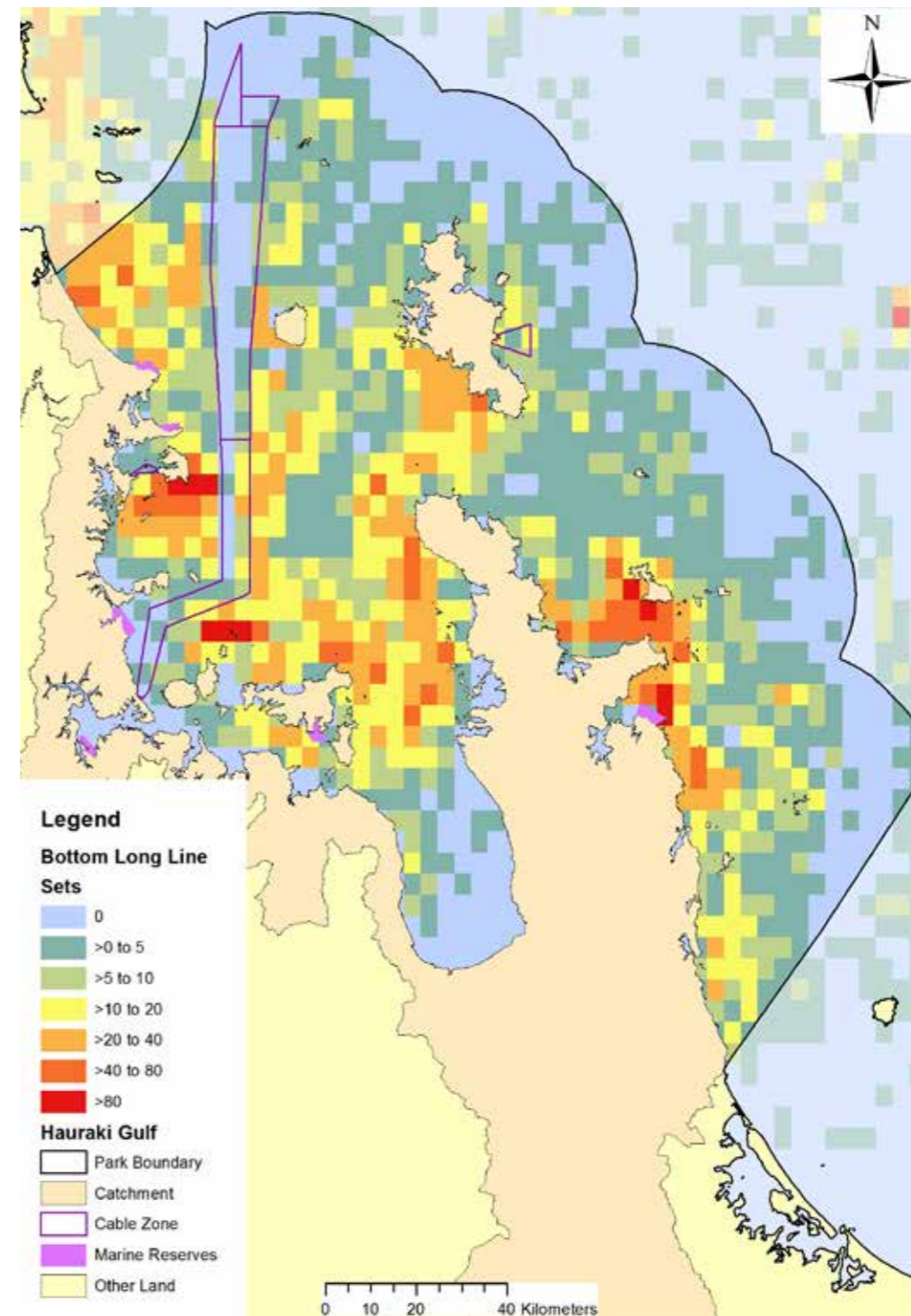


Figure 5-9: Spatial distribution of a) bottom trawls undertaken between 1 January 2011 and 01 January 2014, b) bottom long line sets between 1 January 2011 and 01 January 2014, and c) recreational fishing boats observed during aerial surveys in 2011-12 (see Hartill et al. 2013).

C.

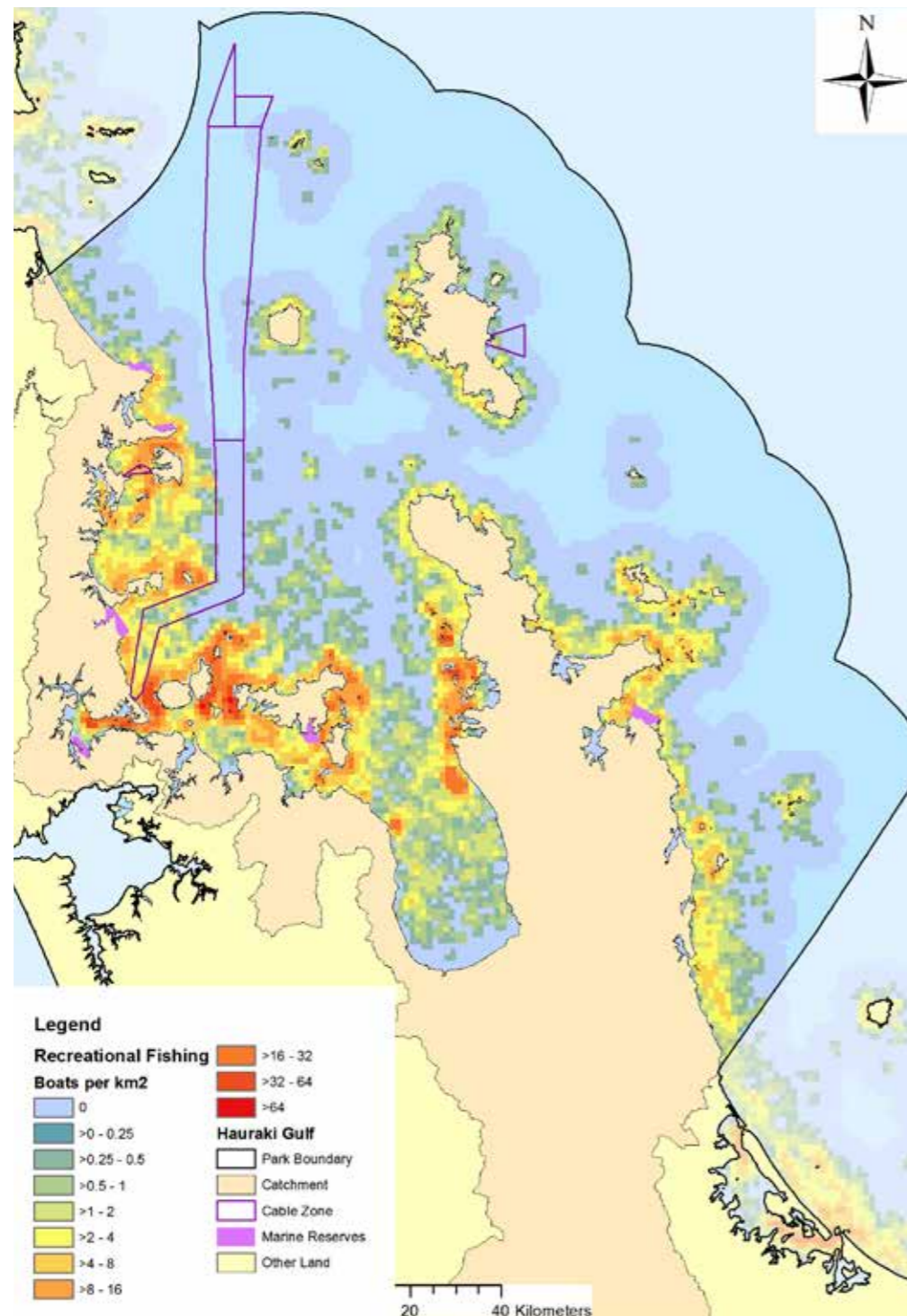


Photo: A mussel farm

5.1.7 CASE STUDY: AQUACULTURE – A GROWING INDUSTRY

Background to aquaculture development

Compared to fishing, aquaculture is a relatively new industry. However, its footprint and effects have been increasing since the 1970s. The first steps toward commercial aquaculture in the Hauraki Gulf began with the trial of small mussel rafts as the mussel dredge fishery was collapsing in 1965 (Paul 2012, Johnson & Haworth 2004). Around the same time, oyster spat collectors were being trialled around Kawau Island and in Mahurangi Harbour. Oyster farms were established in Coromandel and Mahurangi shortly after. During the 1970s mussel and oyster farming techniques improved, and better sources of spat were identified. As a result, mussel and oyster farming gradually expanded between the 1980s and mid-1990s.

Toward the end of the 1990s there was a strong upsurge in the demand for new aquaculture space. In many cases, large areas were being sought for 'spat catching' on a first-come, first-served basis with little regard to the cumulative effects. Regional councils struggled to cope with the number of consent applications being made, and communities became particularly alarmed about the rate and scale of potential aquaculture development. Problems were compounded by coastal plan provisions that were not designed to manage marine farm applications of the number, scale and extent being sought. The *ad hoc* nature of the applications also meant that marine farming had the potential to overshadow broader outcomes being sought for coastal management in both the Auckland and Waikato regions.

In response, the Auckland Regional Council began a process of varying its Coastal Plan. In 2001 Central Government also stepped in, putting existing consent applications on hold and imposing a temporary moratorium on new applications. The government went on to introduce the Aquaculture Reform Bill in January 2005. A key component of that bill was a requirement to limit marine farming to aquaculture management areas (AMAs). These could be initiated by Regional Councils or through private plan changes (Ministry for the Environment *et al.* 2005). However, there was no requirement for any individual or organisation to actually establish them. As a result, AMAs were never established in the Auckland or Waikato Regions.

Government and industry dissatisfaction with a lack of progress on diversifying and expanding aquaculture, led to further reforms to the Resource Management Act in 2011. Those reforms included the removal of provisions related to AMAs. Under the Resource Management Act, marine

farm consent applications are now treated the same as any other activity in the coastal marine area and applications can be made to farm anywhere. The reforms also amended the Waikato Regional Coastal Plan to among other things, establish a new 300 ha zone for finfish aquaculture west of Coromandel, and a 90 ha zone in Wilsons Bay (*Ministry of Fisheries 2011a*). Nitrogen discharge limits of 300 tonnes of per year were included for the Firth of Thames, and 800 tonnes per year for the zone west of Coromandel (see [Section 6.3](#) for information on nitrogen loads from other activities and associated effects). Nitrogen discharges within the Coromandel Marine Farming Area are required to be staged. Progressive stages will not be permitted if earlier stages cause significant adverse effects. Existing farmers outside the Firth of Thames were also given the ability to convert shellfish farms in more than 20 m of water to fish farms. In addition, specific provisions were inserted into the Waikato Regional Plan, which allow mussel farmers outside of the Wilson's Bay Marine Farming Zone to apply for farm extensions of 1 ha or 10% of consented farm space every five years.

The Minister responsible for aquaculture was also given the ability to recommend amendments to regional coastal plans about the management of aquaculture activities, and to direct councils not to receive aquaculture applications for up to one year while provisions to manage high and competing demand are put in place.

The direction set by the 2011 aquaculture reforms is also reflected in the Proposed Auckland Unitary Plan, which also makes consents for new marine farms easier to obtain in the Auckland Region. The proposed Auckland Unitary Plan also anticipates that the Hauraki Gulf marine spatial plan (Sea Change – Tai Timu Tai Pari) will identify aquaculture zones (along with other outcomes), and that these would be considered for inclusion through a future Unitary Plan change.

Aquaculture effects

The ecosystem effects of culturing filter-feeding shellfish such as mussels and oysters are generally well understood (*Ministry for Primary Industries 2013f*), and largely depend on the location and scale of farm activities. The ecosystem effects of shellfish farms that are likely to be of most concern in the Hauraki Gulf are:

- benthic effects caused by the deposition of living and waste material on the seabed;
- the depletion of phytoplankton and fish eggs;
- the hosting and spread of invasive species; and,
- interactions with marine mammals.

Benthic effects are highly likely to occur beneath shellfish farms, but they are typically confined to the immediate vicinity of a farm. The scale of shellfish farms is therefore an indicator of the likely scale of benthic effects. The potential for other effects also increases as the scale of shellfish farming increases.

No farms in the Hauraki Gulf are currently growing fish or other fed species, but 390 ha has been zoned for this activity. The ecosystem effects of any future farming of fed species are less certain than those caused by shellfish farming, but on spatial basis, they are likely to be more significant. Of particular note are:

- the potential for high nitrogen loads from fish farms to compound the effects of land-based nutrient runoff (see [Section 6.3.1](#));
- the overlap of the fish farm zone west of Coromandel with an area that is frequently used by endangered Bryde's whales (see [Section 6.10](#));
- depositional effects are greater than those caused by shellfish farms.

Scale and distribution of marine farms

The effects of aquaculture are not confined to the ecosystem effects. In the Hauraki Gulf, uncluttered coastal space is a finite and diminishing resource, which is highly valued for its intrinsic values. The presence of marine farms also affects those values. Effects on intrinsic values also increase as the size of marine farms increase, and as farms spread to new locations.

In the Hauraki Gulf, consents and zoning for mussel and oyster farms currently cover around 2900 ha of coast, and an additional 390 ha is designated for the culturing of fish or other fed species. The bulk of the existing marine farming space is located in Wilsons Bay within the Firth of Thames (2384 ha, see [Figure 5.10](#)). Other existing marine farms are located in:

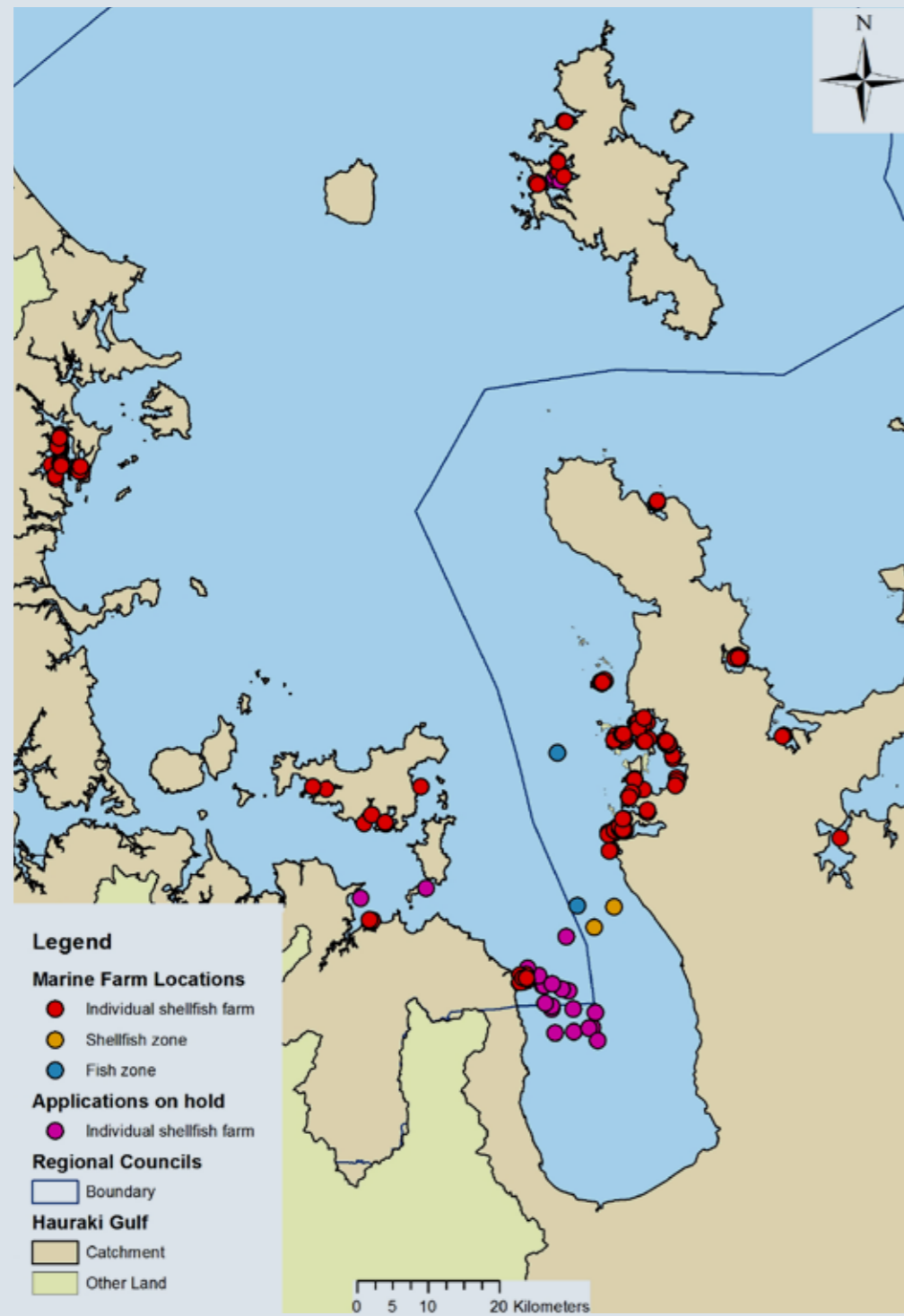
- Mahurangi Harbour;
- Port Fitzroy and Katherine Bay on Great Barrier Island;
- Putiki Bay, Awaawaroa Bay, Te Matuku Bay and Man O War Bay around Waiheke Island;
- Wairoa Bay in the eastern Tāmaki Strait;
- Manaia Harbour, Te Kouma Harbour, Coromandel Harbour, Kikowhakarere Bay and adjoining islands on the western side of Coromandel Peninsula; and,
- Port Charles, Kennedy Bay, Whangapoua and Whitianga on the eastern Coromandel Peninsula.

Applications for a further 4800 ha (approximately) of spat-catching space are due to come off hold on 31 December 2014 ([Figure 5-10](#)). The Auckland Council and Waikato Regional Council are required to process these applications once they come off hold. Applications for a further 253 ha of spat catching space have also been made in the Auckland Region, and Auckland Council and Waikato Regional Council are processing, or have recently granted, a number of applications to cover “oversized” farms and small farm extensions.



Photo: An oyster farm

a.



b.

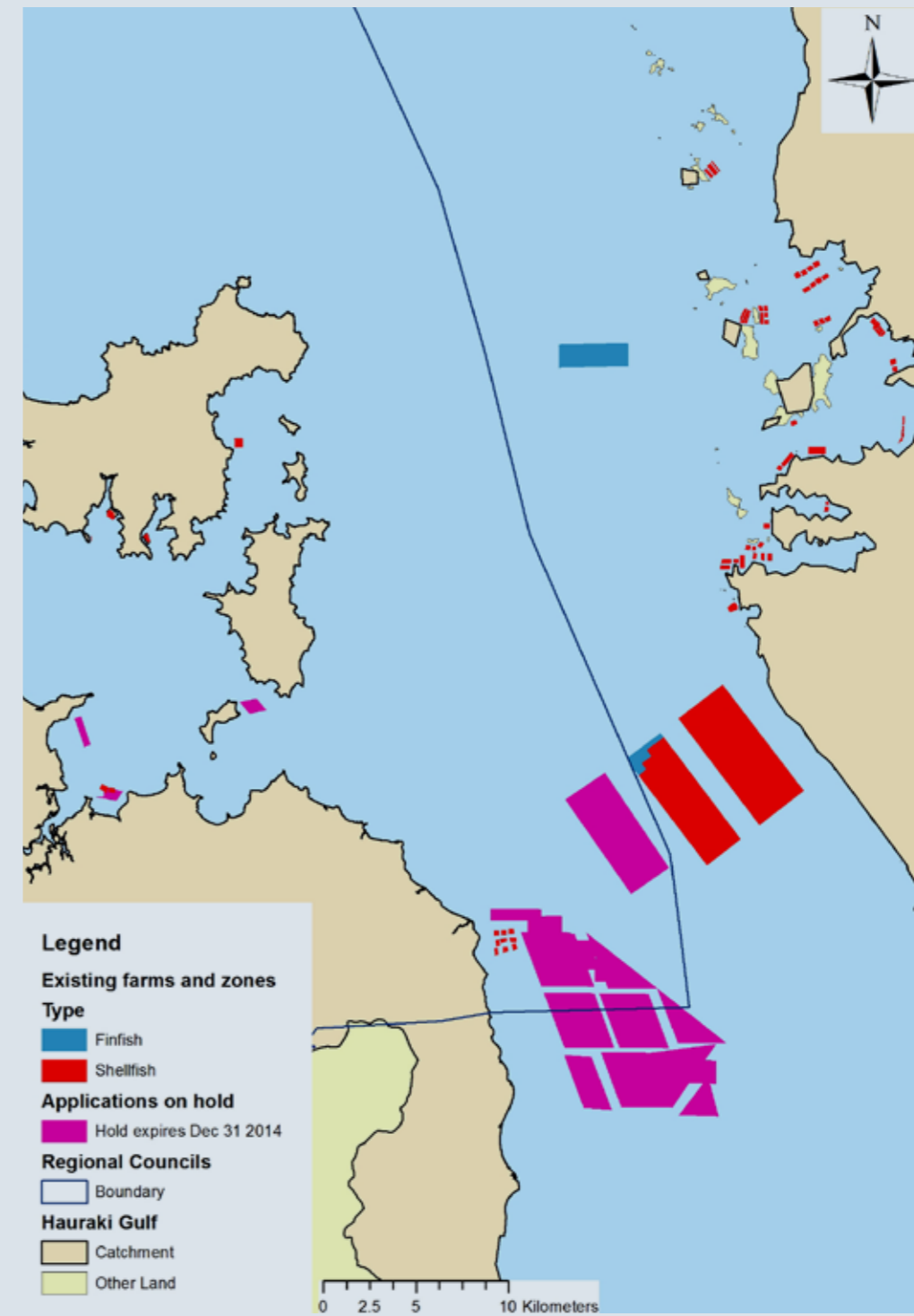


Figure 5-10: Aquaculture in the Hauraki Gulf, including a) the locations of farms in the Hauraki Gulf, and, b) extent of existing marine farms and zones in the eastern Tāmaki Strait, Coromandel and Firth of Thames, together with spat-catching consent applications that will come off hold on 31 December 2014.

5.2 CHANGES FOR TANGATA WHENUA

Overview

Seven Deeds of Settlement between tangata whenua and the Crown have been signed since the last State of the Environment Report in 2011.
Agreements in Principle Equivalents were signed by the twelve iwi of Hauraki, the Hauraki Collective, and the Crown in July 2011.
Ngāti Maru, Ngāti Pāoa, Ngāti Tamaterā, Ngāti Tara Tokanui, and Te Patukirikiri have collectively purchased the largest dairy farming operation on the Hauraki Plains.
Specific requirements were included in the Proposed Auckland Unitary Plan to protect sites and places of significance or value to mana whenua.
The Independent Māori Statutory Board has updated its Schedule of Issues of Significance to Māori in Tāmaki Makaurau and its Māori Plan.
Co-governance between tangata whenua, the Crown and regional and territorial authorities in respect of tūpuna maunga, moana, awa, and other taonga has been negotiated by the Tāmaki Collective and Hauraki Collective.
Co-governance of the Project Steering Group for the Sea Change – Tai Timu Tai Pari Marine Spatial Planning exercise between mana whenua and councils, territorial authorities, MPI and DoC.

There have been a number of significant developments for tangata whenua since the last report in 2011, which assist in redressing historical issues, increasing the recognition of mana whenua as kaitiaki, promoting their involvement in decision making, and safeguarding places and values of significance to mana whenua.

- The Crown and the twelve iwi of Hauraki, comprising the Hauraki Collective, signed Agreements in Principle Equivalents in July 2011. The twelve iwi are Ngāi Tai ki Tāmaki, Ngāti Hako, Ngāti Hei, Ngāti Maru, Ngāti Pāoa, Ngāti Porou ki Hauraki, Ngāti Pūkenga, Ngāti Rahiri Tumutumu, Ngāti Tamaterā, Ngāti Tara Tokanui, Ngaati Whanaunga, and Te Patukirikiri (*Office of Treaty Settlements 2014*). Most of the twelve iwi are expected to sign their iwi-specific Deeds of Settlement by the end of this year, along with the Hauraki Collective Deed.
- The Ngāti Manuhiri Deed of Settlement was signed in May 2011. It included an agreed historical account and Crown acknowledgements, which form the basis for a Crown apology to Ngāti Manuhiri, cultural redress and financial and commercial redress (*Office of Treaty Settlements 2014*).
- The Ngāti Whātua Ōrākei Deed of Settlement was signed in November 2011. It included an agreed historical account and Crown acknowledgements and apology, cultural redress, and financial and commercial redress (*Ngāti Whātua Ōrākei Claims Settlement Act 2012, Office of Treaty Settlements 2014*).
- The Tāmaki Makaurau Collective Deed of Settlement was signed by the Crown and 13 iwi/hapū of Tāmaki Makaurau, being Ngā Mana Whenua o Tāmaki Makaurau (the Tāmaki Collective) in September 2012. The Deed provides collective redress for the shared interests of the Tāmaki Collective in tūpuna maunga, motu, and lands within Tāmaki Makaurau, but does not settle any iwi/hapū historical claims (*Office of Treaty Settlements 2014*). This redress is now reflected in the Ngā Mana Whenua o Tāmaki Makaurau Collective Redress Act 2014.
- The Ngāti Whātua o Kaipara Deed of Settlement was signed in September 2012. It included an

agreed historical account, Crown acknowledgements and apology, cultural redress, and financial and commercial redress (*Ngāti Whātua o Kaipara Claims Settlement Act 2013, Office of Treaty Settlements 2014*).

- The Ngāti Pukenga Deed of Settlement was signed in April 2013. The settlement includes financial and commercial redress, the return of culturally significant properties, and financial assistance with cultural revitalisation and marae revitalisation in Manaia (*Office of Treaty Settlements 2014*).
- The Ngāti Haua Deed of Settlement was signed in July 2013. The Deed included financial redress and the return of culturally significant sites such as the mountain Maungakawa, located within Te Tapui Scenic Reserve. The settlement also acknowledged and recognised the importance of Te Kauwhanganui o Mahuta which is dedicated to the establishment of Te Kauwhanganui (the Māori Parliament) (*Office of Treaty Settlements 2014*).
- The Te Kawerau ā Maki Deed of Settlement was signed in February 2014. The settlement includes a historical account that describes the colonial experience of Te Kawerau ā Maki and their relationship with the Crown since 1840. It also provides for cultural, financial, and commercial redress, including the purchase of 86% of Riverhead Crown Forest Licence land and the vesting of significant cultural sites to the iwi (*Office of Treaty Settlements 2014*).
- The purchasing of the largest dairy farming operation on the Hauraki Plains (the Pouarua Dairy Complex) by Ngāti Maru, Ngāti Pāoa, Ngāti Tamaterā, Ngāti Tara Tokanui and Te Patukirikiri. The dairy complex was purchased using an on-account portion of their Treaty settlement redress, and will allow the collective to exercise kaitiakitanga over their resources. The collective is seeking to manage the farm sustainably for future generations and to work toward improving the quality of ancestral waterways (*Hauraki Gulf Forum 2013b*).
- Specific requirements were included in the Proposed Auckland Unitary Plan seeking to protect and enhance the tangible and intangible values of sites and places of significance or value to mana whenua.
- The Independent Māori Statutory Board released an update to its Schedule of Issues of Significance to Māori in Tāmaki Makaurau and Māori Plan in 2014. Those documents set out what the Māori Statutory Board seeks to achieve, and provides a blueprint for achieving it.

5.2.1 FUTURE DEVELOPMENTS

- The Hauraki Collective Deed will include, among other things, natural resource partnerships between the iwi of Hauraki, the Crown, and regional and territorial authorities in respect of tūpuna maunga, awa, and other taonga. This will restore the mana of the iwi of Hauraki to make decisions alongside their local government partners and exercise kaitiaitanga.
- Redress in respect of Tīkapa Moana, Te Tai Tamahine and Te Moana Nui ō Toi will be negotiated with the Crown in the near future which will enable tangata whenua to safeguard and take care of this taonga not only for the present generation, but for the tūpuna and mokopuna to come.



Photo: Waharoa on Rangitoto Wharf

5.3 CHANGING MANAGEMENT

Overview

Since 2011, central government as well as councils have progressed a number of new legislative and policy initiatives that apply to activities (e.g. fisheries), issues (e.g. freshwater management), species (e.g. seabirds), and areas (Auckland and Waikato regions) that affect the Gulf.
<p>Legislative changes since 2011 include:</p> <ul style="list-style-type: none">the amendment of the Biosecurity Act to provide for better integrated pest management approaches amongst central government agencies and councils,changes to the Maritime Transport Act to improve the management of ballast water discharge,changes to the Resource Management Act to facilitate the delivery of the first Auckland unitary plan; require the benefits and costs of the environmental, economic, social, and cultural effects of proposed policy statements and plans to be assessed and where possible quantified; and to provide more direction on monitoring of the state of the environment,the development and implementation of the Aquaculture Reform (Repeals and Transitional Provisions) Act, which provides for changes to aquaculture permitting and allocation processes, and consideration of the effects of aquaculture on fisheries.
The focus on single species and stocks used to set allowable catches for fisheries has not changed since 2011. However, annual operational plans have been produced for inshore finfish and shellfish fisheries. These plans describe objectives for the management of fish stocks relating to maximising and securing social, cultural and economic benefits from each stock and minimising adverse effects of fishing on the aquatic environment and biodiversity.
Progress is being made in relation to understanding fisheries risks to seabirds, marine mammals, non-target fish, benthic habitats, and elasmobranchs (sharks and rays). National plans of action for sharks and seabirds were updated. These plans guide the Government’s management of seabird and shark interactions with fisheries. Actions relating to black petrels and harvested sharks are particularly relevant to the Gulf.
The National Policy Statement for Freshwater Management 2011 was reviewed and updated in 2014 to include a national objectives framework for freshwater management, which includes some national bottom lines (i.e. for human and ecosystem health), and provides greater direction and guidance on setting freshwater objectives and limits.
Conservation Management Strategies are under review for Auckland and Waikato. These strategies include detailed sets of objectives to support the implementation of the Hauraki Gulf Marine Park Act and marine spatial planning in the Gulf over the next ten years.
The creation of the Aotea Conservation Park on Great Barrier Island was approved in July 2014. This initiative consolidates 12,109 hectares of public conservation land on Great Barrier Island and gives it greater protection.
The Auckland Plan was prepared and the proposed Auckland Unitary Plan was notified. These provide the framework for future development and resource management in the Auckland Region.

The Proposed Waikato Regional Policy Statement was adopted by the Waikato Regional Council, but remains under appeal. Regional and District Plans must be amended to give effect to Regional Policy Statement, and have their changes notified within two years of it becoming operative.
The proposed Thames Coromandel District Plan was notified and submissions have closed. The plan will eventually control landuse and development within the district.
The Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari, was initiated with the goal of developing the first Hauraki Gulf Marine Spatial Plan. Sea Change – Tai Timu Tai Pari is supported by tangata whenua, central government agencies, councils, and the Hauraki Gulf Forum.
It is uncertain whether the actions taken will be sufficient to counter the effects of increasing pressure on the Gulf. Reversing the historic loss of environmental functions and values will be even more difficult.

Since 2011, significant changes to the management frameworks that affect the Gulf have either been signalled, progressed or implemented by central government and councils. Similarly, a number of management decisions have been made which are expected to affect environmental outcomes in the Gulf. At the central government level, legislative and policy interventions that are relevant to the management of the Gulf include initiatives focused on particular issues, activities, species groups, and geographic areas. Legislative changes with relevance to the Gulf environment include amendments to the Biosecurity Act, the Maritime Transport Act, the Resource Management Act, and the Aquaculture Reforms (Repeals and Transitional Provisions) Act.

Revisions to the Biosecurity Act strengthen the involvement of regional councils in pest management, including marine pests. While central government retains overall leadership responsibilities, regional councils now have recognised leadership functions, including improving the coordination and alignment of approaches to regional pest management. Councils are also able to develop and implement pest management plans and programmes. In response to these changes, regional councils have already taken a more active role in marine pest management and eradication. For example, the Waikato Regional Council, in partnership with MPI, conducted its first biosecurity incursion response after the discovery of the Mediterranean fan worm in Coromandel Harbour in 2013. The Waikato Regional Council is also working with MPI and DOC to eradicate two estuarine plant pest species (Manchurian wild rice (*Zizania latifolia*) and cordgrass (*Spartina sp.*)) in the Hauraki Gulf (*P. Russell, WRC, pers. comm.*). Also relating to marine biosecurity, changes to ballast water management requirements have recently been enacted under the Maritime Transport Act. All ships are now required to exchange at least 95% of their ballast water before entering New Zealand waters (*Ministry for Primary Industries 2013e*). This measure is expected to reduce the risk of incursions, and is of particular relevance to the ports of Auckland and Tauranga, which are visited by large numbers of vessels. An import health standard aimed at reducing the biosecurity risk posed by vessel biofouling was also introduced in April 2014. This will be phased in as a voluntary standard for the next four years, and become a compulsory standard in 2018.

Amendments to the Resource Management Act (RMA) since 2011, which are of particular relevance to the Gulf include:

- new provisions relating to monitoring the state of the environment which enable the monitoring methods and the frequency of reporting to be prescribed,
- provisions to support the delivery of the Auckland unitary plan, and
- detailed requirements on the matters to be assessed in relation to decisions on proposed policy statements and plans prepared under the RMA.

The latter change requires the effects of proposed policy statements and plans to be supported by an assessment of environmental, economic, social, and cultural costs and benefits. Decision makers are specifically required to assess whether opportunities for economic growth and employment are anticipated to be provided or reduced. Similar criteria are not specified for environmental, social, and cultural values. These changes are intended to increase the rigour of analyses, but concerns have been raised about the potential for decision makers to give more weight to economic effects than environmental, cultural and other social effects (*e.g. see Wright 2013*). The package of amendments included in the Aquaculture Reform (Repeals and Transitional Provisions) Act also affects the Gulf ([see aquaculture case study](#)).

Reforms for freshwater management, which emerged from the government's Fresh Start for Fresh Water programme, are being rolled out. A key milestone was the release of the National Policy Statement for Freshwater Management in 2014. That introduced a national objectives framework for freshwater management, which includes some national bottom lines (i.e. for human and ecosystem health), and provides greater direction and guidance on setting freshwater objectives and limits. Auckland Council has established a programme "*Wai Ora – Wai Māori Tāmaki Makaurau, Auckland's Freshwater Programme*", to give effect to the National Policy Statement for Freshwater Management. It has a seven-year staged programme (2012–2019), and new plan provisions developed through the programme will then be incorporated into the Unitary Plan by way of a plan change. Waikato Regional Council has begun the Healthy Rivers: Plan for Change/Wai Ora: He Rautaki Whakapaipai project, with an initial focus on the Waikato and Waipa River catchments. This three stage project will develop new provisions for the Waikato Regional Plan. Stage two of the project will address the Hauraki Plains and Coromandel waterways, and is expected to start in 2015.

The focus on single species and stocks used to set allowable catches for fisheries has not changed since 2011. However, annual operational plans were released in 2012–13 for inshore finfish and shellfish fisheries. The plans describe management objectives and actions for stocks nationwide, including those in the Gulf. For shellfish and finfish, actions focus on improving the information bases relating to non-commercial harvest and the benthic impacts of fishing, development and implementation of harvest strategies, and the ongoing review of sustainability measures such as catch limits. For finfish, another key management action was to develop and implement a vessel monitoring programme, to support improved documentation of commercial catch and interactions with non-target species (*e.g. seabirds*).

Progress is also being made in relation to understanding fisheries risks to seabirds, marine mammals, non-target fish, benthic habitats, and elasmobranchs (sharks and rays). These actions are all relevant to enhancing the management of the Gulf's fisheries, and National Plans of Action (NPOA) were updated for seabirds and sharks in 2013. These plans have a five-year term, and articulate management actions relating to the two species groups with a particular focus on managing fisheries impacts. The NPOA-Sharks is focused on recognising the role of sharks in marine ecosystems, maintaining the biodiversity and long-term viability of sharks, and ensuring that any harvest of sharks is sustainable. This plan has risk assessment and research components which are intended to support the development of management measures. The identification

and conservation of critical shark habitats is also highlighted as an objective of the plan. The long-term objective of the NPOA–Seabirds 2013 includes two provisions relevant to the Gulf, that 'seabirds thrive without pressure from fishing related mortalities' and 'New Zealand fishers avoid or mitigate against seabird captures' (*Ministry for Primary Industries 2013h*). Similar to the NPOA-Sharks, the NPOA-Seabirds takes a risk-based approach. In accordance with the plan's objectives, seabird populations currently considered to be at high or very high risk of fishing-induced depletion should move to a lower risk category by 2018. The black petrel is the seabird at greatest risk from commercial fishing bycatch (*Richard & Abraham 2013*). This species is also caught in recreational fisheries (*Abraham et al. 2010*). Measures introduced to reduce fisheries captures of black petrels will also benefit other Gulf seabirds, such as the flesh-footed shearwater.

While no new marine protected areas have been created in the Gulf since 2011, the framework through which marine protection is addressed by central government has developed. This framework is anchored in the Marine Protected Areas Policy and Implementation Plan (*Department of Conservation & Ministry of Fisheries 2005, see section 7.1.2*). In accordance with this Plan, and building on the earlier development of a protection standard, a national-level coastal habitat classification and gap analysis was completed in 2011. This is expected to facilitate the planning of marine protection on a bioregional or sub-regional basis by stakeholder and community-led Marine Protection Planning Forums. These Forums are supported by DOC and MPI. The Hauraki Gulf is identified as a sub-region of the north-eastern Coastal Marine Biogeographic Region. DOC and MPI consider that the Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari will identify areas for marine protection in accordance with the planning and design principles described in the Marine Protected Areas Policy and Implementation Plan.

The Auckland and Waikato Conservation Management Strategies are under review. Previous versions of these strategies were completed in 1995 and 1996 respectively, prior to the establishment of the Hauraki Gulf Marine Park Act. Both draft strategies now include a set of objectives dedicated to the Hauraki Gulf Marine Park and the implementation of the act. These include working to implement the act, supporting the Hauraki Gulf Forum, working with tangata whenua, and enhancing conservation values as well as visitor opportunities and appreciation of the park. Both strategies also include provision to support the Sea Change – Tai Timu Tai Pari process.

In July 2014, the Minister of Conservation approved the creation of the Aotea Conservation Park on Great Barrier Island. The creation of the park will consolidate 12,109 ha of public land already managed under the Conservation Act, and give greater protection to land currently held as stewardship land (which comprises most of the park area). The park will be managed for the protection of its natural and historic resources, and for the facilitation of public recreation and enjoyment.

The amalgamation of councils in the Auckland Region has resulted in major changes to the region's governance and the Council's organisational structure. Auckland Council has taken time to 'bed in', but significant milestones have been achieved, including the preparation of the Auckland Plan and notification of the proposed Auckland Unitary Plan. Local boards have also been active in developing their plans.

The Auckland Plan is Auckland's strategy for creating the world's most liveable city. It includes a strong commitment toward green growth and environmental action as one of the six transformational shifts needed to meet Auckland's challenges over the next 30 years. A key element of the plan is that it aims to accommodate future population growth through the development of a quality compact urban environment with well-designed, higher-density development in selected areas. Population increases will mainly occur within specific growth areas, rather than being evenly spread throughout the catchment. Compact urban development will constrain the effects of Auckland's urban footprint on the Hauraki Gulf.

The Auckland Unitary Plan will replace the existing regional policy statement, four regional plans and nine district plans of Auckland's former local and regional councils³. The proposed plan contains guidance and rules about how people can use and develop land, and how people can use the natural and physical resources of the region, including the coastal marine area. An independent panel is expected to begin hearing submissions on the plan late in 2014, and to release its recommendations to the Council by September 2016. Provisions of particular relevance to the Gulf are summarised below.

- New controls are provided for development and activities that potentially affect outstanding natural landscapes, natural character, significant ecological areas, outstanding natural features, historic heritage and areas of significance or value to mana whenua.
- Urban growth is restricted to areas within the proposed Rural Urban Boundary.
- Regional and district earthworks provisions have been brought together. This means that a more comprehensive approach to managing sediment run-off from earthworks and land disturbance, including relatively small-scale earthwork activities. Some changes are also included on cultivation rules, which require greater setbacks from streams on steeper land. This risk-based approach should also help reduce sediment inputs from horticulture and market gardening.
- Permitted nitrogen application rates for dairy farms have been reduced. The plan is largely silent on the management of farm erosion and associated sediment runoff from pasture, but new rules will phase out livestock access to the coastal marine area, and to lakes, rivers, streams and wetlands on intensively grazed production land.
- Many, if not most coastal overflows from new wastewater networks will be covered by permitted activity rules. Discharges that don't comply with the permitted activity rules will be consented as controlled activities (i.e. consents cannot be declined but conditions can be imposed). For permitted activity discharges, the frequency of wet weather overflows must be an average of no more than two events per discharge location per year. For controlled activity discharges, a programme must be in place to ensure this standard is met by 2040. The plan provides little opportunity for public input on the consenting of wastewater overflows. Public consultation is not required for permitted activities. Limited consultation may occur in relation to controlled activities, but notification will not be required for either consenting process.
- The public stormwater network will continue to be operated using a 'best practicable option' approach. However, the plan places a greater emphasis on the onsite management of stormwater quality and runoff than the previous plans and policies. It also encourages the use of water-sensitive design and green infrastructure during subdivision and development, and requires stormwater from high contaminant generating areas and activities to be treated when development or redevelopment occurs.
- Controls on the untreated sewage discharge from boats have been extended from 500m to 2km off the shoreline, and there are new controls on vessel cleaning and maintenance to manage biosecurity and contamination issues.
- Regionally significant surf breaks are identified, and policies are included for their protection.
- Limits have been introduced for underwater noise.
- Restrictions on the removal of mangroves have been relaxed, with the removal of mangroves that have expanded into new areas since 1996 or from wading bird habitat being permitted.
- Restrictions on reclamation by the Port of Auckland have been strengthened.
- Controls on new aquaculture development have been relaxed.

The proposed Waikato Regional Policy Statement was notified in November 2010. It recognises and responds to the increasing pressure on natural and physical resources since the first Regional Policy Statement became operative. These pressures have resulted in:

- declining biodiversity,
- adverse effects on fresh water quality arising from intensive agricultural practices,
- increased demand for fresh water, and
- increasing development in the coastal marine area.

The proposed Waikato Regional Policy Statement differs from the Operative Regional Policy Statement in its structure, linkages and a prescriptive style. It also contains new provisions on the management of coastal and marine biodiversity, land use and development, and water quality. It seeks to provide an integrated and collaborative approach to resource management, supported by a stronger policy framework that will be implemented through provisions in regional and district plans. It signals the Waikato Regional Council's intent to align its activities, including works and services, education programmes, and environmental initiatives.

The Proposed Waikato Regional Policy Statement

- recognises the sensitivity and vulnerability of the marine receiving environment to sediment and nutrients, and requires the identification of marine water types and establishment of standards to be maintained or achieved,
- adopts a catchment-based approach in managing land use and freshwater quality, including the ability to respond to nutrient-sensitive water bodies when prioritising catchments for specific intervention, and a requirement to identify the current and desired values for freshwater water bodies and establish associated standards to be recognised and maintained,
- requires an integrated management approach including Waikato Regional Council seeking greater collaboration from district councils, government agencies, the dairy sector, tangata whenua and other resource managers and landowners in identifying and using practices that improve water quality,
- adopts a 100-year timeframe to allow for changes in natural physical processes around the coast due to climate change.

Appeals to the Proposed Waikato Regional Policy Statement are currently going through the Environment Court. Regional and District Plans must be amended give effect to Regional Policy Statement, and have their changes notified within two years of the policy statement becoming operative.

³Note that local provisions for the Hauraki Gulf Islands were not included in the Proposed Auckland Unitary Plan, as the Hauraki Gulf Islands Section of the Auckland Council District Plan was only recently made operative. However, they will be incorporated through a future plan change process.

The proposed Thames Coromandel District Plan was notified in December 2013 and submissions closed in March 2014. The plan will control landuse and development within the district. Matters of significance to the Gulf include provisions aimed at retaining biological diversity in identified areas and protecting natural functioning by controlling how and where subdivision use and development is carried out. The plan recognises the negative consequences of *ad hoc* and poorly planned subdivision and seeks to limit them by:

- providing for growth within three towns: Thames, Whitianga and Whangamata,
- providing for very limited growth in the settlements of Matarangi, Pauanui, Tairua and Coromandel, and
- constraining growth outside of these areas.

However, the proposed plan does not identify areas where the potential effects of development on natural character, outstanding natural features or outstanding landscapes make subdivision, use or development are inappropriate.

The Sea Change – Tai Timu Tai Pari Plan process is a unique opportunity to integrate local, regional, and national management tools and approaches, and align them to the objectives of the Hauraki Gulf Marine Park Act. It incorporates elements considered to comprise best-practice marine management (e.g. an ecosystem-based approach, consideration of humans as part of the ecosystem, integrated planning, and a focus on uses across sectors (*McGinnis 2012*)), but it will be non-statutory. The plan will be available in 2015, which will allow the next state of the environment report to consider central government and council responses to it.

A wide range of other non-statutory management actions have also been initiated, or have continued since 2011. These range from local projects, to catchment, region or nation-wide initiatives. Many of these involve working with communities, mana whenua, and stakeholders and will contribute toward improving outcomes for the Gulf ([see “Improving outcomes through non-regulatory tools” case study](#)).

It is also worth noting that environmental outcomes from many of the actions taken since 2011 are unlikely to be realised for a number of years. Past experience also suggests that provisions in proposed plans and policies, which seek to improve environmental outcomes, are likely to be ‘watered down’ during hearings and appeals. Finally, it remains uncertain whether intended actions will be sufficient to counter the effects of increasing pressure on the Gulf. Reversing the historic loss of environmental functions and values will be even more difficult.

5.3.1 CASE STUDY: APPLICATION OF NON-REGULATORY TOOLS

Regulation is only one half of the equation when it comes to addressing environmental issues. A range of other interventions and actions are increasingly being used to address environmental issues. This case study looks at three examples: the Sustainable Catchments Programme and the Rotoroa Island Trust, and the Peninsula Project.

THE SUSTAINABLE CATCHMENT PROGRAMME

The Sustainable Catchment Programme is an Auckland Council initiative that aims to blend science and community action to enhance water quality in priority catchments. It currently includes five catchments that feed into the Hauraki Gulf: Mahurangi (Mahurangi Action Plan), Whangateau, Greater Tamaki, Henderson – Huruhuru (Project Twin Streams), and South Waitemata (Meola, Oakley and Motions). Two of these, the Mahurangi Action Plan and Project Twin Streams, are highlighted below.

Project Twin Streams

Project Twin Streams was initiated in 2002 to reduce flooding, improve coastal and stream water quality, and to enhance streams in the Henderson Creek catchment. The project has been running since 2002 and involves a partnership between the Council and the community. The achievements of this programme include:

- around 700,000 trees planted along stream corridors,
- 34,000 volunteer engagements involving 165 groups and 15 schools,
- 81 houses and 78 parcels of land purchased to restore natural flow paths and reduce flooding, stream erosion and sediment loads,
- 9.3 km of pathways built to provide recreational opportunities and connect communities along the streams,
- the integration of urban art to increase the value, ownership, and pride that the community has in stream enhancement programmes,
- extensive riparian weed removal,
- a range of monitoring and environmental assessments.

Environmental outcomes in Project Twin Streams were augmented through the incorporation of urban art, music, and even drama in restoration efforts. By doing this, Project Twin Streams has created attractive, fun and playful spaces along stream corridors that link communities, bring people together, and connect them with the environment.

“The emphasis on creativity has been a strength of this project – however creativity is often seen as an add on or a nice to have. But the reaching the hearts and minds of people is critical to engaging communities and coming up with new ways of thinking – and has been a key part of the community development approach – thus preserving this strand is essential” (Atlas Communications 2012)

Mahurangi Action Plan

Concerns about Mahurangi Harbour had been growing for many years, and a number of community-led programmes were initiated to improve outcomes for the harbour. However, actions did not become crystallised until monitoring by the Auckland Regional Council clearly demonstrated that the health of the harbour was in serious decline. This highlighted that urgent action was required to save the quality and ecology of the harbour, and it ultimately led to the development of the Mahurangi Action Plan. The plan was first initiated in 2004 by the Auckland Regional Council and the Rodney District Council. Since 2009, tangata whenua, various communities and stakeholders in the Mahurangi have been working with the councils to develop an updated, community-led action plan (*Mahurangi Forum 2010*). The recognition of the traditional

and customary relationships of the tangata whenua of the Mahurangi, and their important role as kaitiaki (guardians) is an integral part of the Mahurangi Action Plan. As Naidia Glavish, Ngati Whatua Chairperson puts it, “*for us to fail our kaitiaki responsibilities, we do not fail for just a lifetime, we fail for the unborn Ngāti Whātua*” (Majorlook Productions 2010). Importantly, the plan aims to restore and maintain a healthy Mahurangi for the benefit of all people by:

- defining the things the community values and is seeking to protect,
- identifying issues that threaten those values, and by
- establishing objectives, actions, responsibilities, and timeframes for addressing those issues.

Progress is being made in implementing the plan. Actions to date have included the fencing of approximately 65 km of stream and coastal edge, resulting in around 38oha of land adjacent to riparian margins being protected from stock grazing between 2006–2011, and the production of around 40 farm management plans which support best practice land use. In addition, funding for around 17 km of fencing and around 30,000 plants was provided by Auckland Council in the 2011-12 to 2013-14 financial years. Engaging directly with farmers has made a tangible difference in getting them to connect their farming practices with harbour quality, and has spurred them into action. Neil Walker, a Mahurangi West landowner recalls that “*after fencing, you see how much the bush has improved and you get quite enthusiastic about the job. It was also quite appalling to see our cattle wandering around the foreshore, over towards the oyster farm, which was quite interesting, so we fenced off all of the foreshore*” (Majorlook Productions 2010).

The Mahurangi Action Plan recognises that there is no quick fix, and this is borne out by ongoing monitoring, which indicates that much more work needs to be done to restore the health of the harbour. Impacts on Mahurangi Harbour have been accumulating over many years, and it is going to take a long term commitment towards sustainable land management practices to turn things around.

Rotoroa Island Trust

The long timeframes anticipated for the recovery of Mahurangi Harbour and for the benefits of Project Twin Streams to accrue in Waitemata Harbour, contrast strongly with the rapid changes occurring on Rotoroa Island. For over 100 years, the Salvation Army used Rotoroa Island as a sanctuary for recovering addicts. However, in 2009 the generosity of philanthropists Neal and Annette Plowman allowed the island to be converted into a sanctuary of a different kind. They established the Rotoroa Island Trust, which with the help of Auckland Zoo, is transforming the island into open sanctuary for native and endemic species (Rotoroa Island Trust 2013). Within a very short period:

- stock and dogs have been removed from the island,
- a wildlife management and translocation plan has been developed,
- around 20,000 pine trees have been felled and chipped and almost 400,000 plants sourced from local seed, propagated and planted on the island,
- a state-of-the-art exhibition centre and museum has also been established to showcase the island’s history, and heritage buildings such as the jail, chapel, and schoolhouse have been restored,
- new amenities such as changing sheds, showers, toilets and barbeques have also been made available, along with boutique holiday accommodation,
- walking tracks have been installed to allow people to enjoy the natural spaces and views on the island,

- mammalian pests have been eradicated, and
- populations of saddlebacks and whiteheads have been established on the island.



Photo: Pōpokatea,
Whitehead
(*Mohoua albigilla*)

The efforts of the Trust have not gone unnoticed and in 2013 it won a Green Ribbon Award from the Ministry of the Environment for its commitment to restoring the island’s biodiversity. The Trust has no plans of slowing down. Milestones out to 2017 include the ongoing introduction of a variety of endemic birds, reptiles, fish and invertebrates. It aims to establish populations of species that can be independent and self-sustaining, and those that require ongoing management and support. This will allow the island to support a higher diversity of species than would naturally occur, and demonstrate the potential for islands to conserve endemic species (Fraser *et al.* 2013).

The Peninsula Project

The Peninsula Project is improving environmental outcomes for Coromandel Peninsula through integrated catchment management. The key aim of the project is to address river and erosion issues from the mountains to the sea through:

- catchment management and soil conservation works to stabilise land by preventing soil erosion,
- river management works to stabilise river and stream banks,
- flood protection to reduce the risk of flooding and improve drainage,
- animal pest control in the upper catchments to reduce the amount of sediment and debris carried downstream when it rains heavily,
- works and services in the coastal environment.

The project is a partnership between Waikato Regional Council, Thames-Coromandel District Council (TCDC), the Department of Conservation (DOC), and Hauraki Māori Trust Board. Financial support provided through this partnership is helping around 60 landowners a year to carry out restoration projects. These include riparian and coastal fencing and planting, wetland and native bush retirement, and soil conservation works like poplar pole planting and the retirement of erosion-prone gullies. So far, around 123,000 eco-sourced native plants have been planted and 165 kilometres of fencing completed along the margins of streams, the coast and forest fragments. This has resulted in the protection of 125 kilometres of stream, and 780 hectares of land being restored and retired. Four years of possum and goat control over nearly 74,000 hectares of Crown and private land has also been carried out, while flood mitigation schemes have been put in place in Coromandel town, Tapu, Pohue, Waiomu, Te Puru and Tararu. Coastal wetlands are also being restored at priority locations.

The Peninsula Project is also the umbrella under which a number of harbour and catchment management plans (HCMPs) have been developed. These plans seek to ensure that everyone in a catchment – from bach owners, farmers and iwi to government agencies – is working toward the common vision of protecting and improving catchment resources and resolving the issues that communities are concerned about. Guiding principles include:

- the promotion of best practice techniques;
- focusing on economic, social, cultural and environmental sustainability;
- recognising the importance of partnerships between agencies, the community and stakeholders;
- collaboration and the sharing of resources.

HCMPs have been developed for Whangamata, Wharekawa and Tairua. Key achievements from these plans include:

Whangamata: As of May 2012, 73 per cent of the rivers and streams in the Whangamata catchment were fenced off to exclude stock access.

Wharekawa: As of December 2013, 95 per cent of the rivers and streams in the Wharekawa catchment were fenced off from stock, including 100 per cent of the Waihitapu sub-catchment. In addition, 29 kilometres of the stream had been vegetated with native species, and unmanaged erosion had been limited to just 40 metres of stream bank. The channel of Wharekawa River is now regarded as being mostly clear and stable.

Tairua: As of March 2010, 57 per cent of the rivers and streams in the Tairua catchment were fenced off from stock, and a regionally significant cabbage tree forest was being restored, along with a number of coastal wetlands.

Importantly, these projects are helping to create proactive communities, with local care groups complimenting the outcomes sought by HCMPs through their own initiatives.

Other projects

The Sustainable Catchment Programme, restoration of Rotoroa Island and Peninsula Project are all examples of non-statutory initiatives that are assisting in improving outcomes for the Gulf. Similar projects are occurring in many parts of the Gulf, ranging from localised initiatives with site-specific outcomes (e.g. the Moehau Environment Group's efforts to aid the recovery of recovery of endangered species in the northern Coromandel and the remediation of legacy contaminant issues at Tui Mine), to large scale projects that cross statutory boundaries and integrate the actions of communities, tangata whenua and management agencies (e.g. the Kaimai Mamaku Catchments Forum which aims to improve outcomes for water, biodiversity and people in the Kaimai Mamaku Catchment). Common themes for many of these projects are a focus on partnerships, and on allowing individuals, communities and organisations to take ownership for environmental problems and be part of the solution.

5.4 CHANGING KNOWLEDGE

The 2011 State of our Gulf report identified five core knowledge needs for the Hauraki Gulf:

1. mapping and classifying the Hauraki Gulf ecosystems and defining its status,
2. defining the ecological infrastructure of the Hauraki Gulf,
3. getting the best return on resource exploitation,
4. defining the interrelationships between land and sea, and
5. adapting to the future.

These five core knowledge needs were still considered to be key priorities by specialists that attended a Hauraki Gulf State of our Gulf workshop held in March 2014. Representatives from NIWA, the University of Auckland, the University of Waikato, MPI, Auckland Council, Waikato Regional Council and Parliamentary Commissioner for the Environment attended.

Progress on addressing the core knowledge needs since the 2011 State of our Gulf report is summarised below.

- Existing data on habitats, amenities and uses of the Hauraki Gulf have been collated and mapped (*Jackson 2014; SeaChange 2014*).
- Estuarine habitats in the Coromandel Peninsula are currently being mapped on a fine scale (*J. Hewitt, NIWA, pers. comm.*).
- Monitoring of rocky reef communities, marine reserves, and environmental parameters (e.g., light, turbidity, sedimentation and underwater acoustics) is being conducted by Auckland University staff and students (*N. Shears, Auckland University, pers. comm.*).
- Zooplankton abundances were found to increase dramatically from the outer shelf to the inner Hauraki Gulf (*Zeldis & Willis submitted*).
- The first known breeding location for the NZ storm petrel, a critically endangered species, has recently been found within the Hauraki Gulf (*Rayner et al. 2014*).
- Habitats shape the diversity and structure of the marine community. In particular, biologically complex habitats, such as seagrass beds, kelp forests and sponge gardens, are particularly important. For example, seagrass and horse mussel beds are critical habitats for early juvenile snapper (*Sim-Smith et al. 2012; Parsons et al. 2014*). Loss of these key habitats can result in major shifts in the species assemblages of the community (*Jones 2013*). The productivity of kelp forests and their importance in fueling food webs is currently being studied (*N. Shears, Auckland University, pers. comm.*).
- High turbidity levels have been found to have negative impacts on the health and feeding of larval and juvenile snapper, thus high sedimentation rates are likely to adversely affect snapper populations (*Lowe, 2013*).
- Single-species fisheries can have a broad effect on the ecosystem. For example, fishing has reduced lobsters from being the third most ecologically important benthic invertebrate in the Gulf, to the least important. The reduction in lobster biomass has effectively removed the key role that lobsters once played in the ecosystem as a benthic predator, and they could now be regarded as being ecologically extinct in heavily fished areas (*MacDiarmid et al. 2013b*).
- Research on the population size, breeding biology, and foraging of at least 15 seabird species is currently underway in the Hauraki Gulf (*Gaskin & Rayner 2013*).
- Marine reserves can be used to increase the populations of targeted species, restore the ecosystem to its natural state, increase the productivity of an ecosystem, and improve the health of animals (*Babcock 2013, post-doctoral project, Auckland University*).
- A review of the ecological effects of aquaculture has been conducted that will assist in

developing a risk assessment tool to help understand the scale, likelihood and magnitude of the potential ecological effects of aquaculture activities (*Ministry for Primary Industries 2013f*).

- Black petrels and flesh-footed shearwaters are the first and third most vulnerable seabird species, respectively, to fishing by-catch mortality, nationwide. They are also the most 'at risk' species to fishing mortality in the Hauraki Gulf. Populations of both species are declining and capture rates are a serious concern for the sustainability of the population (*Bell et al., 2013; Richard & Abraham 2013*).
- The effects of benthic trawling on soft sediment habitat, fauna and processes is currently being researched. In addition, existing data will be used to classify benthic habitats and estimate their sensitivity and vulnerability to fishing disturbance. This research is not being carried out in the Hauraki Gulf, but the findings should be transferable (*Ministry for Primary Industries 2013a*).
- A review and synthesis of knowledge about the linkages between marine fisheries species and biogenic habitats in New Zealand has been undertaken (*Morrison et al. 2014a*). The review concludes that there is robust evidence that some biogenic habitats have been greatly reduced in their extent and quality, but the magnitude of loss is poorly understood. The review also highlights that a number of demersal fish species are strongly associated with biogenic habitats during their juvenile life phases (e.g. snapper, trevally, blue cod, tarakihi, leatherjackets), and that these habitats are likely to provide advantages in terms of growth and/or survival of these juvenile phases. Many of the habitats included in the review are present in the Hauraki Gulf.
- The life histories of coastal finfish have been reviewed in relation to identifying habitats and areas of particular significance their management in New Zealand (*Morrison et al. 2014b*). The species examined displayed a wide range of habitat affinities and geographical structuring, variation in age at maturity and longevity, and associated life histories. The review noted that despite decades of fishing and associated research on fisheries stocks, knowledge about the life histories, habitat usage and spatial structuring of most coastal fish species is arguably modest. A number of recommendations are provided for filling key knowledge gaps.
- Bryde's whales were found to be very vulnerable to ship strikes because they utilise the entire inner Hauraki Gulf, year-round, and spend the majority of their time in surface waters. A reduction in ship speed was found to be the best method of reducing the probability of ship strike (*Constantine et al. 2013; Riekkola 2013*). As a result of this research the Ports of Auckland have recently introduced a voluntary maximum speed of 10 knots within the Hauraki Gulf.
- The ecological effects of fishing on rocky reefs and lobster trap selectivity are currently being studied (PhD projects, Auckland University).
- Best practice methods for mangrove removal or restoration in the Hauraki Gulf are being studied to determine their social and environmental costs versus benefits (*C. Lundquist, NIWA, pers. comm.*).
- The potential for restoring subtidal mussel beds in the Hauraki Gulf, and their possible ecosystem benefits is currently being studied (PhD project University of Auckland and the Mussel Reef Restoration Trust).
- Primary productivity is greatest in the inner Hauraki Gulf where high nutrient inputs from the land and fast nutrient recycling occurs (*Gall & Zeldis 2011*). During winter and spring the Gulf is productive (consumes carbon), however, in summer and autumn the Gulf is respiratory (releases carbon) because of high nutrient loads. These high nutrient loads are causing oxygen depletion and a reduction in pH down to 7.9 in summer/autumn in the Firth of Thames. This is twice that of current acidification in the open ocean (pH change of 0.1 units from pre-industrial oceanic pH of 8.1), and consistent with pH observed in nutrient-impacted coastal zones overseas (*J. Zeldis, NIWA, pers. comm.*).
- Sedimentation has the potential to modify subtidal habitats (*Hadfield et al. 2014*) and is likely to cause an increase in mangrove cover (rather than vice versa) (*A. Swales, NIWA, Multiple Stressors programme*).
- The resilience of kelp forests to sedimentation is currently being studied (PhD project, Auckland University).

- Copper leaching from antifouling paint is a significant source of copper to the marine environment. The total annual copper input from Auckland marinas was estimated to be approximately double the copper input from the entire Waitematā stormwater catchment. Copper concentrations at most marinas exceeded the 90% ANZECC trigger values (*Gadd & Cameron 2012*).
- The potential impacts of climate change and increased stressors on estuarine communities and habitats in the Coromandel is currently being modelled so that we have a better understanding of the risks and implications of climate change impacts (*J. Hewitt, NIWA, Marine Futures programme*).
- A large portion of the Hauraki Plains is at risk inundation by rising sea levels (*R. Bell, NIWA, Climate Change Impacts and Implications programme*).
- Some new fish farming areas in the Gulf are in areas where ichthyotoxic blooms commonly occur (*Rhodes et al. 2013*). Currently, there is a lack of understanding about the mechanisms the cause fish deaths involving harmful algae blooms, making it difficult to develop any mitigation measures.



Photo: Flexible flapjack (*Carpophyllum flexuosum*)

6.

Environmental Indicators

Changes in the Gulf

Tamaki kainga ika me nga wheua katoa – Tamaki, where you eat the fish, bones and all (in reference to how plentiful and succulent the fish in Tamaki once were).

6.1 FISHERIES

Overview

Of the top 15 species of fish commercially caught in the Hauraki Gulf:

- 3 are at or above their target biomass,
- 1 is below its target biomass,
- overfishing is about as likely as not to be occurring for 1 species,
- 3 species are not thought to be at risk of collapse, but not enough is known about their stocks to properly assess their current status,
- the current status of 7 species is unknown.

Fishing has reduced the biomass of snapper and crayfish populations by around 70–80% in the Hauraki Gulf. It has also altered their size and age composition, with populations now dominated by small and young animals, with few large old individuals.

Large reductions in snapper and crayfish populations have altered the functioning and intrinsic values of reef ecosystems within the Hauraki Gulf. In protected areas, predation by snapper and crayfish has a major influence on kelp forest cover and reef productivity. In fished areas, the lack of snapper and crayfish predation leads to a reduction in kelp forest cover and lower reef productivity.

The 2013 snapper stock assessment indicates that snapper biomass has increased since the late 1980s, but it remains below its soft limit and further rebuilding is required. The assessment concluded that the target for the Hauraki Gulf-Bay of Plenty substock needed to be above 30% of the unfished biomass (Bo). However, the stock assessment did not determine what the stock’s target should be. An interim target was established for the stock of 40% of the unfished biomass (Bo), which the harvest strategy standard prescribes as suitable proxy for low productivity fish such as snapper.

In the 2011-12 fishing year the actual catch of snapper was estimated to exceed the Total Allowable Catch (TAC) by around 20%. This was primarily attributed to an increased recreational take. It was estimated that the TAC needed to be reduced by 54% percent to allow the stock to rebuild to the interim target within the timeframe specified by MPI’s harvest strategy.

The Minister for Primary Industries increased the snapper TAC by 6.6% and introduced a range of other management measures, which include, among other things, reducing the recreational bag limit, increasing the recreational size limit, installing vessel monitoring systems on all commercial vessels, requiring all catch under the commercial legal size to be reported, and establishing a Snapper 1 Strategy Group tasked with developing a long-term plan for the management of the stock.

The commercial methods used to fish for snapper do, or are likely to, have a significant impact on other parts of the ecosystem. Serious concerns are emerging about the impacts of long lining on seabirds, and bottom trawling occurs in areas that are known to include sensitive marine habitats.

Photo: Snapper (*Pagrus auratus*)

Slowing growth rates, diminished habitat quality, reduced habitat availability, and altered ecosystem dynamics are likely to have reduced the productivity of the snapper stock, and the capacity of the Hauraki Gulf to sustain snapper populations at historic levels.
Crayfish have gone from being the third-most ecologically important benthic invertebrate group in the Hauraki Gulf, to the least important group. In areas of low biomass, they could be regarded as being ecologically extinct.
Natural crayfish behaviours that are commonly observed in protected areas are rarely (if ever) reported in fished areas (apart from immediately around marine reserves).
Crayfish in the Hauraki Gulf and Bay of Plenty is estimated to be 20% below its current management target, but is considered to be 36% above the biomass required to produce the maximum sustainable yield.
The commercial catch for the CRA2 stock was reduced by approximately 15% from 1 April 2014 to allow the stock to rebuild to the management target. The catch reduction seeks to improve catch rates, but does not explicitly consider the role of lobsters in the broader ecosystem processes, nor does it consider values other than those related to fishing. No changes were made to the allowances for customary or recreational fishers from 1 April 2014.
In 2011, commercial fishers discovered a large scallop bed that had previously been unfished. The area is known to contain sensitive marine habitats. High scallop densities coupled with the large size of the bed means that this area is likely to be subject to ongoing disturbance by scallop dredging, which is likely to compound the disturbance cause by bottom trawling.
Other areas dredged for scallops are also known to contain sensitive marine habitats.
Trends in cockle abundance have varied at the six sites that are regularly monitored by MPI in the Gulf, but all sites have displayed declining trends in the proportion of harvestable sized cockles. This is likely to be due to the recruitment of small cockles, which will subsequently grow through the population and increase the proportion of harvestable sizes.

New Zealand’s fisheries are managed using a quota management system, which was introduced in 1986 to address a concerning decline in some fish stocks. Under this system, New Zealand’s coast is divided into quota management areas (QMA), which can vary among species (*Lock & Leslie 2007*). The Minister for Primary Industries must set the total allowable catch (TAC) in tonnes for quota species within each QMA, which is apportioned to customary, commercial and recreational users. Priority is given to ensuring that there is sufficient allowance for customary harvest, and the remaining catch is divided between the commercial and recreational fishing sectors (*Lock & Leslie 2007*).

The Minister is required to set a TAC that will maintain each stock at, above, or working towards a level that can produce the maximum sustainable yield (MSY). The MSY is the greatest yield (catch) that can be achieved over time while maintaining the stock’s ability to keep producing. The MSY for a given stock will depend on its biology and environmental influences on its population dynamics. Typically, the MSY is produced by a stock at a biomass level (BMSY) well below its unfished state, because increased productivity occurs in smaller populations that comprise younger, faster-growing fish that have less competition for food and space. The Fisheries Act provides for stocks to be managed at biomass levels greater than the BMSY where various factors indicate the

purpose of the Act would be better achieved by a higher target biomass. These factors can include management of specific environmental risks, or achievement of particular social, cultural or economic objectives. The legislation also requires that all sustainability decisions must take into account: effects on associated and dependent species; the maintenance of biological diversity; and, protection of habitat with particular significance for fisheries management.

The Minister tightly regulates the amount of fish able to be commercially harvested by setting an annual total allowable commercial catch (TACC). The TACC for each species is shared among commercial fishery participants that own individual transferable quota (ITQ) for that species. The proportion of the total quota shares they possess is equal to the proportion of the TACC they are allowed to take in any fishing year. Owing to the reporting required for the commercial sector, it is usually relatively simple to obtain information on commercial catch levels (*Lock & Leslie 2007*).

The Māori customary fisheries regulations (‘Kaimoana’ regulations) also require reporting to MPI. However, reliable records of customary fishing are not yet available for the Hauraki Gulf. Māori are also commercial and recreational fishers, and are required to conduct those activities in accordance with the appropriate regulations (see [Case Study: Māori Fishing](#)).

In contrast, recreational harvesting is managed using multiple measures such as seasonal closures, bag limits, size limits, and restrictions on fishing equipment and locations. Reporting of recreational catch is not required, therefore recreational harvest quantities are estimated through various methods such as aerial and boat-ramp surveys. Consequently, the size of the recreational catch is more uncertain and can change in an unknown fashion with changes in the size of the fishing population, stock biomass, fishing patterns, and/or access to sophisticated fishing technology.

Within this report, fishery indicators are considered in terms of the state of the environment, rather than the state of the fishery. Fisheries assessments seek to maximise the yield, while maintaining the stock’s productive capacity. This is achieved by deliberately fishing down stocks to levels where productivity is maximised. Models indicate that this usually occurs somewhere between 30 and 60% of unexploited levels (*Mace 2001*), but it can be lower. As a result, fishing is a major environmental stressor that affects the whole of the Gulf. In this report fisheries data is therefore interpreted from an environmental management perspective, rather than from a fisheries sustainability or productivity standpoint. However, there is considerable overlap between the two, and the objectives sought for fisheries overlap those sought for the Hauraki Gulf. Sustainability indicators developed by MPI are therefore provided in [Section 6.1.1](#) below. These are complemented by more detailed information on:

- the state of three ecologically, economically and culturally important species (snapper, crayfish and cockles), and
- bottom disturbance.

6.1.1 INDICATORS OF FISHERIES SUSTAINABILITY

Sustainability indicators for the top 15 inshore finfish species caught in the Hauraki Gulf (by catch weight) are presented in **Table 1**. Depending on the species, these indicators are assessed in relation to:

1. quota management areas, which are much larger than the Hauraki Gulf, or
2. north-eastern New Zealand, Hauraki Gulf and Bay of Plenty substocks, which are contained within, or include parts of the Hauraki Gulf.

The status of fisheries and stocks is characterised by MPI in the following way:

- **overfishing:** If average fishing mortality is higher than the rate that will produce the MSY (or another appropriate target), overfishing is deemed to be occurring. If overfishing continues, such

stocks will ultimately be depleted below the biomass that produces the MSY.

- **depleted** (below the soft limit): If stock levels reach less than 50% of the biomass that will produce the MSY, or 20% of unfished stock levels (whichever is higher), they are depleted (or overfished) and in need of rebuilding.
- **collapsed** (below the hard limit): If stock levels reach less than 25% of the biomass that will produce the MSY, or 10% of unfished stock levels (whichever is higher), they have collapsed.

The Harvest Strategy Standard for New Zealand fisheries specifies that for stocks falling below the soft limit, a formal, time-constrained rebuilding plan is triggered, whereas fisheries closures should be considered if stocks fall below the hard limit (*Ministry of Fisheries 2008*).

Of the 15 key species listed:

- 2 species (red gurnard and kahawai) are at or above target levels and are not considered to be depleted or at risk of collapse.
- Snapper is below the target level and needs rebuilding. It is not at risk of collapse in the short term, but a reduction in catch is likely to be required to prevent the stock declining towards collapse over the medium to long term (see Section 6.1.3 for more detail).
- John dory is likely to be below its target level in the North East New Zealand – Hauraki Gulf substock, and about as likely as not to be at or above the target in the Bay of Plenty substock. Neither of these substocks are considered to be depleted or at risk of collapse.
- 3 species (pilchard, baracoutta and grey mullet) are not considered to be at risk of collapse, but not enough is known about these stocks to assess their status against targets and limits.
- Overfishing of trevally is about as likely as not to be occurring, but this cannot be confirmed because of a lack of reliable data. Not enough is known about this stock to assess its status against targets and limits.
- For the remaining 7 species (jack mackerel, tarakihi, flatfish, yellow-bellied flounder, leatherjacket, rig and parore) the status of the stocks is unknown, because an appropriate quantitative analysis has not been undertaken or because the analyses that have been carried out have not been definitive enough to assess their status.

Changes in the status of stocks since the 2011 State of our Gulf report are listed below.

- Snapper: The SNA1 stock status was reassigned from ‘at target levels’ and ‘not depleted’, to ‘well below target levels’ and ‘mildly depleted’. The change in status was caused by a change in the target level rather than a decrease in the stock biomass (biomass has increased since the 1980s).
- John dory: In 2010 there was insufficient information about the status of the North East New Zealand – Hauraki Gulf or Bay of Plenty John dory substocks to determine whether the substocks were at their target levels. Additional information collected since 2010 indicates that the North East New Zealand – Hauraki Gulf substock is likely to be below its target level, and the Bay of Plenty substock is about as likely as not to be at or above its target.
- Red gurnard: In 2010 there was insufficient information about the status of the East–Bay of Plenty gurnard substock to determine whether the stock was at its target level. Additional information collected since 2010 indicates the stock is currently around the target level. Insufficient information is available to determine whether overfishing is occurring, but catch rates have been relatively consistent since 1986–87, suggesting that they are probably sustainable.
- Tarakihi: In 2009 the TAR1 East Tarakihi stock was assessed as slightly overfished but not in danger of collapse. However, the recent assessment of the TAR1 East stock concluded that there is insufficient information available about the stock to make any conclusions about the stock status.

6.1.2 CASE STUDY: MĀORI FISHING

Kaimoana has always been an important taonga for Māori, primarily as a food resource and additionally as a means to enhance mana; if you had access to abundant kaimoana you could provide it to your guests and also use it for trade. Today kaimoana remains just as important to Māori as a food source and means to enhance mana. Collectively, Māori are also the largest group in the New Zealand fisheries, controlling over a third of the industry, a position which is the culmination of negotiations with government that started in the late 1980s and finalised by the Māori Fisheries Act in 2004.

Māori/iwi organisations have a reasonable proportion of the commercial quota for the Hauraki Gulf (~40%), with which they hope to generate an economic yield for the organisations they own, and ultimately their beneficiaries. Many iwi organisations also seek to implement the concept of kaitiakitanga in their activities, including commercial fishing. The expression of kaitiakitanga requires Māori to take into account the sustainability of individual species, the broader impacts of fishing, the ability for whanau, hapū and iwi to obtain food for their needs, and the economic returns that fisheries provide to iwi. The challenge is to get the balance right, and to determine how that should be decided, recognising that there is no single voice for Māori.






All commercial fishing is subject to the Quota Management System (QMS). Interestingly, the intent of the QMS is similar to kaitiakitanga – both are focused on the sustainability of the fishery – but they differ slightly as the QMS seeks to maintain the fishery at sustainable levels (the maximum sustainable yield: a ‘tipping-points’ approach), whereas a kaitiakitanga approach might aim to enhance the mauri of the fishery.



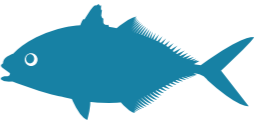


Enhancing mauri is not solely dependent upon the action of taking fish in a sustainable manner – it also includes contributing mātauranga Māori to the collective understanding of the fishery and the role iwi play in decision-making. In order to be fully effective, all actions should be based on kaitiakitanga principles and measures such as a rahui (ban) need to be universally applied across all sectors: commercial, recreational, and customary. A number of statutory tools are available to accomplish this, including Taiapure and Mahinga Mātaitai reserves, which can be established under the Fisheries Act 1996. Such measures give Māori better control over local fisheries and recognise their role as kaitiaki.

Some iwi organisations are also exploring how to use their fishing quota more efficient and sustainably. One example being examined, is the Icelandic model, where 97% of each fish is used. The highest yielding product is the skin, sold to fashion houses such as Gucci and Dolce&Gabbana. Nutraceuticals are also derived, leaving the fillet as one of the least-valued products. This is a stark contrast to the NZ model where the fillet is virtually the only product.

For many Māori the ability to catch/gather their own kaimoana is very important. The maintenance of the fishery for subsistence, pleasure and traditional and customary practices is therefore of similar importance. Under the Fisheries Act, a proportion of the total allowable catch is set aside for customary fishing. This is typically used to obtain kai moana for specific events such as tangi or weddings. However, much of the fish caught by Māori is likely to be obtained in accordance with the recreational fishing regulations. As a consequence, the amount of fish available to individuals and their whanau is reduced as the recreational the catch is spread more thinly, for instance, through declining bag limits. The daily bag limit for recreational fishers has progressively been reduced from 30 to 20 snapper in 1993, 15 in 1994, 9 in 1997 (*Ministry for Primary Industries 2013*), and 7 in 2014, and further reductions may be required to allow the snapper stock to rebuild.

Table 1: Status of major Hauraki Gulf commercial finfish stocks reported in MPI’s 2013 Stock Status Table (16 October 2013), with comments obtained from the 2013 plenary report (MPI, 2013). Note that the extent of quota management areas vary among species, but are generally larger than the Hauraki Gulf.

					
	Snapper	Jack mackerel	Pilchard	John dory	Red gurnard
Last assessed	2013	None	None	2013	2013
QMA or substocks	SNA1 (HG-BoP)	JMA1	PIL1	JDO (HG & EN, and BoP)	GUR1E
At or above target levels	Very unlikely to be	Don't know	Don't know	Unlikely to be	About as likely as not
Overfishing	Likely	Don't know	Unlikely	About as likely as not	Don't know
Depleted	About as likely as not	Don't know	Don't know	Unlikely	Unlikely
Collapsed	Very Unlikely	Don't know	Unlikely	Unlikely	Very unlikely
Comments	Status of snapper stocks in SNA1 have declined since the last assessment in 2000, when stocks were considered to be around target levels and not depleted. Estimated biomass in 2013 was 19% of unfished biomass, well below the interim MSY of 40% unfished biomass. See Section 6.1.3 for more details. The change in status was caused by a change in the target level rather than a decrease in the stock biomass, which has increased by 68% since its minimum level in the 1988.	3 species of jack mackerel are caught with 80% of the TACC coming from JMA1. It is not known whether catches are at the level of the current TACCs or recent catch levels are sustainable in the long term.	There have been no stock assessments of pilchard and no estimates of current biomass are available. It is not known if the current catches or TACCs are sustainable. Reported landings have been decreasing since 2003, with landings in 2011–12 only 14% of 2003–04 landings.	John dory is mainly taken as a bycatch species. Estimates of absolute reference and current biomass are not available, but the HG-EN and BoP substocks are unlikely to be depleted. Recent catches and the current TACC are likely to be sustainable in the short-term, but it is not known whether they are sustainable in the long-term. There is some concern about declining landings and catch rates in the HG-EN substock since 2005. The CPUE of the BoP substock has fluctuated close to the long-term mean since the early 2000s.	Red gurnard are mainly taken as bycatch in GUR1E. Stock abundance appears to be cyclic but there is no information on recruitment. Given that landings have been relatively stable since 1986–87, recent catch levels are unlikely to compromise long-term sustainability. Additional information since the 2010 assessment indicated that the stock is around target level and is not depleted or at risk of collapse.

					
	Kahawai	Tarakihi	Trevally	Flatfish	Yellow-bellied flounder
Last assessed	2009	2012	2006	2008	None
QMA or substocks	KAH1	TAR1	TRE1	FLA1	FLA1 Hauraki Gulf
At or above target levels	Likely to be	Don't know	Don't know	Don't know	Don't know
Overfishing	Unlikely	Don't know	About as likely as not	Don't know	Don't know
Depleted	Unlikely	Don't know	Don't know	Don't know	Don't know
Collapsed	Very Unlikely	Don't know	Don't know	Don't know	Don't know
Comments	Assessments carried out in 2008 predicted that biomass in KAH1 fisheries management area (including the Hauraki Gulf substock) would increase over the next five years. It is unlikely that the stock will decline below the biomass that produces the MSY at currently assumed catch levels.	Landings and catch rates have been gradually declining since the late 1990s. The decline appears to have stabilized at around 60% of the long term mean. It is not known whether catch rates are at, above or below a level that can produce the MSY.	The 2006 assessment for TRE 1 was not accepted by the Pelagic Working Group because of the lack of a reliable abundance index. Recent catches reported for TRE1 are less than the estimated maximum constant yield (MCY) levels and below the TACC. Reduced proportions of older age classes in the single bottom trawl catch between 1999–2000 and 2006–07 combined with the strong drops in landings in 2006–07 and 2007–08 may indicate that stock abundance is declining at current catch levels.	Flatfish is a combined grouping of eight species. The Hauraki Gulf is an important fishing ground for two of these: yellow-bellied flounder and sand flounder. Fishers often report these species under the generic flatfish code, even though they also have their own species-specific codes. See below for further comments on yellow-bellied flounder.	Catch rates per unit effort have declined since 2006–07 and are currently around the long term mean. The lack of species specific reporting is limiting the ability to assess stocks.

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	Leatherjacket	Rig	Baracoutta	Grey mullet	Parore
Last assessed	None	2013	None	2007	None
QMA or substocks	LEA1	SPO1	BAR1	GMU1	PAR1
At or above target levels	Don't know	Don't know	Don't know	Don't know	Don't know
Overfishing	Don't know	Don't know	Don't know	Don't know	Don't know
Depleted	Don't know	Don't know	Unlikely	Don't know	Don't know
Collapsed	Don't know	Don't know	Unlikely	Unlikely	Don't know
Comments	There are no estimates of reference or current biomass. It is not known whether the leatherjacket stocks are at, above or below a level that can produce the MSY.	Since the early 1990s there have been no apparent trends in catch rates. No estimates of current or reference biomass are available and it is unknown whether the current TACC is sustainable.	Estimates of current and reference biomass are not available for any baracoutta stocks and therefore it is not known if current TACCs and recent catches are sustainable or whether they are at levels which will allow the stocks to move towards a size that will support the MSY.	The Hauraki Gulf substock makes a relatively minor contribution to catches in the GMU1 fisheries management area. Catch rates have fluctuated in this substock since 1990, but have not displayed consistent trends. Harbours and embayments appear to contain relatively distinct sub-populations of grey mullet.	Estimates of current and reference biomass are not available. It is not known if recent catch levels or TACCs are sustainable.

6.1.3 SNAPPER (TĀMURE)

Snapper are the dominant fish in northern inshore marine communities, and occupy a wide range of habitats including rocky reefs and areas of sand and mud bottom. They are most abundant in 15m to 60m water depth, but can also be found in depths of about 200m (*Ministry for Primary Industries 2013b*). Snapper reach sexual maturity sometime between their second and fifth year, with spawning occurring in spring and summer (*Francis & Pankhurst 1988*). Adult fish often form transient spawning aggregations in the same locations each year (*Zeldis et al. 2005; Jackson & Moran 2012*). The distribution of snapper eggs suggests that spawning aggregations in the Hauraki Gulf are often associated with regions of high plankton densities (see **Figure 6-1** for a typical example of egg distribution), suggesting that adult fish choose spawning locations that can support high feeding rates in larvae (*Zeldis et al. 2005*). High water temperatures and food abundance appear to be critical for the survival of snapper larvae and the subsequent success of the year class. In years where food is plentiful, snapper larvae are up to 30 times more abundant, which often leads to higher abundances of juvenile and adult snapper in subsequent years (*Zeldis et al. 2005; Hamer et al. 2010*).

Snapper larvae spend 17–33 days in the plankton before settling in the shallow waters of harbours and estuaries (*Sim-Smith et al. 2012*). Juvenile snapper less than 6 months old prefer to settle in areas that have complex biological habitats, such as seagrass beds, horse mussel beds and sponge gardens (*Usmar 2009; Sim-Smith et al. 2012; Lowe 2013*). Historically, soft-sediment, subtidal green-lipped mussels beds were also likely to be an important settlement for snapper (*McLeod 2009*), though no research has been conducted on the recruitment of snapper to green-lipped mussel beds. These biological habitats may offer fish higher food abundance, and a refuge from predators and water currents. Subtidal seagrass and mussel beds within the Hauraki Gulf have almost completely disappeared (*McLeod 2009; Turner & Schwarz 2006*), and this loss of settlement habitat for juvenile snapper may have resulted in reductions in snapper abundance. After around 6 months, snapper gradually move out of the shallows and disperse around the coastal environment, occupying a wide range of habitats from rocky reefs, bare mud/sand and turfing algae (*Parsons et al. 2014*). Migration rates can be high in juvenile and sub-adult snapper, and fish have been recorded to travel up to 300 km from their settlement estuary (*Hamer et al. 2005*).

Snapper are generalist feeders, who consume a wide range of prey including crustaceans, shellfish, worms, fish and urchins (*Godfriaux 1969, Usmar 2012*). Protected snapper and crayfish populations have a positive effect on kelp forest cover and primary productivity in the Hauraki Gulf through the consumption of kina (*Evechinus chloroticus*) (*Babcock et al. 1999; Shears & Babcock 2002*). Kina grazing creates and maintains reef or urchin barrens by denuding kelp cover and preventing its re-establishment. Consequently, kelp-free urchin barrens tend to be more prevalent in areas where fishing is allowed, and less prevalent in protected areas such as marine reserves (*Babcock et al. 1999, Shears & Babcock 2002*).

Snapper is a highly prized and intensively fished species. The Hauraki Gulf is a nationally significant for its large contribution to the overall snapper stock. It is the most targeted commercial species in the Gulf, and snapper yields (by weight) are greater than any other species. Snapper are also New Zealand’s most sought-after recreational saltwater fish (*Bradford 1999*). As a result, fishing has had a major effect on the size and characteristics of the Hauraki Gulf snapper population, with the overall spawning stock biomass of the combined Hauraki Gulf and Bay of Plenty substocks being reduced by around 80% (**Figure 6-2**), and the population becoming dominated by small fish. The Hauraki Gulf is part of the “Snapper 1” (SNA1) quota management area, which is subdivided into three substocks: East Northland, Hauraki Gulf and Bay of Plenty (**Figure 6-3**).

The current biomass of snapper in the Hauraki Gulf – Bay of Plenty substock is below its soft limit, as defined in accordance with MPI’s harvest strategy standard (*Ministry of Fisheries 2008*). That

situation triggers the need for a formal, time-constrained rebuilding plan. The interim target for the SNA1 stock is 40% of the unfished biomass, but the actual target will be determined through the SNA1 strategy group, which MPI have established (see [Case Study: Snapper management decision](#)).

Surveys of marine reserves also demonstrate the effects of fishing on snapper populations. Fished populations around marine reserves have low numbers of mainly young snapper that are below or near the legal size limit, while protected populations contain large numbers of snapper, with a high proportion of older fish above the legal size (*Sivaguru 2007, Haggitt et al. 2010*). For example, between 2000 and 2007 the mean densities of legally harvestable snapper around the Cape Rodney to Okakari Point Marine Reserve have varied from 1% to 14% of densities inside the reserve (*Sivaguru 2007*). Similarly, between 2000 and 2012 the mean density of legally harvestable snapper around the Te Whanganui-a-Hei (Hahei) Marine Reserve varied from 0% to 28% of mean densities within the reserve (*Haggitt et al. 2010, Haggitt unpublished data*). In contrast, densities of undersized snapper outside these reserves frequently exceeded mean densities inside the reserves. Mean snapper size ranged from 289 mm to 404 mm in the Cape Rodney to Okakari Point Marine Reserve (cf. 148 mm to 242 mm outside) between spring 2000 and autumn 2007, and 233 mm to 323 mm in the Hahei Marine Reserve (cf. 144 mm to 290 mm outside) between spring 2000 and autumn 2010.

While fishing is likely to have the greatest influence on the Hauraki Gulf snapper population, there are a range of other factors which could potentially compound fishing effects. These are summarised in **Table 2**. It is also notable that snapper growth rates have been declining in recent years, which has resulted in a substantial net weight loss in the SNA 1 fishery over the past two decades. Slowing growth rates will undoubtedly have a negative impact on the ongoing productivity of the snapper stock (*Walsh et al. 2011*). The causes of slowing growth have not been determined but they could include a combination of: changes in environmental quality and the resources used by snapper, increasing competition for available resources as the snapper population increases, and fisheries-induced evolutionary selection for slower growth (see *Enberg et al. 2012 for a recent review of fishing-induced evolution of growth*).

Overall, the existing data suggests that fishing has reduced the snapper population by around 80% or more in the Hauraki Gulf and Bay of Plenty, with the greatest impact on old, large fish. This represents a major reduction in the population of an individual species, and has contributed to an alteration in the functioning and intrinsic values of reef ecosystems within the Hauraki Gulf. The effects of removing snapper from the ecosystem are likely to be compounded by fishing methods such as bottom trawling that physically disturb the seafloor, and kill or injure benthic species (see [Section 6.1.6](#)). Seabird mortality from snapper long lining is also a serious concern (see [section 6.11](#)). Snapper growth rates have also slowed. The reasons for this have not been determined, but the consequences are likely to include a reduction in snapper productivity. From a Māori perspective, the mauri of this species could be regarded greatly diminished (see the [Māori Fishing Case Study](#)).

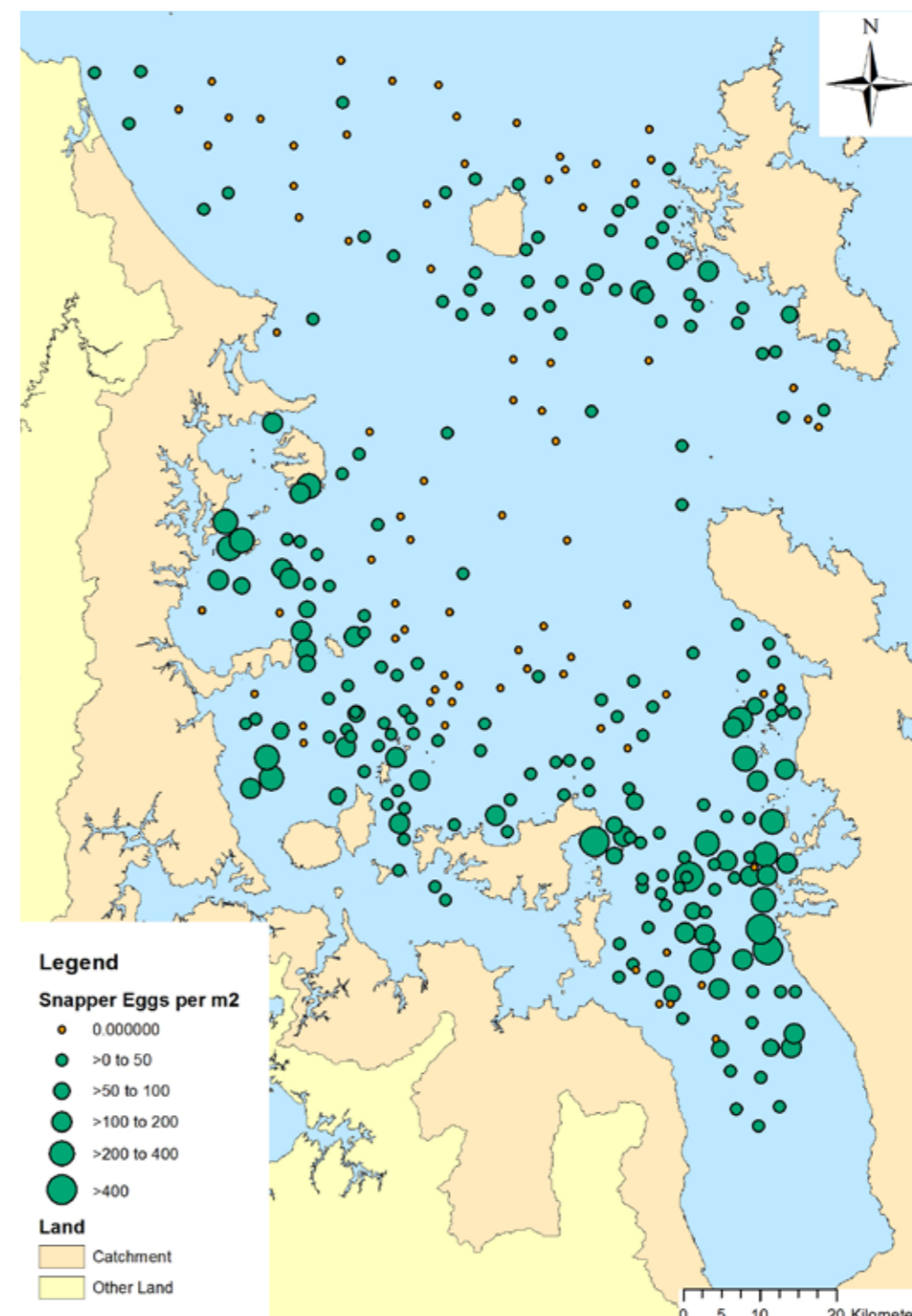


Figure 6-1: Density of <24 hour old snapper eggs obtained during a December 1992 survey (data provided by John Zeldis, NIWA).

Figure 6-2: Model reconstruction of the biomass of the Hauraki Gulf snapper substock in a) tonnes, and b) as a percentage of the unfished biomass (adapted from Ministry for Primary Industries 2013d). The dotted lines represent the interim target (40% Bo), the soft limit (20% Bo) and the hard limit (10% Bo).

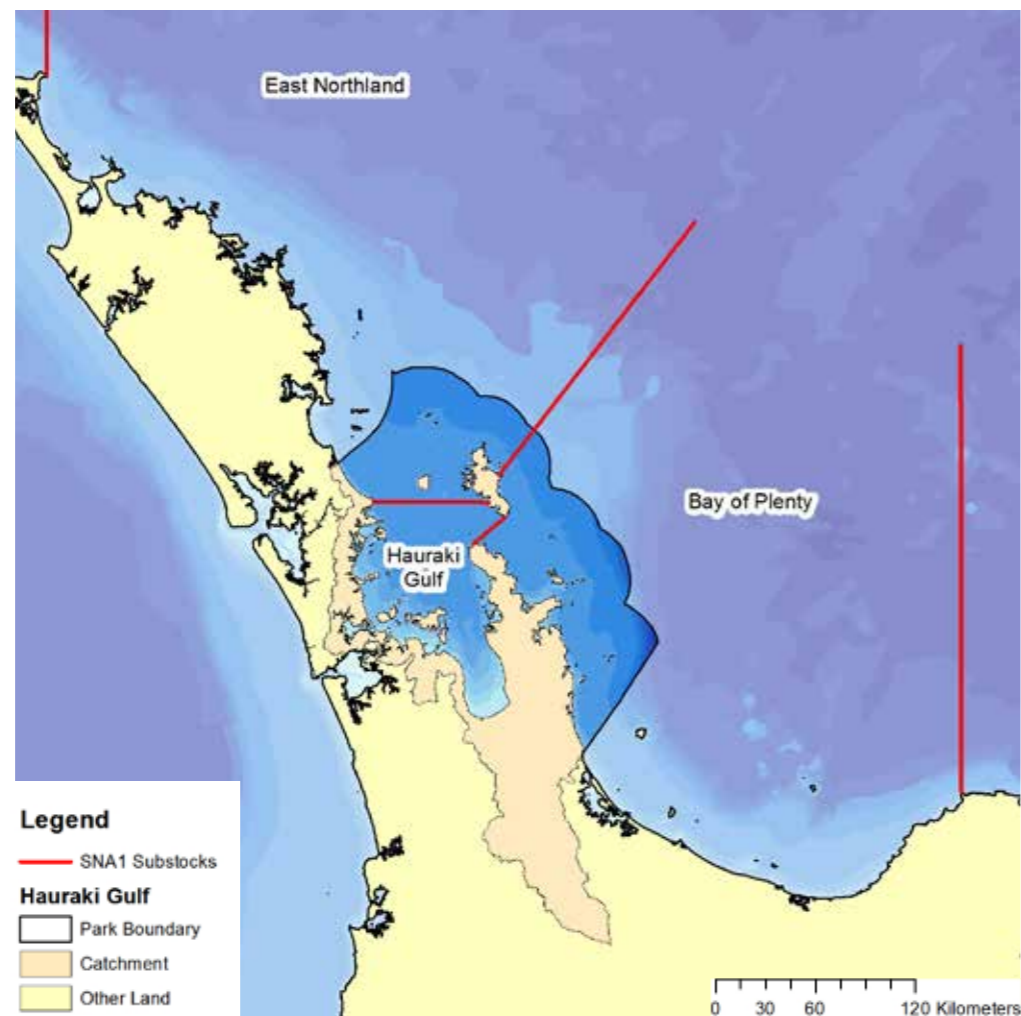
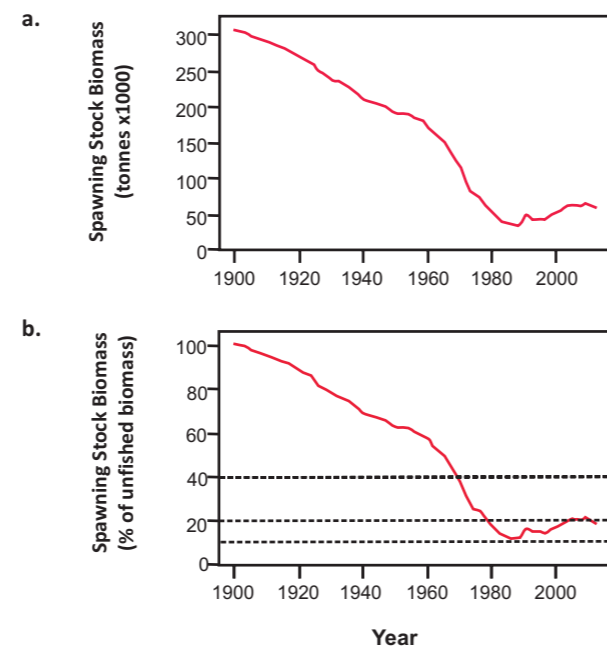


Figure 6-3: East Northland, Hauraki Gulf and Bay of Plenty substocks in the Snapper 1 (SNA1) quota management area (adapted from Figure 7 in Ministry for Primary Industries (2013j)).

Table 2: Major human influences on snapper populations. Information has been summarised from Parsons *et al.* (2014).

Effect	Impact on snapper population	
Incidental fishing effects	Spawning disturbance	Disruption of spawning events by fishing may decrease the reproductive output of snapper.
	Bottom disturbance	Reduced habitat quality could affect the environmental carrying capacity for snapper.
	Alteration of prey availability	Fishing can directly and indirectly alter the availability of prey species.
Land-based effects	Increased nutrients	Small increases in nutrients could increase the availability of food (plankton) for snapper larvae. However, large increases in nutrient inputs could be detrimental to snapper health if they decreased foraging ability at high turbidity levels, diminished seagrass habitats due to low light levels, and increased incidences of harmful algae blooms and low dissolved oxygen levels.
	Increased sediment	<ul style="list-style-type: none"> High concentrations of suspended sediments decrease the foraging ability of snapper and impair their gill function. Sediment alters habitat characteristics and quality. Sediment affects the availability of prey species.
	Toxic compounds	The effect of toxic compounds on snapper has not been specifically studied. Currently, few if any sites in the Hauraki Gulf are likely have contaminant concentrations that could cause population level affects.
Habitat modification	Dredging, trawling, reclamation and construction results in the loss or reduced quality of habitats used by snapper.	
Aquaculture	<ul style="list-style-type: none"> Mussel farms provide additional food and habitat complexity for snapper. Mussels may extract snapper eggs, though the extent and effect of this predation is unknown. 	
Invasive species	Invasive species that have been accidentally introduced into NZ may be a food source, competitor or predator of snapper.	
Climate change	The impact of climate change on snapper populations is unknown and difficult to predict.	

6.1.4 CASE STUDY: SNAPPER MANAGEMENT DECISION



Photo: Snapper (*Pagrus auratus*) amongst Common Kelp (*Ecklonia radiata*)

The Hauraki Gulf Marine Park falls within the boundaries of the “Snapper 1” (SNA1) quota management area, which for assessment purposes is subdivided into three substocks: East Northland, Hauraki Gulf and Bay of Plenty. The management of the SNA 1 fishery was reviewed in 2013 in response to new information, which indicated that the actual estimated catch of 9,065 tonnes was well above the total allowable catch of 7,550 tonnes in the 2011–12 fishing year (*Ministry for Primary Industries 2013b*).

Commercial landings of snapper have been relatively stable since 1997, with 4614 tonnes taken in 2011–12. Most of the snapper taken commercially is caught by bottom long-lining and bottom trawling (*Ministry for Primary Industries 2013a, b*). In March 2014, 108 quota holders were entitled to snapper annual catch entitlements (ACE) of more than 1 tonne in the SNA1 stock (*Register Of Quota Holders, FishServe, March 3 2014*). However, the quota tends to be concentrated within a smaller number of organisations. Over 50% of the ACE was held by two companies, and 80% is held by 12 companies. Māori interests were entitled to around 41% of the annual snapper catch.

The combined recreational and customary allowance for SNA 1 was 2600 tonnes in 2011–12, but the actual recreation catch was estimated to be around 3754 tonnes. By far the greatest recreational catch was taken from the Hauraki Gulf (2490 tonnes). Most recreational catch is taken by boat-based fishers (about 85%) using hook and line methods (over 90%), but there is also targeting of snapper by land-based fishers using surfcasting and kontiki (long-line) methods, and by netting and spear-fishing. Recreational catch is considered to have been increasing quite rapidly since the 1990s, particularly in the inner Hauraki Gulf (*Ministry for Primary Industries 2013a*). Information on customary Māori catch of SNA 1 is incomplete. Consequently, customary catch levels are uncertain.

The current estimated biomass of snapper in the Hauraki Gulf-Bay of Plenty substock is 306,000 tonnes (95% confidence intervals 288,000–325,000 tonnes), which equates to 19% of the unfished biomass (95% confidence intervals 15–23%) (*Ministry for Primary Industries 2013b*). The Ministry for Primary Industries has an interim target of managing the stock at 40% of the unfished biomass (40% Bo). The Hauraki Gulf-Bay of Plenty substock is regarded to be as ‘about as likely as not’ below its soft limit (20% Bo). In accordance with the Harvest Strategy Standard (*Ministry of Fisheries 2008*), the movement of stocks to levels below their soft limit triggers a formal, time-constrained

rebuilding plan. Soft limits provide a buffer, which allows action to be taken before stocks reach their hard limit (10% Bo). Breaching the hard limit would possibly lead to the closure of the fishery (*Ministry of Fisheries 2008*).

Model projections based on the assumption that snapper recruitment over the next five years would be similar to recruitment observed over the most recent ten years for which data is available (i.e. 1994 to 2004), predict that the spawning biomass of the Hauraki Gulf-Bay of Plenty substock will slowly increase over the next five years (*Ministry for Primary Industries 2013b*). However, recruitment between 1994 and 2004 was well above average and no recruitment information is available for the subsequent decade. If the full series of recruitment observations (1970–2004) is used, the five year projections suggest that the Hauraki Gulf-Bay of Plenty substock will decline over the next five years.

Longer term (2050) projections suggest that maintaining the previous TAC (that was in place from 1997 to September 2013) would lead to the substock steadily declining towards collapse (i.e., levels below the hard limit of 10% Bo). Rebuilding the biomass to 40% Bo is predicted to allow annual yields to increase from the existing TAC of 7,550 tonnes to 12,000 tonnes (with around 9,900 tonnes coming from the Hauraki Gulf-Bay of Plenty substocks). However, this would require a medium to long-term reduction in catch. Modelling predicts that for the Hauraki Gulf-Bay of Plenty substocks, the interim target of 40% Bo:

- would be reached in less than 24 years if a 60% reduction in the TAC was implemented,
- would be reached in around 36 years if a 40% reduction in the TAC was implemented,
- is unlikely to be achieved by 2050, if a 20% reduction in the TAC was implemented.

MPI’s harvest strategy specifies that stocks like snapper, which have fallen below their soft limit, should be rebuilt back to at least the target level in a time frame which is no longer than twice the time it would take if all harvesting ceased (*Ministry of Fisheries 2008*). Estimates suggest that for the Hauraki Gulf-Bay of Plenty substock, this would have required the overall TAC of 7,550 tonnes to be cut by 56% (*Ministry for Primary Industries 2013b*). However, the actual catch of snapper was estimated to be 9,065 tonnes, and consequently, the actual reduction needed to be greater than 56% to achieve the interim target within the required time frame.

After taking into account a range of additional social, cultural, and economic factors the Minister for Primary Industries set the TAC at 8050 tonnes. In addition, the following mix of compulsory and voluntary measures is to be implemented:

- a reduction in the recreational bag limit from 9 to 7 fish per day, and increased the recreational size limit from 27 cm to 30 cm,
- a move on rule to reduce juvenile mortality, whereby commercial fishers are required to move fishing spots when small juvenile fish are making up a significant portion of their catch,
- a requirement to report all small catch under the commercial legal size to obtain more information on juvenile mortality,
- a maximum size on fish caught on commercial long-lines to reduce mortality of non-market, but recreationally important, large fish,

- deployment of cameras or observer coverage on:
 - 25% of SNA 1 trawl vessels by 01 Dec 2013
 - 50% of all trawl vessels by 01 Oct 2014
 - 100% of all trawl vessels by 01 Oct 2015
- Vessel Monitoring Systems (VMS) on all commercial vessels,
- a scientific tagging survey to obtain up to date and reliable information on the status of the SNA 1 stock,
- the development of new gear technology (Precision Seafood Harvesting) aimed at reducing by-catch, avoiding small fish, and improving catch quality.

A Snapper 1 Strategy Group has also been established to develop a long term plan for the management of the SNA1 stock. During 2014 and into 2015, the scope of this group's discussions will include establishing objectives and appropriate target levels for the SNA1 fishery, setting research and monitoring priorities, determining catch allocation, and establishing appropriate responses to the impacts of fishing on productivity, other fish stocks, and the marine environment. Membership of the SNA1 strategy group includes the commercial, recreational, and customary fishing sectors, and the group is convened by an independent Chair. Non-extractive stakeholders are not currently represented, although some hold strong views about the SNA 1 fishery, particularly about the management target, and interactions with the broader ecosystem through incidental catch, habitat disturbance and trophic cascades.

To come close to the REMAK approach endorsed by the Hauraki Gulf Forum, snapper catches in the Gulf would need to be reduced significantly. A more holistic approach would also need to be taken toward the management of the snapper stock, with a broader focus on ecosystem function rather than simply maintaining sustainable catches. The establishment of the SNA1 strategy group provides an opportunity to move towards this outcome. However, the omission of non-extractive users from the group suggests that the management focus remains mainly geared toward utilisation, and that less weight may be given towards other potential outcomes.



Photo: Snapper (*Pagrus auratus*)

6.1.5 CRAYFISH (KOURA)

The common New Zealand crayfish, *Jasus edwardsii*, is actually a relatively slow-growing and long-lived spiny lobster. *Jasus edwardsii* are by far the most important lobster species in New Zealand, both in terms of their ecological role and their economic importance. They have been fished for centuries by Māori, and have supported a commercial fishery for over 100 years. Today 52 quota holders are entitled to Annual Catch Entitlements (ACE) in the CRA2 crayfish substock (*Resister Of Quota Holders, Fishserve, March 3 2014*). Over 50% of the ACE is held by 10 companies and 80% held by 23 companies. Māori interests are entitled to around 36% of the crayfish ACE.

Crayfish are generalist feeders that prey on a wide range of invertebrates, as well as consuming fish and algae (*MacDiarmid et al. 2013b*). Feeding rates vary throughout the year in relation to moulting and reproductive cycles, with prolonged periods of non-feeding during the mating and moulting seasons, being punctuated by periods of extremely high consumption (*Kelly et al. 1999*). Crayfish and predatory fish such as snapper have a positive effect on kelp forest cover and primary productivity in reef habitats by consuming kina (*E. chloroticus*). Kina grazing prevents kelp from becoming established and growing, leading to the formation of urchin barrens. These are open areas of pink, coralline algae-covered reef, which are devoid of large brown seaweeds. Consequently, kelp-free urchin barrens tend to be more prevalent in areas where fishing is allowed and less prevalent in protected areas such as marine reserves (*Babcock et al. 1999, Shears & Babcock 2002*). Crayfish also forage beyond the reef, where they prey on shellfish and other animals living in sandy habitats. Experiments indicate that they also play an important role in the survivorship of adult bivalve populations on the sandflats adjacent to reefs (*Langlois et al. 2006*).

Fishing has had a major effect on both crayfish populations and the broader ecosystem (*Ministry for Primary Industries 2013c, Shears & Babcock 2002, MacDiarmid et al. 2013b*). Modelling predicts that prior to human arrival, lobsters were the third-most ecologically important benthic invertebrate group in the Hauraki Gulf. Since the 1950s, fishing has reduced their occurrence to the point where they are now the least important benthic invertebrate group. In areas of low biomass, *MacDiarmid et al. (2013b)* suggest that they could be regarded as being ecologically extinct. Today, high densities of crayfish are only known to occur in the Hauraki Gulf within a few, fully protected marine reserves.

Fisheries modelling indicates that the total biomass of crayfish has been reduced to around 33% of its 1945 level in the CRA2 stock (*Paul Breen pers. comm.*), which covers the fishery from the Hauraki Gulf to East Cape. The biomass of crayfish above the legal size limit (i.e. the recruited biomass) has been reduced to around 20% of its 1945 level (**Figure 6-4**). The stock is estimated to be 36% above the biomass required to produce the maximum sustainable yield (BMSY), but 20% below its current management target of 459.6 tonnes (BREF) (see **Figure 4-3**). The current target is based on the biomass of legal sized males for the period 1979 to 1981. Neither the current nor the projected biomass are estimated to be near the soft limit of 20% of the unfished spawning stock biomass (SSBo, i.e. the unfished biomass of mature females), which would trigger the need for the stock to be re-built.

Monitoring has shown that crayfish populations around two of the Gulf's marine reserves have been reduced by more than 70%. The 2011 State of our Gulf Report reported that between 2000 and 2009, the mean density of lobsters in fished areas outside the Cape Rodney to Okakari Point Marine Reserve has fluctuated between 6% and 28% of that within the reserve, while densities outside the Te Whanganui-a-Hei Marine Reserve have fluctuated between 5% and 15% of those inside. The Cape Rodney to Okakari Point Marine Reserve has not been re-surveyed since the previous report, but the results from 2011 and 2013 surveys of the Te Whanganui-a-Hei Marine Reserve are consistent with those reported earlier.

The previous State of our Gulf Report and the most recent monitoring data from Te Whanganui-

a-Hei Marine Reserve, also highlights that the composition of lobster populations has been substantially altered by fishing. Reserve populations are dominated by lobsters above the legal size limit, with relatively high numbers of old and large animals. In contrast, fished populations are characterised by low numbers of sub-legal animals (**Figure 6-5**). Large male and female lobsters have been shown to make a disproportionate contribution to reproduction by producing more sperm and eggs, mating more frequently, and defending access to favourable mates (*MacDiarmid 1989, MacDiarmid & Butler 1999*). Large lobsters also display different behaviours than small-sized ones. For instance, they regularly forage for extended periods on offshore sandflats, where they form defensive aggregations for mutual protection during the daytime (*Kelly et al. 1999*). In contrast, sub-legal lobsters in the Hauraki Gulf appear to mainly remain within reef habitat.

The commercial catch for the CRA2 stock was reduced by 36 tonnes to 200 tonnes from 1 April 2014 to allow the stock, and associated catch rates to re-build to the current fishery target. No changes were made to the allowance for customary or recreational fishers. Note that the current fisheries target does not explicitly consider the role of lobsters in the broader ecosystem processes, nor does it consider values other than those related to fishing, such as the intrinsic values of large crayfish or crayfish aggregations (**Figure 6-6**). It is also notable that ecosystem effects of reducing snapper and crayfish populations were detected in the 1990s (*Babcock et al. 1999*), when the crayfish biomass was estimated to be much higher than the current fishery target. It therefore seems unlikely that the current fisheries target will restore broader ecosystem processes.

Overall, the existing data suggests that fishing has reduced lobster populations by around 70% in the Hauraki Gulf, with the greatest impact on old, large crayfish. This represents a major reduction in the population of an individual species, and has contributed to an alteration in the functioning and intrinsic values of reef ecosystems within the Hauraki Gulf. From a Māori perspective, the mauri of this species could be regarded greatly diminished. Current approaches to the management of this species may allow fishing to be sustained, but they are unlikely to resolve broader the environmental issues associated with the reducing crayfish populations, and altering their age and size characteristics.

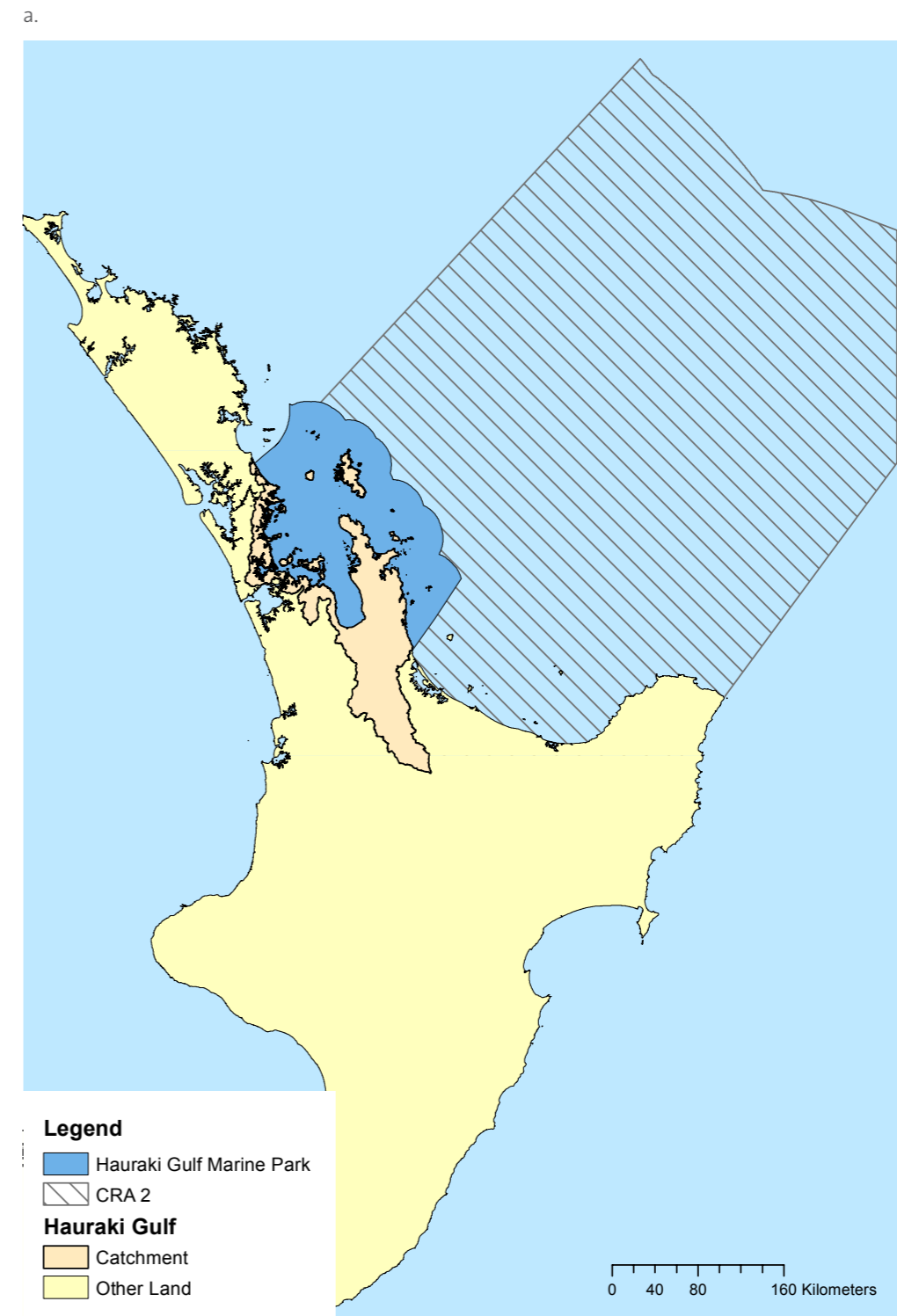


Figure 6-4: a) Map of the CRA 2 quota management area relative to the Hauraki Gulf Marine Park

b.

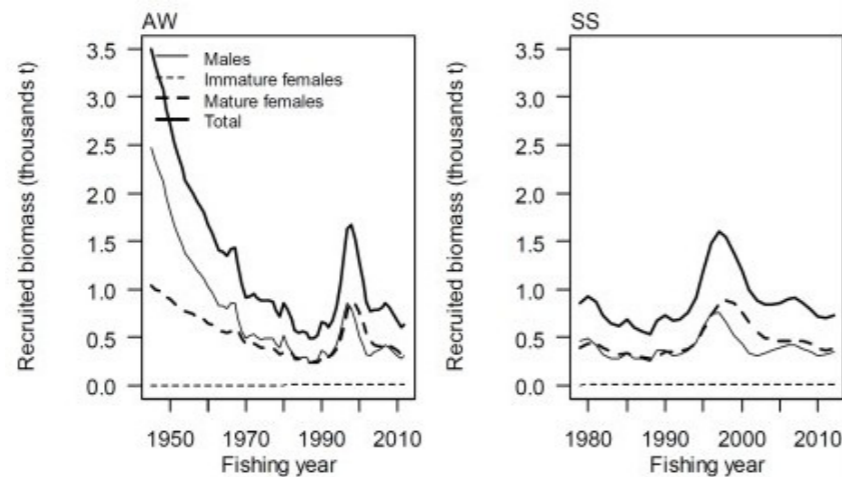


Figure 6-4: b) Historical reconstruction of autumn-winter (AW) and spring-summer (SS) biomass of crayfish above the legal size limit (i.e. the recruited biomass) in CRA 2 (from Starr et al. 2014).

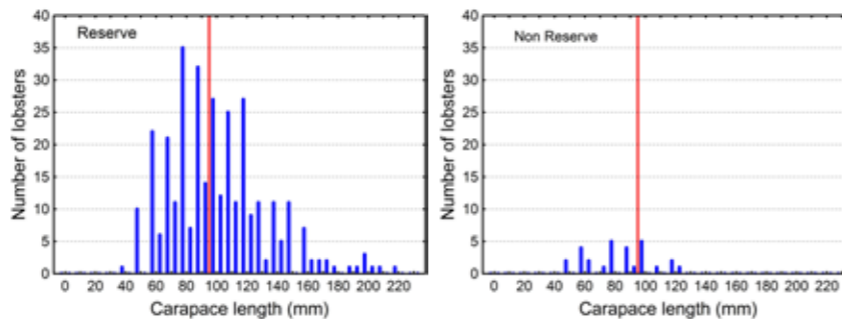


Figure 6-5: Size frequency distributions of lobsters recorded during the 2013 survey of the Te Whanganui-a-Hei Marine Reserve (Data provided by Tim Haggitt).



Figure 6-6: Aggregation of mainly female crayfish during the spawning season in Tawharanui Marine Reserve.

6.1.6 BENTHIC DISTURBANCE

Bottom trawling and dredging are relatively indiscriminate methods of fishing, which capture, disturb and injure both target and non-target species. They also affect habitat quality by removing emergent biota (e.g. see **Figure 6-7**) and physical features, and evening out seabed sediments. Such disturbance has important consequences for seafloor biodiversity, which is strongly related to local variation in sediment characteristics and the presence of emergent features (see Thrush et al. 2001 and references within). For instance, a recent comparison of adjoining trawled and untrawled areas in the Marlborough Sounds showed that the fished areas have muddier sediments with less shell-gravel, reduced habitat complexity, reduced cover of emergent biota, and low proportions of large and rarer shellfish (Handley et al. 2014). The environmental significance of bottom trawling and dredging impacts has led to these activities being ranked the third equal (with increased sediment loads) and seventh highest of 65 identified threats to marine habitats in New Zealand respectively⁵ (MacDiarmid et al. 2012).

Bottom trawling is prohibited south of a line running approximately between Kawau Island and Colville Bay, and from a number of inshore zones on the eastern side of Coromandel Peninsula (see **Figure 5-8**). Trawling is also prohibited in a number of cable zones in the Hauraki Gulf. However, it is still one of the most commonly used methods of catching fish, accounting for around 30% to 40% of the total catch in the Gulf (Ministry of Fisheries 2009b, Hauraki Gulf Forum 2010), and occurring over a wide area (**Figure 5-9**). Around 12,450 bottom trawls occurred in the Hauraki Gulf during the three year period from 1 January 2011 to 1 January 2014 (unpublished data, Ministry for Primary Industries).

The commercial scallop fishery in the Coromandel management area started in the 1970s and was introduced into the quota management system in 2002. Currently, seven vessels operate in the fishery, which carried out around 27,600 dredge tows between the 2010 to 2012 fishing seasons (unpublished data Ministry for Primary Industries). Fishers have historically dredged for scallops in a number of discrete beds around Little Barrier Island, east of Waiheke Island (though not in recent years), at Colville, north of Whitianga (to the west and south of the Mercury Islands), Slipper Island and Waihi (**Figure 6-9**). In 2011, fishers discovered a large, previously unfished scallop bed in 45–50m water. The bed contains good densities of large scallops and lies mainly within statistical reporting area 2W, with a smaller portion in area 2S (see **Figure 6-9**). However, it is not known whether the large biomass of scallops in the bed is a persistent feature, or the product of successful recruitment in recent years (Ministry for Primary Industries 2013c).

This fishery is managed with the ability to provide for an in-season increase to the TAC/TACC after considering survey information about the abundance within a fishing year. At the close of that fishing year, the TAC/TACC reverts back to the catch limits that applied at the beginning of the fishing year. The discovery of the new scallop bed led an in-season increase of the TACC from 22 tonnes meat weight to 100 tonnes in each of the 2009–10 and 2010–11 fishing seasons. In 2011–12 the in-season review resulted in an increase in the TACC from 22 tonnes to 50 tonnes meat weight, and to 325 tonnes meat weight in 2012–13. Recreational fishers are estimated to harvest roughly 3 to 8 tonnes (meat weight) per annum: mainly through diving and the dredging of shallower beds (Ministry for Primary Industries 2013c).

The range of areas historically dredged has reduced markedly since the 1980s, and, therefore, so has the impact of the scallop fishery. However, the shift from dredging scallop beds around Little Barrier Island and Mercury Bay (which have a long history of dredging), to the new area west of Coromandel Peninsula increases the recent footprint of dredging in the Gulf. High scallop densities coupled with the large size of the bed means that this area is likely to be subject to ongoing

⁵ Ocean acidification and climate change were ranked greatest and second greatest threats.

disturbance by scallop dredging, which will compound disturbance by bottom trawling (see **Figure 5-9**). However, there is currently no data on the level or effect of incidental catch or discarding by fishers (*Ministry for Primary Industries 2013c*). Conversely, a shift in dredging effort toward the new scallop bed could reduce impacts on other areas. The environmental outcomes of doing this are likely to depend on benthic recovery rates, changes in fishing effort, and how the effort is distributed.

Historic accounts suggest that the seafloor in some of the areas targeted by bottom trawlers and scallop dredges, such as the area west of Cape Colville, once contained diverse communities of emergent species (**Figure 6-8**, see Ayson 1901 and Ayson 1908). Rudimentary by-catch data collected during a scallop survey in 2012 (*Williams 2013*) indicates that a variety of ecologically significant and sensitive species are still present in this and other areas targeted by the scallop fishery. These include emergent species such as kelp, sponges and horse mussels, and infaunal bivalves such as dog cockles and morning star shells. The Ministry for the Environment has included 'beds of large bivalve molluscs' (including horse mussels, dog cockles and scallops), 'sponge gardens' and 'macro-algal beds' in its list of 13 sensitive marine habitats in the EEZ (*MacDiarmid et al. 2013a*). As discussed above, large emergent species like sponges, horse mussels and kelp are particularly important because they provide structural complexity in otherwise featureless habitats, and have a positive influence on biodiversity. Infaunal shellfish beds also add complexity to soft sediment ecosystems by altering boundary flow conditions, providing hard surfaces on which other flora and fauna can grow, and increasing the richness and abundance of the invertebrate communities (*MacDiarmid et al. 2013a*).

Figure 6-7: Emergent species, such as these sponges and horse mussels in Jones Bay on the southern side of Tawharanui Peninsula, are very sensitive to fishing or other activities that disturb the seabed (*photo courtesy of Shane Kelly*).

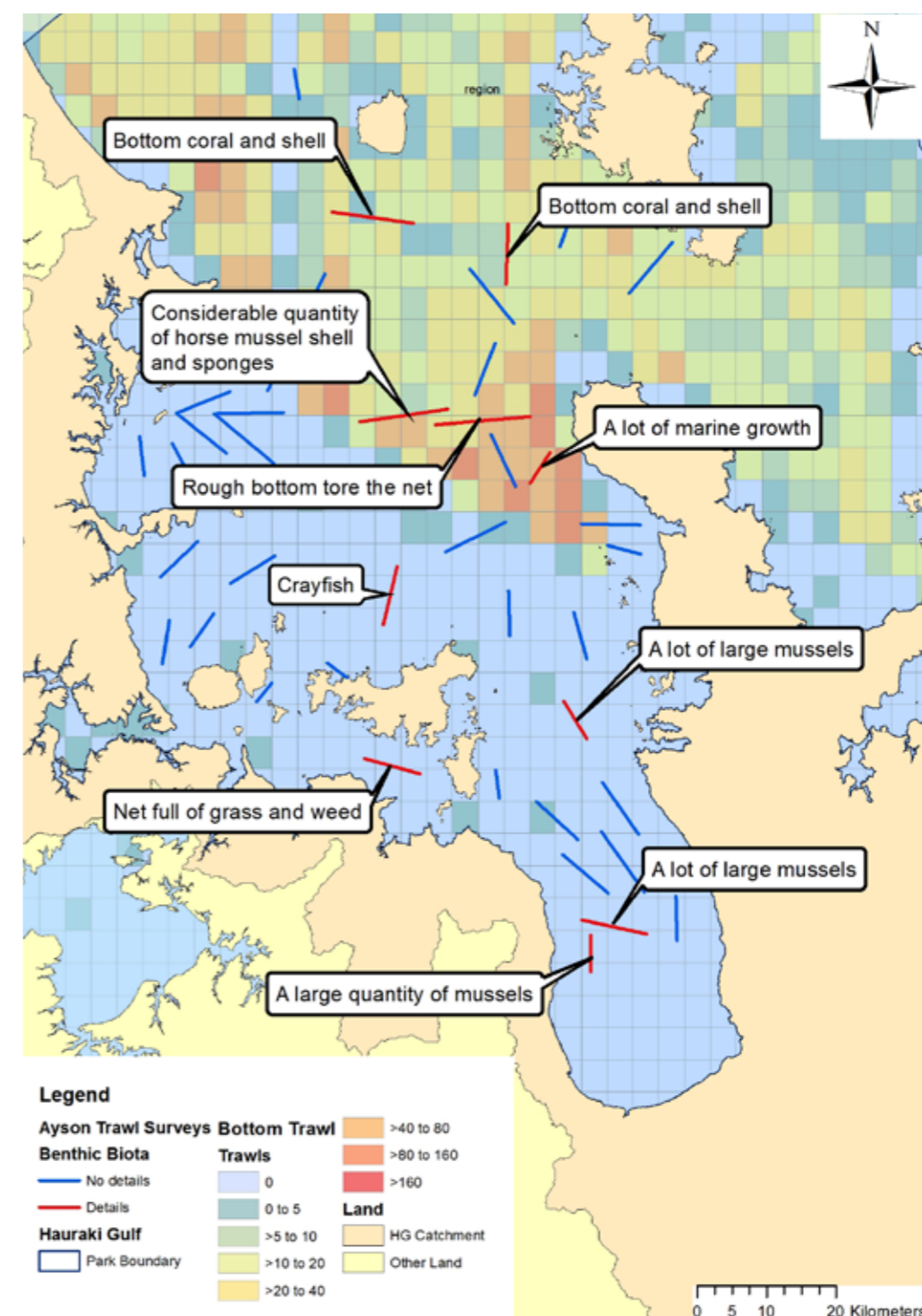


Figure 6-8: Bottom biota recorded during trawl surveys carried out in 1901 and 1907 by the Inspector of Fisheries, L. F. Ayson (see Ayson 1901, 1908). Trawl lines are overlaid on a grid showing the number of bottom trawls undertaken between 1 January 2011 and 1 January 2014. Details about the bottom biota were provided for the red trawl lines, as indicated.

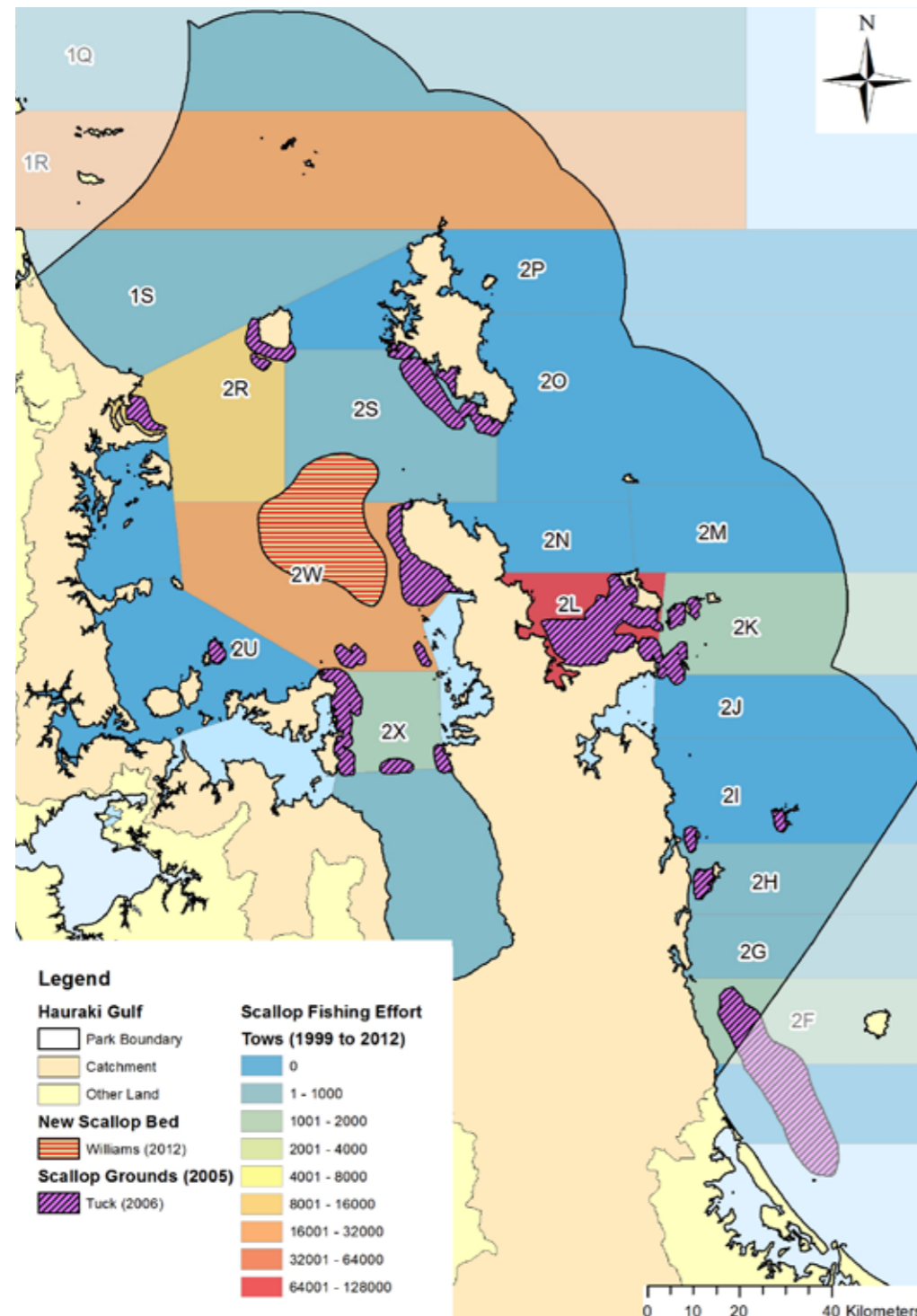


Figure 6-9: Total number of scallop tows in fishing reporting areas between 1999 and 2012. Also shown are the areas where commercial scallop dredging is prohibited; commercial scallop beds identified in Tuck *et al.* (2006); and, the approximate extent of the recently discovered, deep water scallop bed in Areas 2W and 2S (based on Williams 2012).

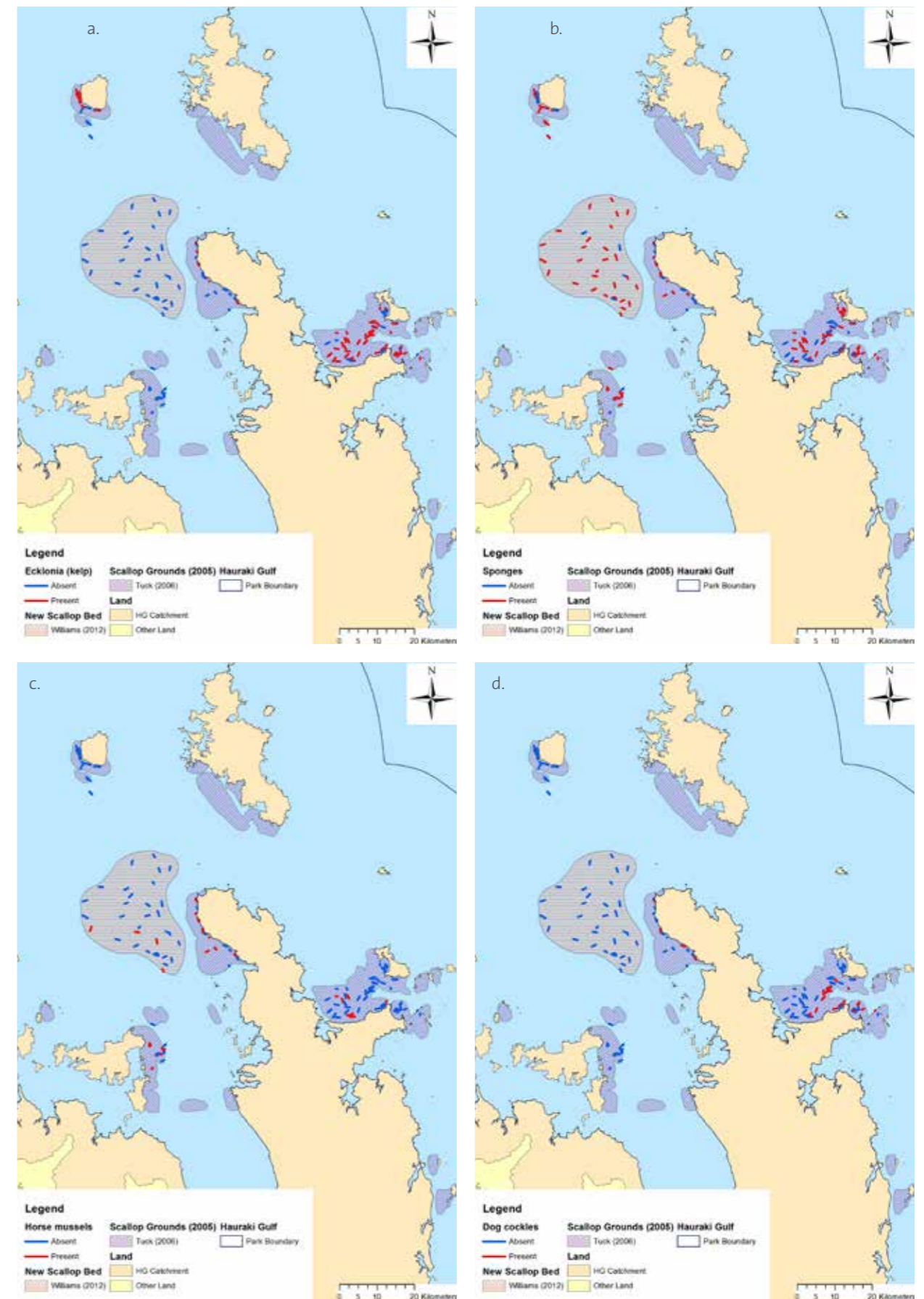


Figure 6-10: Scallop survey tows where: a) kelp (*Ecklonia radiata*); b) sponges; c) horse mussels; d) dog cockles were obtained as by-catch (data obtained from MPI, see Williams 2013 for details on the survey).

6.1.7 COCKLES (TUANGI)

Cockles (*Austrovenus stutchburyi*) are filter-feeding bivalves that are among the most numerous of shellfish in the sheltered shores of harbours and estuaries, with densities of up to 4,500 per m² being reported in some areas (Ministry for Primary Industries 2013b). Cockles burrow to around 25 mm, and flourish between low and mid-tide where sediments contain less than 50% mud (Stephenson 1981). Cockles may live for up to 20 years (Owen 1992), with maturity occurring at around 18 mm shell length (Ministry for Primary Industries 2013b). They form a major part of the diet for a range of different animals, including mud whelks (*Cominella glandiformis*), sand flounder (*Rhombosolea plebeia*) and pied oystercatchers (*Haematopus finschii*) (Jones & Marsden 2005). Cockles are regarded as ‘ecosystem engineers’, playing an important role in the exchange of energy and nutrients between the seabed and the water column, and in the composition of seabed communities (Thrush *et al.* 2006). They also have a major influence on productivity and nutrient dynamics in estuaries due to their size, wide spread distribution, high abundance, and their role in mixing the upper two to three cm of the sediment (Sandwell *et al.* 2009).

Cockles are not commercially harvested in the Hauraki Gulf, but they do support recreational and customary fisheries. Coastal middens indicate that cockles and pipis were the most frequently exploited marine species by pre-European Māori around the Gulf (Smith 2011), and they still remain an important species. Details on recreational and customary harvest are limited, but Kearney (1999) found that in Whangateau Harbour harvesting was concentrated in the areas where high densities of large cockles occurred. The largest individuals (generally bigger than 30 mm wide) were specifically targeted. Greatest harvesting effort coincided with public holidays and summer weekends, particularly when low tides occurred in mid-early afternoon. The majority of harvesters were Māori (54%), followed by New Zealand European (26%), Asians (15%) and Pacific Islanders (4%). Most people collected cockles two to five times per year, but 29% gathered shellfish more than nine times per year, and most harvesters took more than the legal bag limit (150 cockles per day at time of study – subsequently reduced to 50 cockles per day in the Auckland and Coromandel areas).

Many communities have established shellfish monitoring programmes in their areas, with the assistance of DOC, councils and the Ministry for Primary Industries (Figure 6-11). For instance, over the 2012–13 summer months, 570 volunteers, including those from 10 school groups, were involved in the survey of 12 sites. A number of other sites are also regularly or occasionally surveyed. No region-wide trends in density are apparent in the community monitoring data, with most sites showing natural fluctuations around an average. The most notable change is related to a mass die-off of cockles in early 2009 at Lewis Bay in the Whangateau Harbour. That event reduced the density of adult cockles by 60% from around 750 to 300 per m². Signs of recovery are apparent in the latest survey results which show a pulse in the number of small cockles (Hauraki Gulf Forum 2013).

The Ministry for Primary Industries (or MFish) has also independently monitored cockle abundance and size at 14 sites in the Hauraki Gulf since 1998 (Figure 6-11). Monitoring has occurred intermittently at eight of these sites, and regularly at six sites (Figure 6-12). Key results from sites that have been regularly monitored are outlined below.

- There has been no consistent Gulf-wide trend in cockle abundance, rather individual beaches display varying patterns over time.
- Cockle numbers at Okoromai and Tairua have been relatively stable since monitoring began in 1998 and 2000 respectively.
- Cockle numbers at Whangamata have varied widely through time, with notable peaks in 2004 and 2011. However, they have not displayed a consistent long term trend.
- Cockle numbers at Umupuia gradually declined between 1998 and 2007. A rahui was imposed in 2007 and the population has subsequently rebuilt to the 1998 level. The rahui is due to be reconsidered in October 2014.

- Cockle numbers in Whangapoua approximately doubled between 2004 and 2005, and have remained stable up until the latest survey in 2011.
- Cockle numbers in Whangateau Harbour are high relative to the other monitoring sites. Numbers increased between 2002 and 2004, then gradually declined through to 2010. The harbour was closed for cockle and pipi harvesting in 2009 following a mass die-off that was thought to be caused by disease and high temperatures. The closure is set to be reconsidered in March 2016.
- The proportion of harvestable cockles has generally displayed declining trends at all of the sites that are regularly monitored. This is likely to be due to the selective harvesting of large cockles and/or strong recruitment of small cockles (particularly at beaches closed to harvesting) (Figure 6-13).

Cockle (and in some cases other shellfish) harvesting is also banned at a number of other beaches in the Hauraki Gulf (Figure 6-14). Eastern and Cheltenham Beaches were closed in the 1990s because of substantial declines in shellfish populations. Since 2008, shellfish harvesting has also been banned from Cockle Bay between 1 October and 30 April. Cockle numbers at the Cockle Bay monitoring site increased by 2.2 million to 22.8 million between 2009 and 2011, and the proportion of harvestable cockles has also increased (Pawley 2012).

No new closures have been implemented since the 2011 State of our Gulf Report was produced, and none of the beaches closed in 2011 have been reopened.

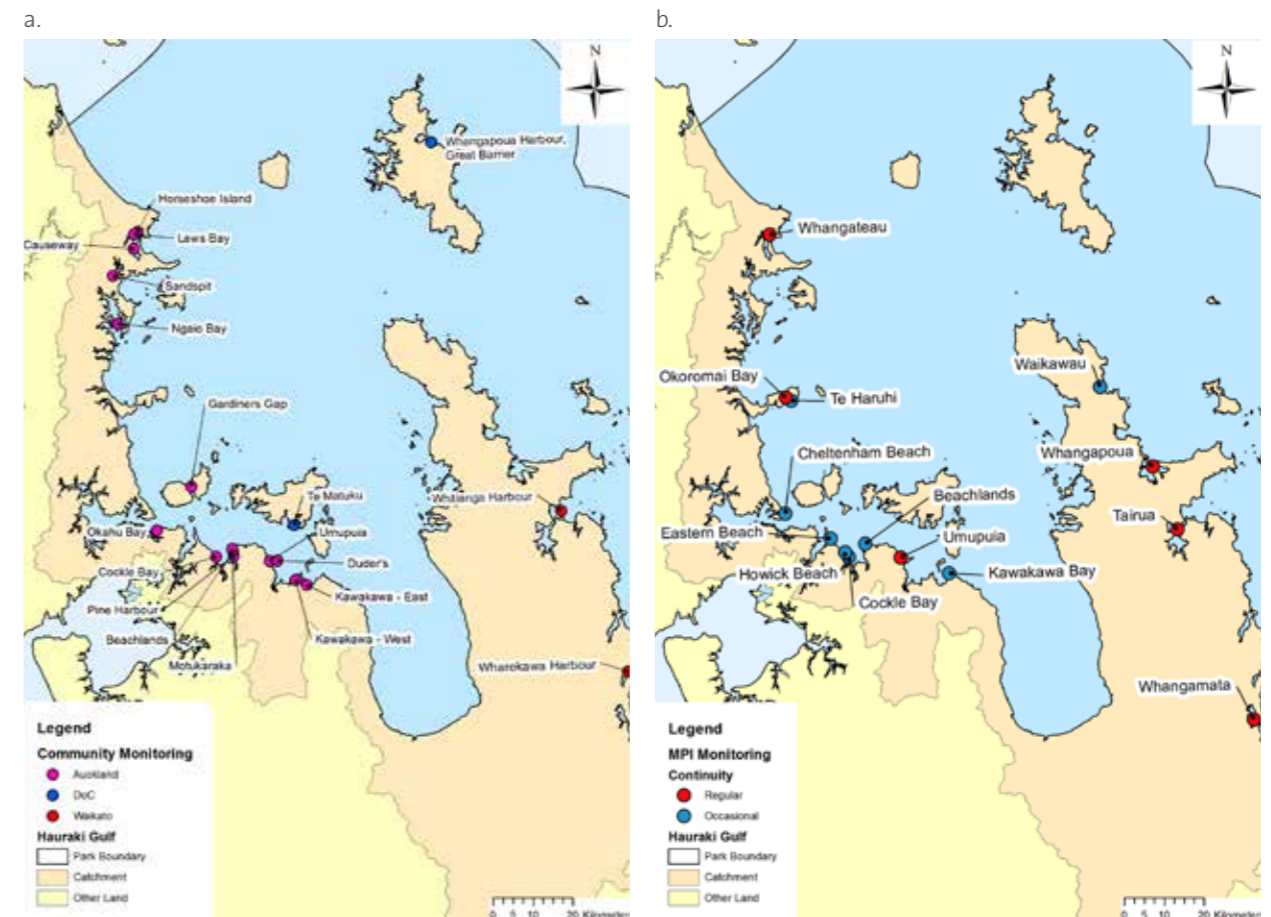


Figure 6-11: Shellfish and beach sites that are regularly or occasionally monitored by a) community groups coordinated by the Auckland Council, Waikato Regional Council, or Department of Conservation, and b) the Ministry for Primary Industries.

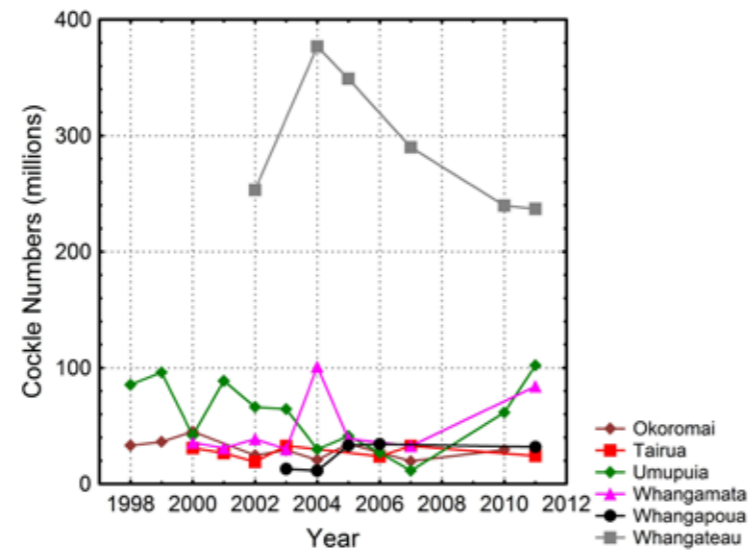


Figure 6-12: Variation in estimated number of cockles at sites that have been regularly monitored by the Ministry for Primary Industries (or MFiSh) since 1998.

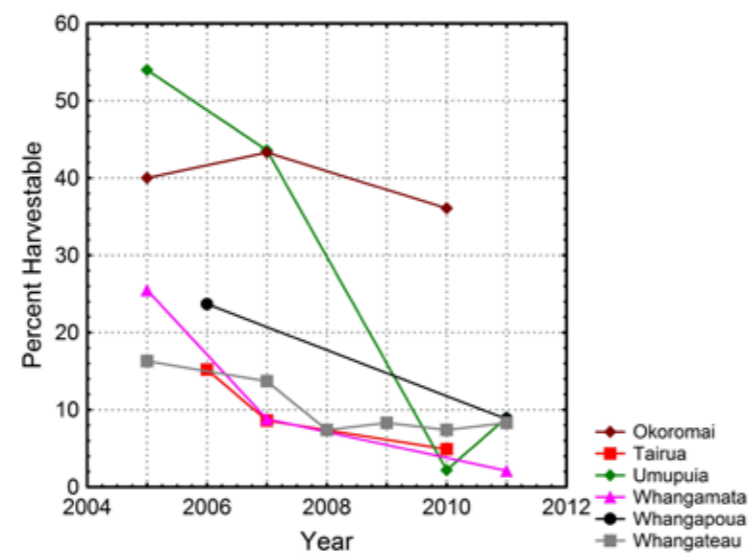


Figure 6-13: Change in the percentage of cockles of harvestable size from sites surveyed in 2010 and/or 2011.

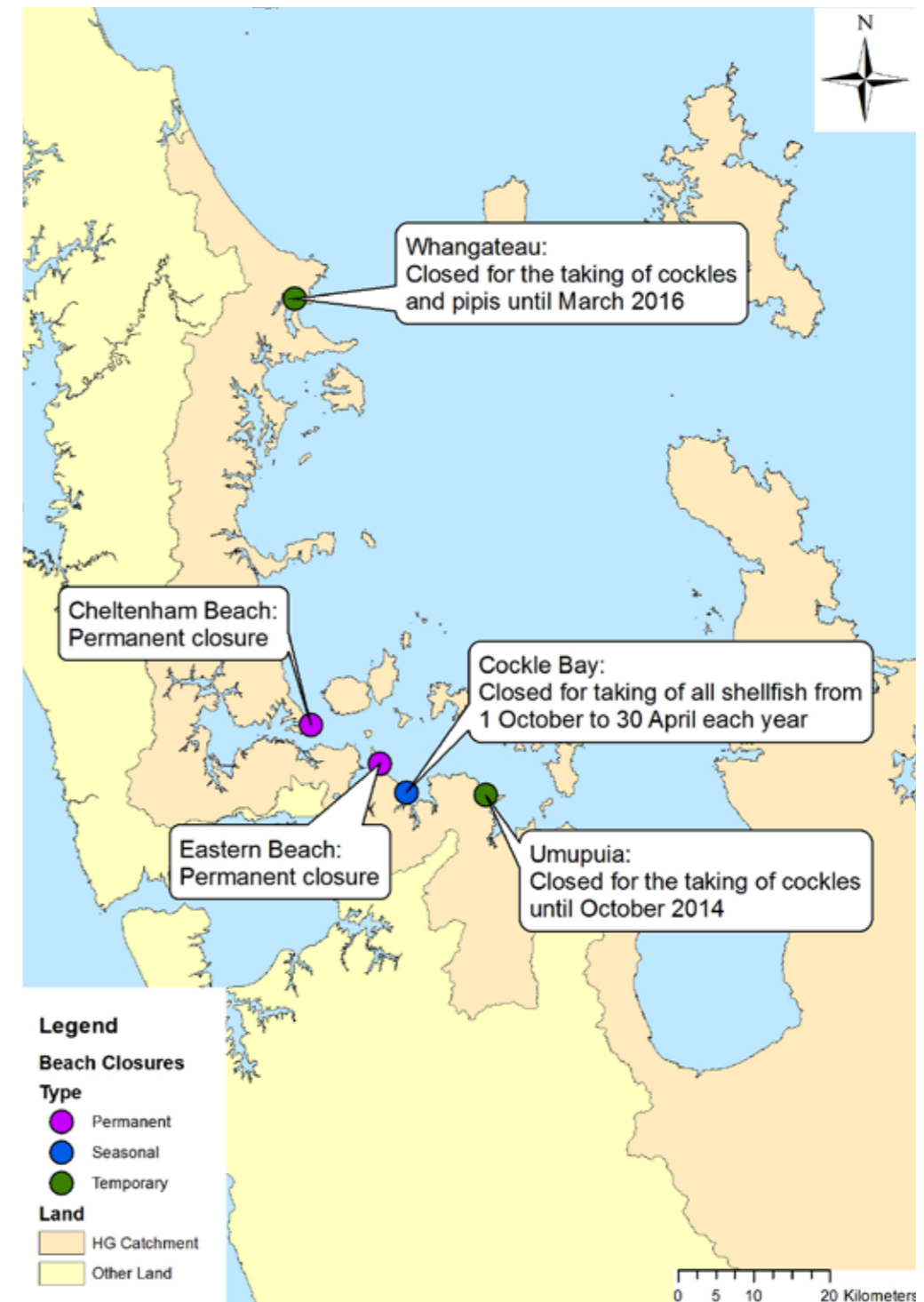


Figure 6-14: Beaches that are currently closed by the Ministry for Primary Industries for cockle, pipi and/or shellfish harvesting. Also note that harvesting cannot occur in marine reserves administered by the Department of Conservation.

6.2 TOXIC CHEMICALS AND BENTHIC HEALTH

Overview

A relatively small proportion of the Hauraki Gulf is affected by sediment contamination. It includes older urban estuaries and tidal creeks in Auckland, and the south-eastern Firth of Thames, where low level sediment quality guidelines (TELs) are frequently exceeded for copper, lead and/or zinc. Localised contaminant hotspots are associated with landfills, ports, marinas, and industrial activity.
The key contaminants are copper, lead, zinc and to a lesser extent mercury. A range of other contaminants potentially compound the effects of the key contaminants.
Lead concentrations are improving at some of the worst affected estuaries in the Auckland Region. Lead concentrations tend to be stable or declining at other sites.
Copper concentrations are improving at some of the worst affected estuaries in the Auckland Region. Copper concentrations tend to be stable or slowly changing at most other sites.
Zinc concentrations tend to be relatively stable, slowly changing or increasing reasonably rapidly in the Auckland Region. The upper Tāmaki Inlet is notable for increasing trends in zinc.
Insufficient data is available from the Waikato Region to assess temporal trends.
Mercury concentrations exceed high level guideline (PEL) values in in Kuranui Bay, Thames, and low level guidelines south of Thames and at sites in the upper Tāmaki Inlet, Hobson Bay, and Henderson Creek.
Benthic health is affected by a combination of fine sediments and chemical contaminants. In the Auckland Region, benthic health is most degraded in the Upper Waitematā Harbour, southern inlets of Waitematā Harbour, the upper Tāmaki Inlet, and upper sections of tidal creeks in Whitford embayment.
From a Māori perspective, the mauri of areas with elevated contaminant concentrations and poor benthic health could be regarded as diminished. Declining trends in copper and lead concentrations point toward improving mauri in some areas. Conversely, increasing concentrations of zinc are consistent with the ongoing loss of mauri.

Human activities generate a variety of toxic heavy metals and organic compounds that are used in the coastal environment (e.g. anti-fouling paints, oils and fuels), or which enter coastal waters through spills, run-off, and discharges. Contaminants originate from ongoing activities and historical activities that can have continuing, long-term environmental consequences. Major spills sometimes have immediate and catastrophic effects, but many contaminants slowly accumulate to toxic levels over time (typically decades). Contaminants commonly bind to sediments and other particulate matter, which settles out and accumulates on the seabed. Elevated contaminant concentrations in coastal sediments affects the survival, reproduction and/or behaviour of benthic organisms. Monitoring and investigations carried out by Auckland Council (and the former Auckland Regional Council), Waikato Regional Council and DOC indicate that key causes of sediment contamination in the Gulf are urbanisation, historical mine activity, and agriculture (Kim

2007, Mills & Williamson 2008, 2009). Diffuse sources of contamination, such as stormwater runoff, are particularly problematic because:

- contaminant sources are often hard to identify, remove, replace, or contain, and
- most stormwater treatment options are expensive, relatively inefficient, and require space that is difficult to find in fully developed urban areas (e.g. see Ouwejan et al. 2007).

Toxic contaminants also come from discrete sources such as port and industrial activities, marinas, and landfills. Contaminant loads from these sources can be very high. For instance, copper loads from Auckland’s marinas are estimated to be roughly double the stormwater load coming from the entire Waitematā Harbour catchment (Gadd & Cameron 2012). Contaminant concentrations in coastal sediments around ports, marinas and industrial sites can also be much higher than concentrations in coastal sediments affected by diffuse contaminant sources.

In urban areas the key contaminants are zinc, copper, lead, and to a lesser degree, mercury. A variety of other metal and organic contaminants co-occur with these metals, and potentially compound their effects. New contaminants are constantly emerging and, consequently, researchers are struggling to keep pace with the rapidly increasing list. For instance, recent tests for 46 pharmaceuticals in Auckland estuary sediments detected 21 products at one or more sites. Of these, 18 products were in the Pharmac 2007 schedule (Stewart 2013). Emerging contaminants, such as endocrine-disrupting compounds and pharmaceuticals, are particularly problematic because: biological effects occur at extremely low concentrations (which are often below the detection limits of most analytical instruments); guidelines are not available; and there is no standard or common method of analysis and monitoring (Bolong et al. 2009).

Māori are particularly concerned about the effects of contaminants on the mauri of the coastal areas, and on ecology, amenity, and kai moana (seafood). For instance, Ōkahu Bay, a traditional mahinga kai for Ngāti Whātua o Ōrākei, has an unenviable history of physical modification and pollution from wastewater discharges, road runoff, and marina and hardstand facilities. The hapū are therefore actively involved in the restoration of the bay, with the goal of providing ‘waters fit to swim in at all times, with thriving eco-systems that provide sustainable kaimoana resources to a Ngāti Whātua Ōrākei community who have strong daily presence in, on, and around the bay as users and kaitiaki’ (Ngāti Whātua o Ōrākei 2012 – see [Restoration of Te Whenua Rangatira Case Study](#)).

6.2.1 CONTAMINANT CONCENTRATIONS AND TRENDS

In the Auckland Region, contaminant concentrations are most elevated in the sheltered estuaries and tidal creeks associated with old urban catchments (**Figure 6-15**, Mills et al. 2012). In these locations, lower TEL sediment quality guideline values are frequently exceeded for zinc, copper and lead (see **Table 4** for a description of sediment quality guidelines). Of the 50 sites in the Hauraki Gulf that are regularly monitored by Auckland Council, 25 exceed TEL guideline values for at least one of these contaminants (compared with 21 sites in 2011). All of these sites are in tidal creeks and estuaries associated with urban catchments, or in the upper Waitematā Harbour where copper concentrations are slightly elevated. None of the sites had concentrations of copper, lead or zinc that exceeded probable effects level (PEL) guideline values (whereas 2 sites exceeded PEL guideline values for at least one contaminant in 2011).

Copper, lead, and zinc concentrations have now been monitored in the Auckland Region for long enough, and at frequent enough intervals to estimate trends (**Figure 6-16** and **Figure 6-17**). Statistically and environmentally significant⁶ trends have been detected at:

6. Statistically and environmentally significant trends are those where there is a relatively high probability that the result is not simply due to random variation (noise) in the data, and rates of change are greater than 1% of respective TEL guideline values per year.

- 12 sites for lead concentrations with all of these displaying declining (i.e., improving) trends,
- 13 sites for copper concentrations, with the majority (nine) displaying declining (i.e. improving) trends, and
- 12 sites for zinc concentrations with the majority of these (eight) displaying increasing (i.e. worsening) trends.

Notably, some of the most contaminated sites are showing the greatest improvement in copper and lead concentrations (i.e. Whau Inlet and Oakley Creek sites). However, sites in the upper Tāmaki Inlet have relatively high, and worsening zinc concentrations.

In the Waikato Region sediment contamination appears to be primarily related to runoff from contaminated mining sites and agriculture. Previous investigations have shown that sediments along the Thames coastline are contaminated with one or more heavy metals (*Kim 2007, also see the 2011 State of our Gulf Report*). Monitoring carried out by the Waikato Regional Council in 2013 indicates that copper, lead and zinc concentrations continue to exceed TEL guideline values around Thames, while mercury concentrations exceed the higher level PEL guideline value in Kuranui Bay (**Figure 6-15**). Guideline values are not exceeded at sites further north of Thames, on the western shore of the Firth, or in Tairua. Monitoring of these sites has not been carried out frequently enough to examine trends in contaminant concentrations.

The completion of Tui Mine remediation in 2013 was a major milestone in addressing legacy mine contamination. Tui mine produced base metals including copper, lead and zinc from 1966 until it was abandoned in 1973, leaving one of the most metal-polluted environments in New Zealand (*Sabti et al. 2000*). The mine site, located on the western slopes of Mount Te Aroha, is within the catchments of Tui and Tunakohoa streams, which flow into the Waihou River and downstream into the Firth of Thames. The project was completed in two phases (*Waikato Regional Council 2014*).

1. Preparatory work and the treatment of the old underground mine workings, which discharged contaminated water into the Tunakohoa Stream. The workings were partially plugged with engineered concrete bulkheads, and an alkaline solution (lime or cement) was injected into the ground to counter the strongly acidic conditions.
2. Remediation of the tailings dam area, involving a one-metre cap of clean fill being placed over newly-shaped land. The cap has been grassed and is designed to stop oxygen and water entering the stabilised tailings in the short term until vegetation cover establishes.

Table 3: Sediment quality guidelines and background concentrations

Sediment and water quality guidelines are commonly used to assess the potential for contaminant-related ecological effects. These are usually provided as a set of low and high values. – TEL (Threshold Effect Levels, MacDonald *et al.* 1996) guideline values provide an early warning of contamination, which allows timely management intervention to prevent or minimise adverse environmental effects. TEL guidelines are low-level limits that are indicative of contaminant concentrations where biological effects are ‘rarely’ expected to occur. O’Connor (2004) defines ‘rarely’ as having an observed frequency of 5 to 8%, leading to a rule of thumb that low-level guideline concentrations correspond to a 10% probability of toxicity. PEL (*Probable Effect Levels, MacDonald et al. (1996)*) guideline values indicate that adverse environmental effects have a high probability of occurring and management intervention may be required to remediate the problem. They are indicative of contaminant concentrations where biological effects are frequently expected to occur.

Parameter	Nominal background concentration in the Auckland Region	TEL Guideline Value	PEL Guideline Value
Copper	c. 5 mg/kg ¹	18.7 mg/kg	108.2 mg/kg
Lead	c. 5 mg/kg ¹	30.2 mg/kg	112.2 mg/kg
Mercury	Undetermined	0.13 mg/kg	0.70 mg/kg
Zinc	c. 35 mg/kg ¹	124 mg/kg	271 mg/kg

1. Diffuse-Sources Limited (2004)

6.2.2 BENTHIC HEALTH

Auckland Council has recently revised its Benthic Health Model, which was used to rank the condition of intertidal communities in relation to stormwater contaminants in the 2011 State of our Gulf Report (*see Hewitt et al. 2012*). The revised model now takes into account the effects of both sediment texture and contamination. Sites continue to be ranked on a five point scale from 1 to 5, which equate to health rankings of ‘extremely good’ to ‘unhealthy with low resilience’. Degraded sites tend to have fewer rare and large taxa. Rare taxa are patchy and occur in low numbers, but they have a strong influence on community structure and make a substantial contribution to overall biodiversity. They are also important in maintaining the stability and resilience of ecosystems, especially in changing environments. Large taxa (such as pipis and cockles) can make a disproportionately high contribution to ecosystem functions through the deep mixing of sediments, modification of water flows along the seabed and providing sizeable packages of food for fish and other larger consumers. They are also likely to affect oxygen, carbon and nutrient exchanges between the water column and the sea floor, leading to effects that are beyond simple changes in composition (*Hewitt et al. 2009*).

The most recent benthic health rankings for each site are provided in **Figure 6-18** (*data from Hewitt et al. 2012*). Of the 107 sites assessed in the Hauraki Gulf:

- 4 sites had an ‘extremely good’ grade,
- 24 sites had a ‘good’ grade,
- 30 sites had a ‘moderate’ grade,
- 24 sites had a ‘poor’ grade, and
- 25 sites had an ‘unhealthy with low resilience’ grade.

Sites with the worst benthic health tend to be located in upper tidal creeks, and are subject to runoff from urban and/or rural catchments. The Upper Waitematā Harbour, southern inlets of Waitematā Harbour, the upper Tāmaki Inlet, and upper sections of tidal creeks in Whitford embayment stand out as areas with degraded benthic health. Most of these sites have elevated concentrations of at least one heavy metal. The exception is tidal creeks in Whitford embayment, where poor benthic health is likely to be related to high levels of mud.



Photo: Tāmaki Estuary

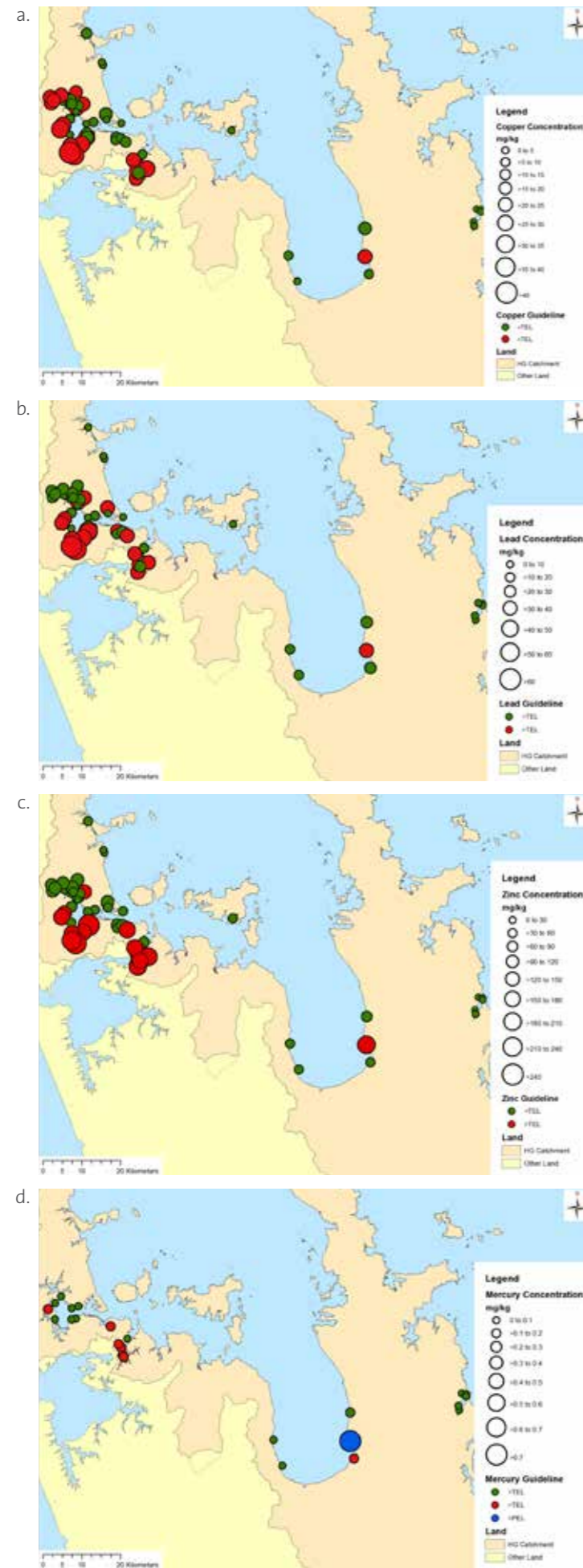


Figure 6-15: Concentrations of a) copper, b) lead, c) zinc and d) mercury in coastal sediments. Bubble colour relates to threshold effects level (TEL) guideline values (MacDonald *et al.* 1996) and bubble size is proportional to metal concentration (mg/kg). Concentrations were obtained using strong acid digestion of the <500 μ m sediment fraction. Data provided by Auckland Council.

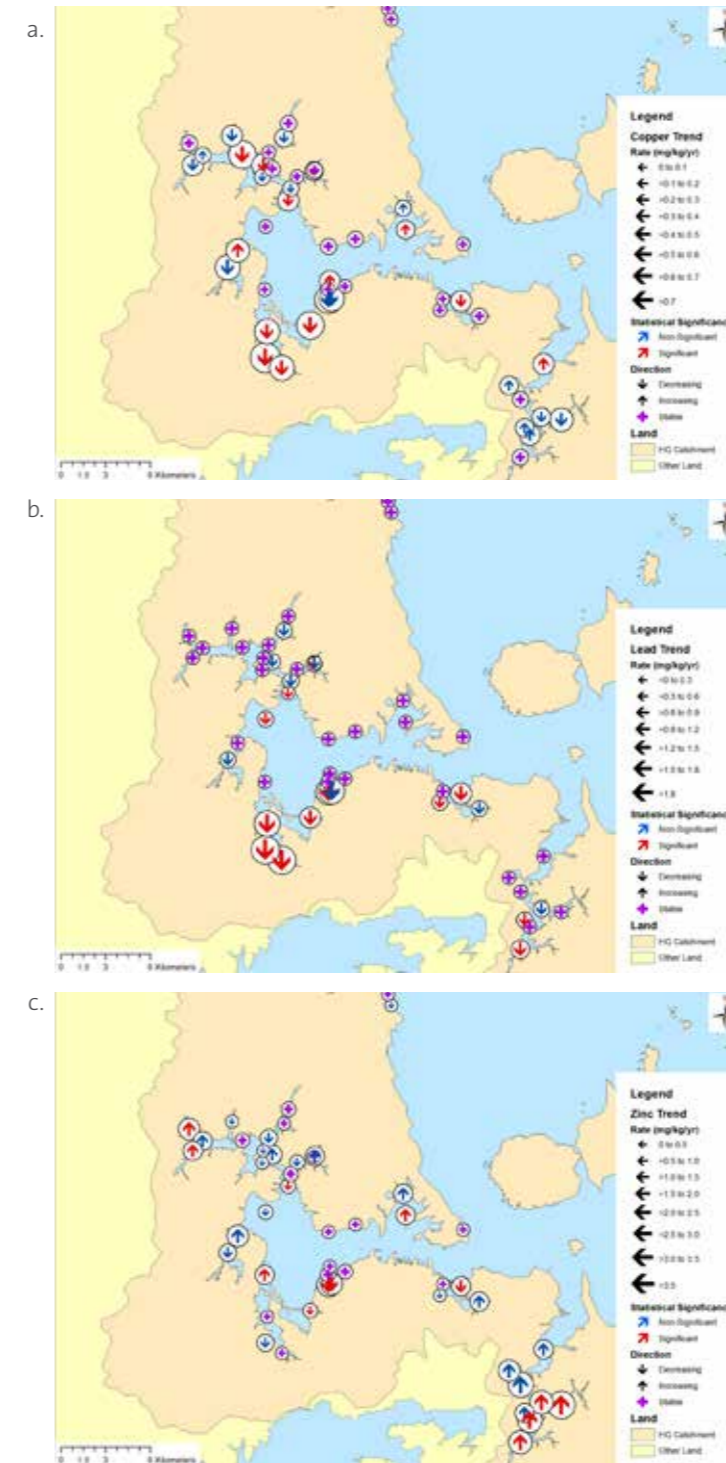


Figure 6-16: Trends in the concentrations of a) copper, b) lead, and c) zinc in coastal sediments around the Auckland urban isthmus. Arrow colour indicates whether the trends are statistically significant (red) or not (blue). Arrow size is proportional to the rate of change (mg/kg/yr). Concentrations were obtained using strong acid digestion of the <500 μ m sediment fraction. Data provided by Auckland Council.

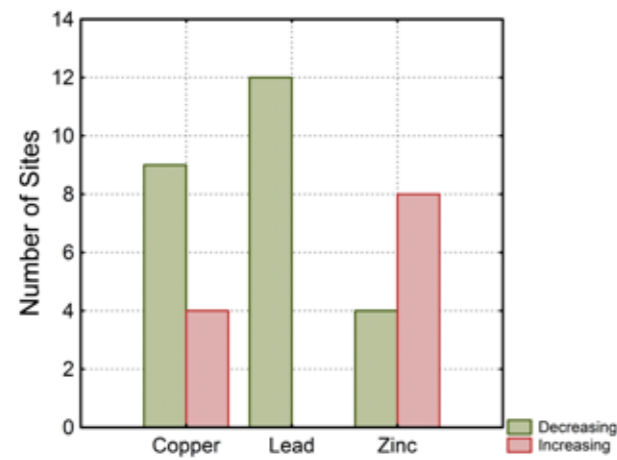


Figure 6-17: Number of sites (out of 50) in the Auckland Region with statistically significant ($p < 0.05$) and environmentally significant trends in copper, lead and/or zinc concentrations. Data provided by Auckland Council. Statistically and environmentally significant trends are those where there is a relatively high probability that the result is not simply due to random variation (noise) in the data, and rates of change are greater than 1% of respective TEL guideline values per year.

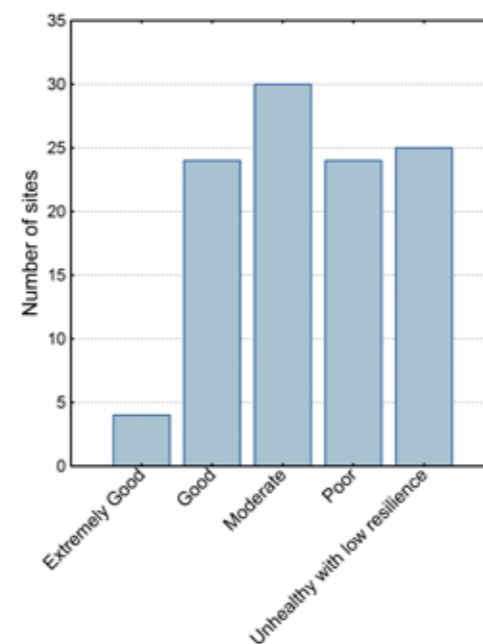
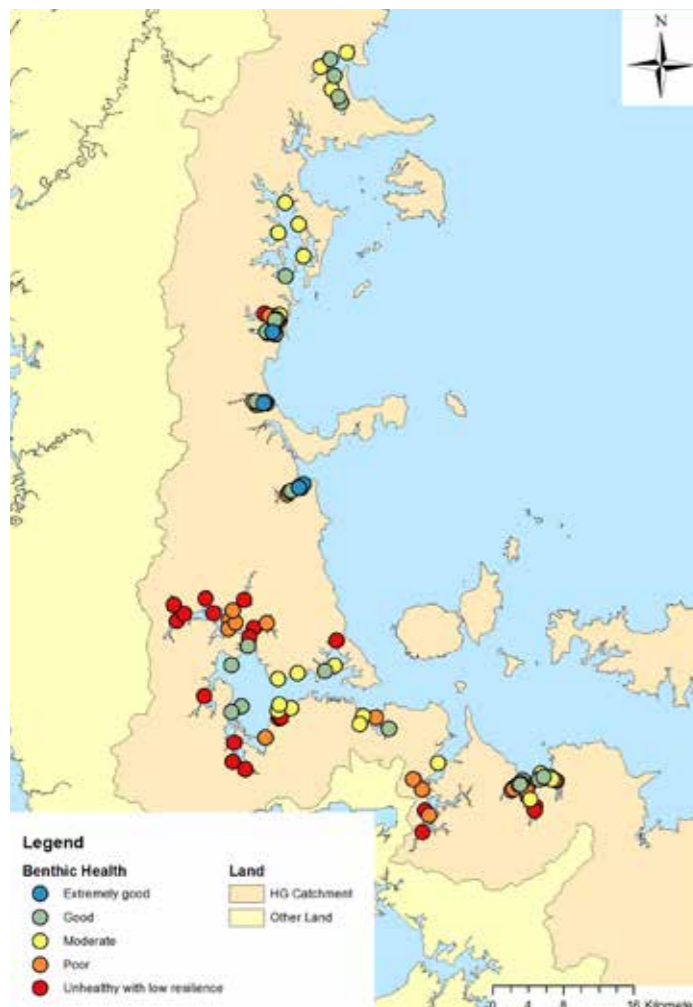


Figure 6-18: Ecological health of benthic communities in relation to sediment and stormwater contaminants. Health is ranked from 'extremely good' to 'unhealthy with low resilience' (Hewitt *et al.* 2012).

6.2.3 CASE STUDY: RESTORATION OF TE WHENUA RANGATIRA



Photo: Mussel reef restoration at Ōkahu Bay

Ngāti Whātua Ōrākei understand the effects of poor environmental management better than most. They have witnessed what poor environmental practice leads to, and have experienced the effects of disregarding the culture and wellbeing of a people. For 46 years between 1914 and 1960, the discharge of untreated sewage from the Ōrākei outfall prevented the hapū from using their traditional coastal resources, and had an appalling effect on their health and living conditions. Their traditional land and coastline around Ōkahu Bay was radically altered by the construction of a sewage pipeline, high capacity roads, marinas and other infrastructure. These altered water flows in the bay and still generate contaminants, which end up in the sea, affecting kai moana and the broader ecosystem. These impacts, which were forced upon the hapū, have left an indelible imprint. Ngāti Whātua Ōrākei no longer accept that they must bear the environmental costs of decisions made by others, and are actively working to build capacity, resolve legacy issues, and create better outcomes for future generations.

A key stepping stone in that process was the development of the Ōkahu Catchment Ecological Restoration Plan. The Plan is grounded in Ngāti Whātua Ōrākei philosophies and mātauranga about Ōkahu Bay, and its catchment, waterways, land, biodiversity, ecology and people. The plan provides a framework for managing Te Whenua Rangatira ('chiefly or noble land') of the Ōkahu Bay Catchment. Te Whenua Rangatira is a remnant of the Ōrākei Block comprising 6 areas: Takaparawhau, Tai Hara Paki, Kohimaramara, Papakāinga, Te Ngāhere and Ōkahu Bay. The spiritual significance of the land was recognised by Ngāti Whātua Ōrākei ancestors who sought to safeguard Te Whenua Rangatira as a place which links water, land, forest and sky (Tangaroa, Papatūānuku, Tānemahuta and Ranginui) maintaining a strong link with surrounding cultural landmarks within the isthmus and beyond.

During the development of the plan, Ngāti Whātua Ōrākei consulted widely amongst their people and asked them to describe how they would know when their relationship with Ōkahu Bay had been restored. This resulted in the following vision:

'Waters fit to swim in at all times, with thriving marine eco-systems that provide sustainable kaimoana resources to a Ngāti Whātua Ōrākei community who have strong daily presence in and on the bay as users and kaitiaki'.

Stormwater and wastewater runoff are therefore key issues for the plan. These carry sediment, metal and organic contaminants, and pathogens to the coast.

To address these matters, the traditional knowledge of Ngāti Whātua Ōrākei is being complemented by science and cutting-edge technologies. Underlying this philosophy is the need to take a holistic approach to management, which recognises both the spiritual and physical aspects of the environment. A fundamental concern is the need to improve the mauri of waterways and the bay. Novel new methods, such as the Mauri Model which integrates mātauranga and science, have enabled Ngāti Whātua Ōrākei to better understand and plan for improvement of the mauri.

The hapū is actively building its capacity by fostering relationships with researchers from the University of Auckland and Ngā Pae o te Māramatanga. It is also forging new and strengthening existing relationships that can contribute towards prosperous, successful futures, and ultimately a healthier Hauraki Gulf. For instance, it has engaged with the Auckland Council Sustainable Catchment Programme, which supports community-based environmental actions. The programme builds the capacities of communities who are already engaged in kaitiakitanga, to work as a collective towards enhancing environmental outcomes. It provides an integrated catchment-based, planning and implementation framework to improve the long term health of priority habitats.

One of the key people leading the charge is Environmental and Social Capital Broker Richelle Kahui-McConnell. Richelle fiercely defends the obligations and rights of Ngāti Whātua Ōrākei as kaitiaki, and actively demonstrates what they mean through her actions. On any given day, she can be seen helping families to create their own vegetable gardens, connecting Ngāti Whātua Ōrākei school children with scientists to help build capacity for the hapū, planting trees, or working with science, marina or council staff on shellfish enhancement, stream daylighting or any number of other initiatives. Richelle is firmly focussed on the future and is determined to see the mauri restored to Te Whenua Rangatira. She recognises that some things may never be completely unwound, but is always looking for better ways of doing things and for opportunities to use mātauranga Māori principles to improve existing outcomes.

A snapshot of other activities that the hapū are currently involved in that will help improve outcomes for them and the Gulf include:

- Quantifying heavy metal contamination in Ōkahu Bay,
- Replanting of native trees in the Ōkahu Bay Catchment,
- Advanced planning for the daylighting a piped stream, which once ran through Ōkahu Domain,
- The creation of mussel beds to filter stormwater and other contaminants running into Ōkahu Bay,
- Ngāti Whātua Ōrākei is also leading a range of projects to restore the mauri to Te Whenua Rangatira in collaboration with Auckland Council, University of Auckland and Ngā Pae o te Māramatanga.

Ngāti Whātua Ōrākei are deeply committed to realising the dreams and aspirations of their people to enhance Te Whenua Rangatira, including Ōkahu Bay and its surrounding catchment. This work fits within a wider goal of improving overall outcomes for their people by strengthening links to their natural and cultural heritage, and has flow on benefits for the Gulf.

6.3 NUTRIENTS

Overview

Greatest nutrient inputs to the Hauraki Gulf come from landuses associated with dairy farming on the Hauraki Plains.
Overall, the Matamata-Piako District has the greatest number of cows per hectare of any district in New Zealand. Nationally significant numbers also occur in the Hauraki District.
Cow numbers increased by 45% in the South Waikato District between 1999 and 2013. Smaller increases also occurred in the Matamata-Piako and Hauraki Districts.
Nitrogen concentrations have increased over the past 20 years in the Waihou River, which is estimated to provide around 58% of the load to the southern Firth of Thames. Average annual nitrogen loads from Hauraki rivers are estimated be 3,716 tonnes, and are predicted to continue increasing out to 2020.
Aquaculture reforms in 2011 allow an additional 800 tonnes of nitrogen per year to be discharged from finfish aquaculture in the new Coromandel Marine Farm Zone, and 300 tonnes per year to be discharged in the Wilsons Bay Area C (see Aquaculture Case Study, Section 5.1.5).
In the Auckland Region, coastal nutrient concentrations are highest in the Upper Waitematā Harbour and Tāmaki Inlet. Environmentally significant phytoplankton blooms occasionally occur in these areas.
Coastal nutrient concentrations have generally been declining (improving) in the Auckland Region.
The relative contribution of nutrient inputs from municipal wastewater treatment plants and overflows from the wastewater pipe system is likely to be greater in the Auckland Region (<i>c.f. the Waikato Region</i>), but they are still likely to be well below the overall nutrient load from agricultural sources.
Routine monitoring by councils of coastal nutrients is not carried out in the Firth of Thames, but a long-term investigation by NIWA suggests that nutrient inputs are leading to coastal ocean oxygen sags and acidification.
The lack of coastal water quality monitoring in the Waikato Region means that long term trends in water quality are not being tracked in most parts of the eastern Hauraki Gulf.

Nutrients are necessary to sustain the plant (algae) growth that forms the foundation of the food chain. Slight increases in nutrients can increase ecosystem productivity, but high nutrient levels are detrimental and potentially lead to nuisance phytoplankton and seaweed blooms, reduced water quality, and toxic effects. The Hauraki Gulf is naturally maintained by nutrients that upwell from deep offshore waters, recycled from the seabed, and washed off the land. Humans have increased nutrient inputs through wastewater discharges, fertiliser application and livestock effluent. Nitrogen has the greatest effect on water quality in the coastal marine environment, and is therefore the nutrient of primary concern for the Hauraki Gulf. Phosphorus is also a key nutrient and is of secondary concern for the marine environment⁷.

7. Note that in freshwater systems phosphorus is usually the primary nutrient of concern, and nitrogen the secondary nutrient of concern

Greatest human-mediated nutrient loads come from the Hauraki Plains, where the number of cows per hectare are among the highest in the country (see Section 5.1). Predicted nitrogen loads from the Hauraki Plains are already among the highest in New Zealand, and they are expected to continue increasing out to 2020 (Parshotam *et al.* 2013). Between 2003 and 2012, the major rivers draining to the southern Firth of Thames were estimated to have carried an average annual load of 3,716 tonnes of nitrogen and 256 tonnes of phosphorus (Bill Vant, WRC, unpublished data). This compares with average annual nitrogen and phosphorus load estimates of 3,295 tonnes and 261 tonnes, respectively between 2000 and 2009 (Vant 2011). Average annual nitrogen loads from these rivers were therefore 12% higher, and phosphorus loads 2% lower in the most recent 10 year period. Note that average river flows were around 5% higher during the latter period, and could have accounted from some of the increase in nitrogen loads (Bill Vant, WRC, Pers. comm.).

The Waihou River is estimated to contribute around 58% of the combined nutrient mass to the southern Firth of Thames. The Piako River, Waitoa River and Kauaeranga River each convey around 24%, 16%, and 2% respectively (data provided by Bill Vant, Waikato Regional Council) (see Figure 6-19 for the locations of these rivers). In the 20 years between 1993 and 2012, total nitrogen concentrations increased by 0.5% to 1.7% per annum at monitoring sites along the Waihou River (including the Waiomou and Waiohotu tributaries). In contrast, total nitrogen concentrations at sites along the Piako and Waitoa Rivers were stable or declined by 0.8% per annum (Vant 2013). Total phosphorus concentrations have remained stable or declined at all sites. The most notable improvement is in the lower Waitoa River, where total phosphorus concentrations declined by 18% per annum between 1993 and 2012. This is an anomaly related to extremely high concentrations in the 1990s, which were caused by the use of phosphoric acid as a cleaning agent in the Waitoa dairy factory (Bill Vant, Waikato Regional Council pers. comm.). Point source discharges are estimated to contribute around 8% of the nitrogen and 25% of the phosphorus carried by the Hauraki rivers, while background sources are estimated to contribute about 23% of the total nitrogen and 28% of the total phosphorus loads. The remaining 70% of the nitrogen load and 46% of the phosphorus load is estimated to have come from diffuse agricultural sources (Vant 2011).

Auckland rivers and streams tend to have relatively low nutrient loads because of their small size, and low and declining numbers of dairy cow (see Section 5.1 and Figure 6-19). The average annual nitrogen load from Auckland's largest river in the Hauraki Gulf catchment (i.e. Wairoa River) is estimated to be 120 tonnes per annum. Representative loads from other Auckland rivers (Otara and Oteha (urban), and Mahurangi (rural)), are 25, 9 and 24 tonnes per annum respectively.

A greater proportion of nutrient inputs in the Auckland Region is likely to come from municipal wastewater treatment plants, and overflows from the wastewater pipe system (see Sections 5.1 and 6.4). Between 2010–11 and 2012–13, annual total nitrogen load from the two largest wastewater treatment plants to discharge into the Hauraki Gulf (i.e. Rosedale and Army Bay) are estimated to have varied from 197 to 253, and 47 to 63 tonnes respectively. This is similar to the total nitrogen load estimated to be coming from wastewater treatment plants and industrial discharges in the Hauraki Catchment (262 tonnes per year (Vant 2011)), and well below total agricultural loads. Total nitrogen loads are not measured at the other wastewater treatment plants in the Auckland Region. However, given the sizes of the populations they service, additional loads are likely to be relatively minor (note that wastewater from urban areas in the southern Waitematā and Tāmaki areas is processed at the Mangere Wastewater Treatment Plant, which discharges to Manukau Harbour).



Figure 6-19: Major streams and rivers in the Hauraki Gulf catchment. Rivers where nutrient loads have been estimated are labelled.

6.3.1 COASTAL NUTRIENTS

Auckland Council has consistently collected coastal water quality data at monthly intervals from 20 sites in the Hauraki Gulf since 1987–1993. Another two sites, at the entrances to Turanga Creek (Whitford) and Wairoa River (Clevedon), were added to the programme in 2009. Ammonia-N and nitrate-nitrite-N are immediately available for phytoplankton and macroalgae uptake and growth, and are used as key indicators for nitrogen. Total nitrogen concentrations have not been measured for the full reporting period, and therefore, are not reported here. The key indicators used for phosphorus are soluble reactive phosphorus and total phosphorus. Soluble reactive phosphorus is immediately available for uptake and growth by phytoplankton and macroalgae, while total phosphorus is only partially available. Total phosphorus provides a measure of the overall store of phosphorus in a water sample.

Median ammonia-N and nitrate-nitrite-N concentrations were relatively low in exposed coastal areas and Mahurangi Harbour between 2004 and 2013⁸, moderate in the Central Waitematā and outer Tāmaki Inlet, and highest in the upper Waitematā Harbour and upper Tāmaki Inlet. Similar patterns were observed for soluble reactive phosphorus and total phosphorus concentration, although differences between the central and upper Waitematā Harbour were less pronounced (**Figure 6-20**). Over this period, significant phytoplankton blooms⁹ were detected on seven occasions in the Upper Waitematā Harbour and one occasion in Tāmaki Inlet. However, declining trends prevailed for all four indicators of nitrogen and phosphorus (**Figure 6-21**), which is consistent with improving water quality in coastal areas of the Auckland Region.

Waikato Regional Council periodically monitor coastal water quality in the Hauraki Gulf with Whangamata being monitored in 1999–2001; Whangapoua in 2006–07, the Southern Firth of Thames in 2006–07; and, Whitianga in 2010–11. These data provide a snapshot of water quality during the periods when sampling was carried out, but they do not allow current state or trends in water quality to be determined. In the 2011 State of our Gulf report, the available data were assumed to indicate that water quality in the southern Firth of Thames was reasonably good, with no obvious grounds for concern.

However, emerging results from a long-term research program being carried out by NIWA, suggests that nutrient inputs have increased coastal productivity to the point where they cause seasonally elevated carbon dioxide concentrations in the water and a corresponding sag in dissolved oxygen (driven by the breakdown of organic material). The increase in carbon dioxide concentrations is leading to seasonal acidification of Firth of Thames waters (in summer and especially autumn), where pH levels down to 7.9 have been recently recorded (c.f. pH of around 8.1 in the outer Gulf). This change is twice that of current acidification in the open ocean (pH change of 0.1 units from pre-industrial oceanic pH of 8.1), and is consistent with pH observed in nutrient-impacted coastal zones overseas (*Provoost et al. 2010*). A change of this magnitude is notable because it will potentially compound acidification caused by increasing levels of atmospheric carbon dioxide. Further research is needed to understand the implications of these preliminary results, but a key concern is the effects that acidification will potentially have on the survival and growth of shellfish and other organisms (*John Zeldis, NIWA pers. comm.*).

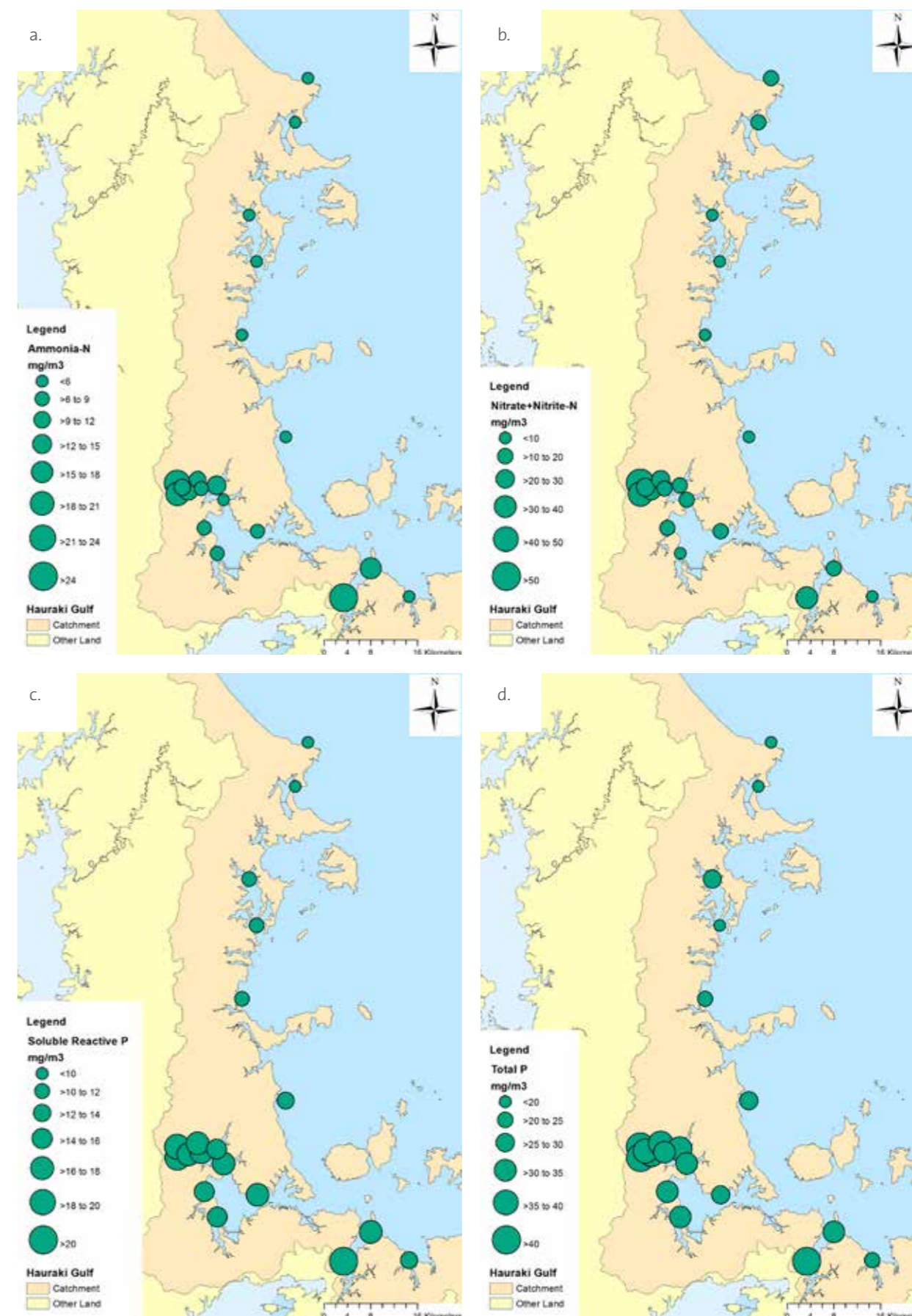


Figure 6-20: Median concentrations (mg/m³) of a) ammonia-N, b) nitrate+nitrite-N, c) soluble reactive phosphorus, and d) total phosphorus in coastal water sampled monthly between 2004 and 2013 at all sites except Turanga Creek, Whitford, and at the mouth of Wairoa River, Clevedon. The latter two sites were sampled between 2009 and 2013. Bubble size is proportional to nutrient concentration.

8. 2009 to 2013 for the Turanga and Wairoa sites

9. Blooms producing chlorophyll a concentrations of > 0.03 mg/l

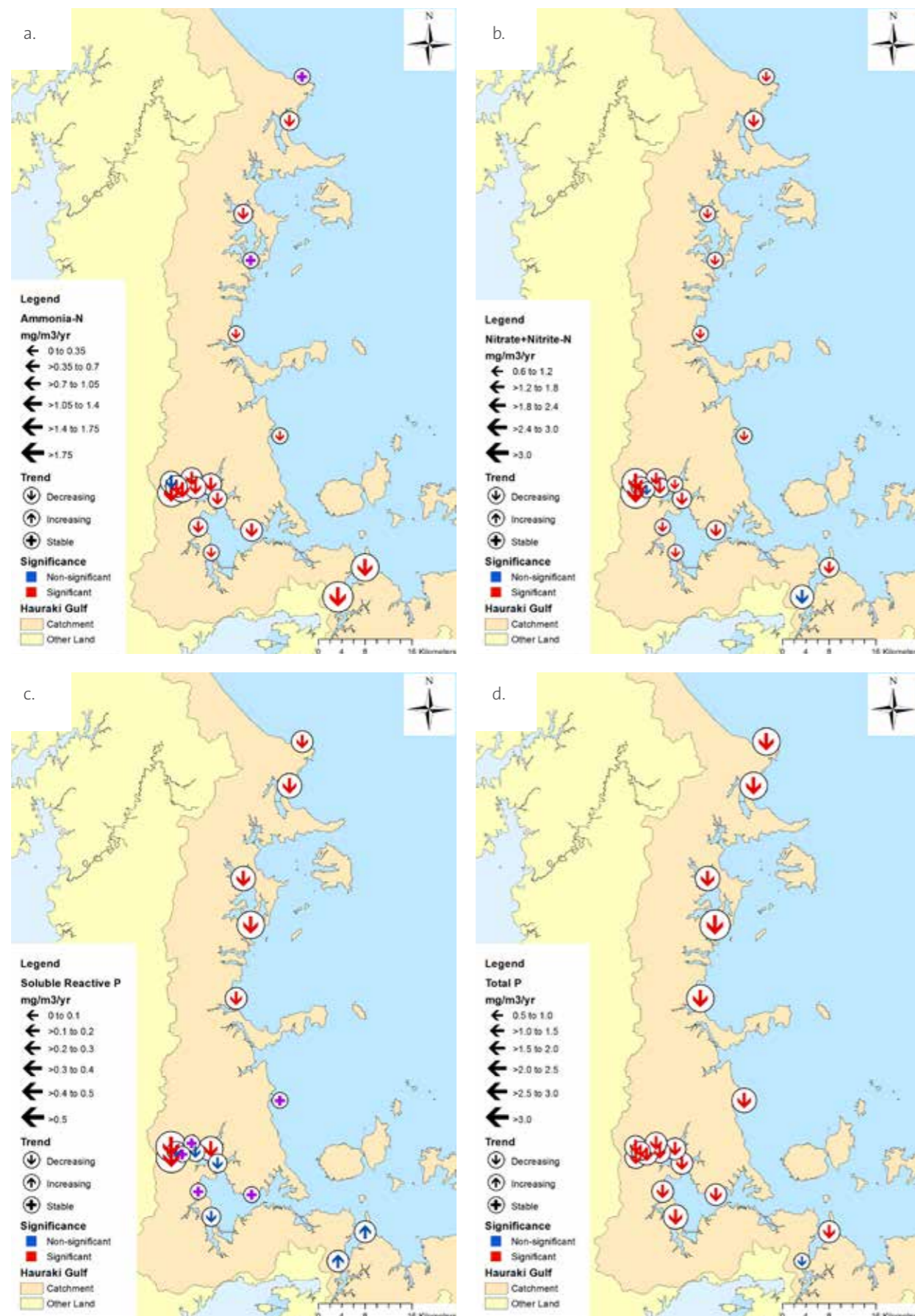


Figure 6-21: Trends in the concentrations (mg/m3/yr) of a) ammonia-N, b) nitrate+nitrite-N, c) soluble reactive phosphorus, and d) total phosphorus in coastal water sampled monthly between 2004 and 2013. Arrow size is proportional to the rate of change and arrow colour indicates whether trends were statistically significant (red) or not (blue). Crosses indicate stable concentrations.

6.3.2 CASE STUDY: WHAIA TE MAHERE TAIAO A HAURAKI – HAURAKI IWI ENVIRONMENTAL PLAN



In 1999, after years of discussion and deliberation by Hauraki Whānui, the Hauraki Māori Trust Board began to develop their environmental plan. Published in 2004, the Executive Summary of Whaia Te Mahere Taiao o Hauraki – Hauraki Iwi Environment Plan, describes it as:

'A strategy for collective action by Hauraki Whānui to sustain the mauri of the natural environment and cultural heritage of the Hauraki rohe over the next 50 years. It accepts that it is not possible to return the environment to the state it was in before the forests were felled, the swamps drained and the shellfish beds depleted. It is however possible and practicable to return to a situation where fisheries and bird life is more abundant, our waters clearer and cleaner and our forests a place to hear bird song again.'

The vision is captured in the statement – *'Kia mau ki te mauri o te Taiao o Hauraki'* and is articulated below:

'It is 2050. Hauraki people are able to enter the great forests of Tāne and witness a place alive with life. Kukupa again make their migration from the mountains to the lowland forests to feast upon the berries of the matai, the miro and the karaka.'

Most of our waterways in rural and urban areas have been restored to their indigenous state and are now home to increasing populations of fish. Water-plants have increased providing a home for kaeo and protecting young of tuna and inanga. There are no longer any contaminants polluting our waterways and harbours, and many more wetlands exist because of the past and present activities of kaitiaki.

These places of the land and sea have once again become abundant food baskets. Kaitiaki are protecting the harvesting of mahinga kai, mahinga mātaimai and taonga raranga for tribal communities in accordance with tikanga.

All waahi tapu and cultural heritage sites and landscapes in Hauraki are being protected, managed and rehabilitated by kaitiaki at all levels of the tribal spectrum. No use or development of waahi tapu or cultural heritage sites takes place without the express consent of the Iwi, hapū and whānau involved.

Hauraki people have embarked on a number of economic development initiatives since the settlement of their treaty claim in 2007. The kinds of businesses invested in are environmentally sound, and based on resource sustainability, traditional economies and cultural heritage such as sustainable aquaculture, heritage tourism, energy efficiency, waste reduction, riparian, coastal and wetland restoration.

Hauraki people are making final decisions about change in the environment through the eyes of the next generation. This is because our mokopuna have been taught what it is to be kaitiaki and the tikanga about how to manaaki the environment from their whaea, matua and whānau. They also freely take the tools from western science to enhance their kaitiaki activities.

Kaitiaki are no longer pre-occupied with educating central and local government agencies and communities about the Treaty of Waitangi. That is because it is no longer talked about but carried out as a living charter.'

Mauri is the life energy force or unique life essence that gives being and form to all things in the universe. Tikanga (correct procedure) has emerged around this duty bringing with it an intimate knowledge and understanding about local environments and a set of rules that guide Hauraki way of life, both spiritual and secular. Sustaining the mauri of a taonga, whether a resource, species or place, is central to the exercise of kaitiakitanga. The key goals of the plan are:

- **Mauri.** Hauraki Whānui sustaining and enhancing the mauri of ecosystems, habitats, species and natural resources under their care in the Hauraki tribal region.
- **Protecting our Past.** Hauraki Whānui protecting wāhi tapu, cultural heritage sites, places and landscapes and associated traditional knowledge in the Hauraki tribal region.
- **Supporting Kaitiaki.** The kaitiaki role of Hauraki Whānui is being maintained and enhanced.
- **Making Decisions.** Hauraki Whānui are making informed decisions about the environment and heritage of the Hauraki tribal region in accordance with tikanga.
- **Building Partnerships.** The Treaty of Waitangi is being upheld by central and local government, industry and local communities and reflected in the way they make decisions.
- **Community Awareness.** Communities understand and value the contributions of Hauraki Whānui in environmental management and heritage protection.

Some central principles are articulated in the plan:

- **Rangatiratanga:** each one of us wisely exercising our right to make final decisions over how taonga are managed, developed, used and protected.
- **Kaitiakitanga:** each one of us fulfilling our ancestral obligations to taonga.
- **Wairuatanga:** each one of us respecting the wairua inherent in taonga in recognition of the spiritual connection between humankind and the natural world.
- **Manaakitanga:** each one of us exercising our rights and responsibilities in a way that is beneficial for taonga.
- **Whanaungatanga:** each one of us exercising our rights and responsibilities towards taonga in a way that acknowledges our whakapapa, each to the other including the natural world.
- **Kotahitanga:** each one of us exercising our rights and responsibilities in a way that strives towards collective goals whilst recognising the autonomy and needs of each participant.

The plan is both aspirational and practical. It is grounded in mātauranga Hauraki, is future-focussed – envisaged through the ‘eyes of mokopuna yet unborn’ and provides practical advice. The plan is as much a blueprint to achieve success for Hauraki Iwi as it is an educational document for the various local, regional and national governmental agencies, and the general community, with whom Hauraki Whānui interact.

A decade has passed since the Hauraki Māori Trust Board published Whaia Te Mahere Taiao o Hauraki and it is timely to reflect on how effective the plan has been in realising the aspirations for which it was intended and considering its impact.

Whaia Te Mahere Taiao o Hauraki has enjoyed wide uptake by local, regional and central government. It has been lodged with Auckland Council, Waikato and Bay of Plenty Regional Councils, taken into consideration or referred to in many places including the Auckland Unitary Plan, Waikato Regional Council Policy Statement, Smart Growth (Bay of Plenty), Matamata/Piako District Council Waihou Catchment Management Plan, Thames/Coromandel District Council, National Policy Statement for Freshwater Management, Ministry for the Environment and reports for the Parliamentary Commissioner for the Environment. Notably the plan is also referred to in council plans outside of the Hauraki rohe – for example the Far North District and Kaipara Councils. The widespread uptake of the plan ensures that Hauraki values, ideals, and dreams are being considered.

Whaia Te Mahere Taiao o Hauraki is grounded in mātauranga Hauraki, articulates the aspirations of Hauraki Whānui to realise the vision of ‘Kia mau ki te mauri o te Taiao o Hauraki’. It is immediately apparent that many of the dreams and aspirations are shared by many communities in the Hauraki Gulf. Although only 10 years old, clearly the plan has had some impact, even outside of the Hauraki rohe, and we can look forward to what further beneficial impacts for the Hauraki Gulf lie in the future.

6.4 MICROBIOLOGICAL CONTAMINATION (PATHOGENS)

Overview

Microbiological contamination originates from a variety of sources.

Beach monitoring indicates that action guideline values for contact recreation are occasionally exceeded on many Auckland beaches, and that the frequency of exceedance is relatively stable.

Beach monitoring no longer occurs in the Waikato Region, so trends in microbiological contamination are not being tracked in the eastern Hauraki Gulf.

Microbiological contamination of natural shellfish beds is not routinely monitored. As a general rule it is considered unsafe to consume shellfish gathered from urban areas, because of the relatively high risk of wastewater contamination.

Wastewater discharges to marine and freshwater environments degrades the mauri of these waters, and is highly offensive to Māori.

Wastewater management has vastly improved since the 1950s, but overflows of dilute, untreated wastewater still occur on a frequent basis in Auckland urban areas. The construction of the Central Interceptor sewer will alleviate significant overflows around Central Auckland, but occasional overflows will still continue in many urban areas.

In the Waikato Region the discharge of untreated sewage to the coast is prohibited, but wastewater overflows do occasionally occur.

New regulation introduced in the proposed Auckland Unitary Plan will reduce the risks associated with the discharge of wastewater from boats in the Auckland Region. However, these rules will not apply in the Waikato Region, where controls default to the less stringent Resource Management (Marine Pollution) Regulations 1998.

Inputs from agriculture, domestic animals and natural sources of microbiological contaminants (e.g. birds) are also likely to effect the Hauraki Gulf.

Microbiological contaminants include pathogens that pose a health hazard when water is used for contact recreation (such as swimming and other high-contact water sports) or when contaminated seafood is consumed. Today, most of the ill-health effects are minor and short lived, but there is potential for contracting more serious diseases, such as hepatitis A, *giardiasis*, *cryptosporidiosis*, *campylobacteriosis* and *salmonellosis* (Ministry for the Environment & Ministry of Health 2002).

Rivers, streams, lakes and the coast are mahinga kai (food gathering areas), and the discharge of wastewater into water is deeply offensive to Māori. It diminishes the mauri of these waters and affects the health and living conditions of tangata whenua, and other people. It is also noted that historically, Māori have been amongst the people worst affected by sewage discharges to the Hauraki Gulf (see 'Restoration of Te Whenua Rangatira' case study).

Microbiological contamination is also a serious issue for marine farmers. It has a major influence on the suitability of areas for marine farming, and affects harvesting from operational farms. Contamination risks increase when it rains, so rainfall limits are used to determine when harvesting can occur, and the length of time after rain before harvesting can re-commence. In addition, shellfish cannot be harvested from farms without confirmation that water testing has occurred during the growing cycle, and testing has confirmed that the products are safe to eat (Aquaculture New Zealand 2014).

The key sources of microbiological contaminants are human and animal waste. Treated and untreated wastewater enters the coastal environment through discharges from municipal and industrial wastewater treatment plants, overflows from wastewater networks, seepage from septic tanks, discharges from boats, and contaminated stormwater.

Wastewater management has vastly improved since the 1950s, but overflows of dilute, untreated wastewater still occur on a frequent basis in Auckland areas serviced by the combined sewer network (see [Figure 5-1](#)), and occasionally in suburbs, towns and settlements of both the Auckland and Waikato Region. The construction of the Central Interceptor sewer will alleviate overflows around the Central Auckland area, but overflows will continue to occur in many parts of the city (see [Section 5.1 for further information](#)). There are 34 municipal wastewater treatment plants in the Hauraki Gulf catchment ([Figure 6-22](#)). Only five of these discharge directly to the coast, with an additional site discharging indirectly to the coast via seepage. The remaining treatment plants discharge to freshwater receiving environments (16 plants) or land (12 plants).

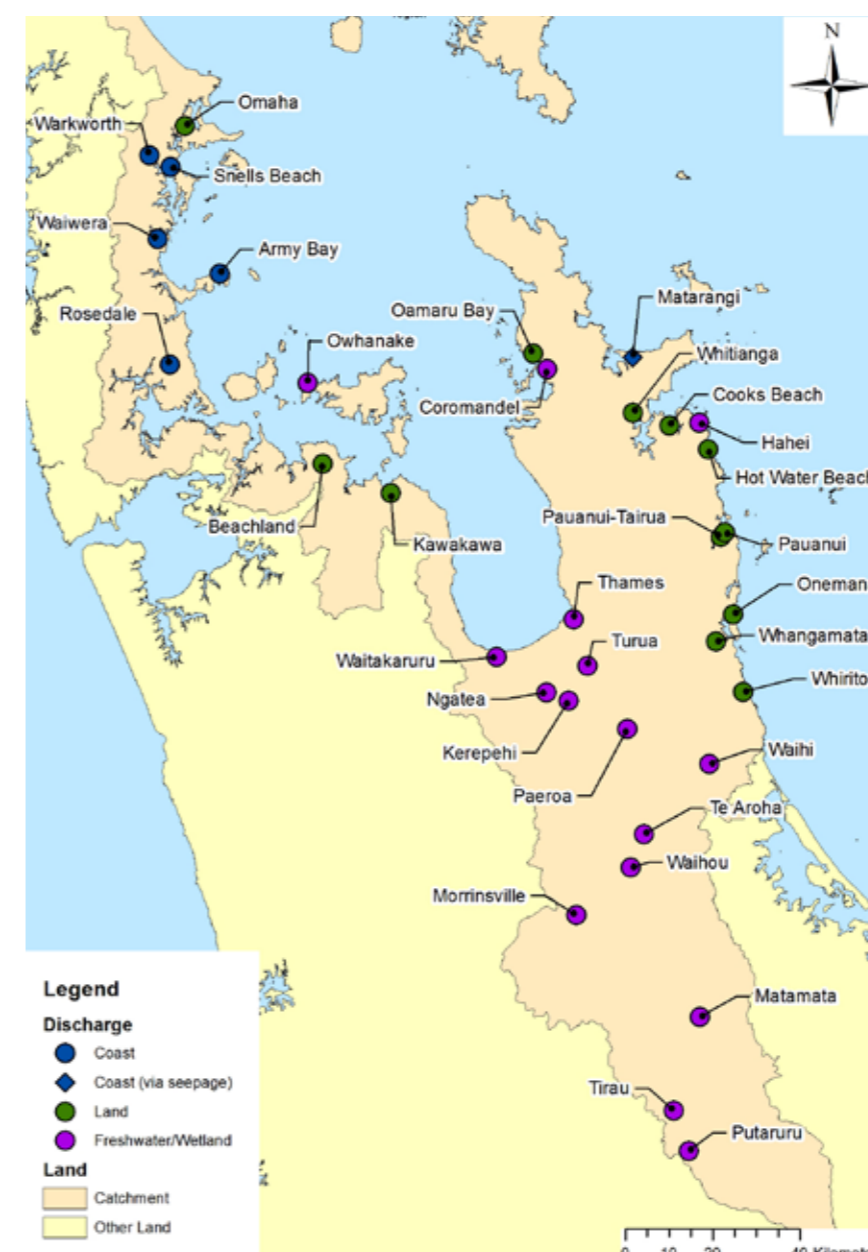


Figure 6-22: Wastewater treatment plants in the Hauraki Gulf catchment. The discharge receiving environments are also shown.

Many coastal communities do not have reticulated wastewater networks, and are therefore reliant on septic tanks. The performance of septic tanks varies widely, and is responsible for poor water quality in some locations. The effects of septic tanks on coastal water quality tend to increase as the extent of development and housing density increase (*Andrew Nobel, Auckland Council, pers. comm.*).

Wastewater discharges from boats are another source of microbiological contamination. Recent changes introduced through the Proposed Auckland Unitary Plan generally prohibit the discharge of wastewater in the Auckland Region unless vessels are more than 2 km from shore and in water greater than 5 m deep. Discharges also have to be more than 500 m from marine farms or mātaimai reserves, and more than 200 m from marine reserves. These provisions do not apply in the Waikato Region, where regulation defaults to the less restrictive provisions of the Resource Management (Marine Pollution) Regulations 1998 (*Figure 6-23, see Faire & Kelly 2012*).

Birds, dairy farming, and to a lesser degree sheep farms are also significant pathogen sources (*McBride et al. 2002*). Other domestic animals may also contribute.

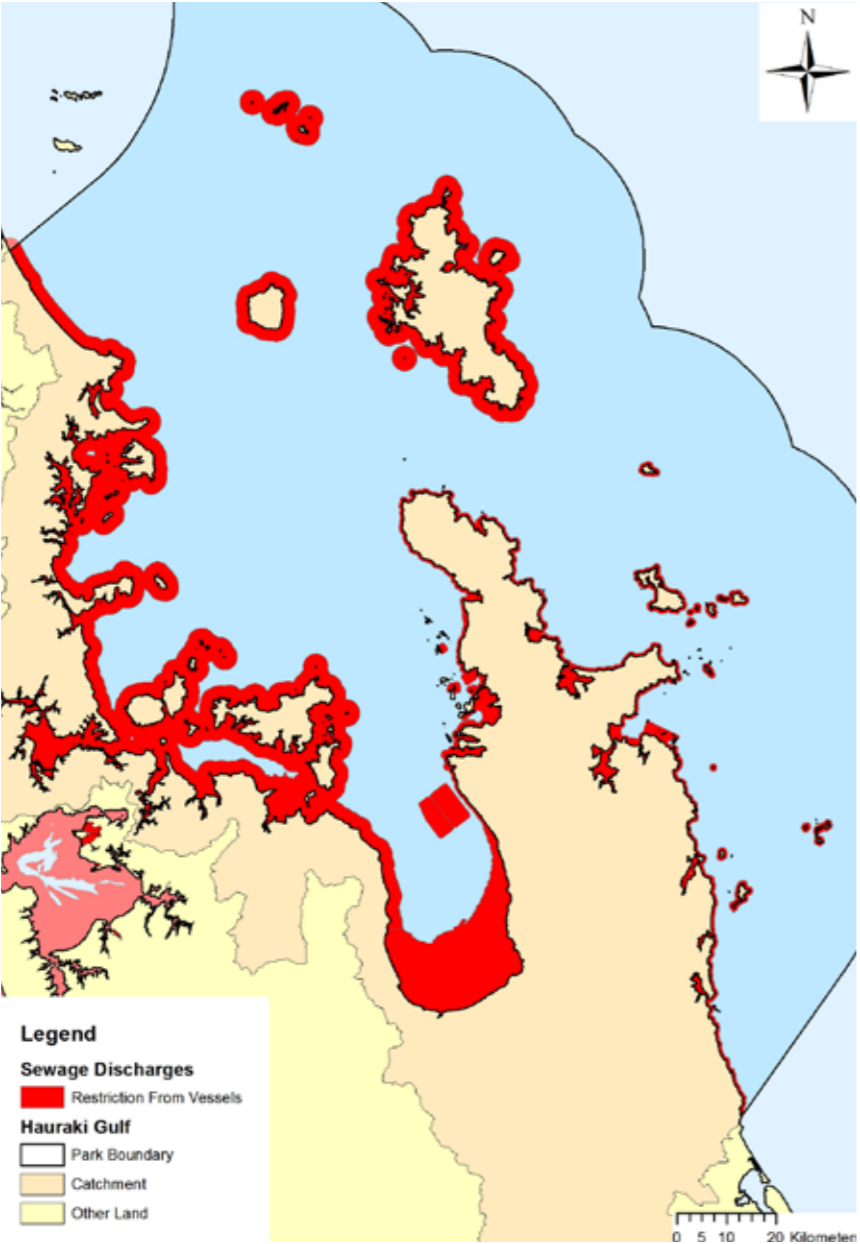


Figure 6-23: Areas where the discharge of sewage from vessels is restricted.

6.4.1 MICROBIOLOGICAL INDICATOR

The key indicator used for microbiological contamination is the concentration of Enterococci bacteria on beaches used for swimming. Enterococci are an indicator of harmful pathogens that can cause illness. A variety of beaches in the Auckland Region are monitored during summer (November to March/April), in accordance with the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (*Ministry for the Environment, Ministry of Health 2002, see Table 4*). Monitoring is generally carried out once per week during the summer period but, occurs more frequently if high Enterococci counts are detected. Routine monitoring is no longer carried out in the Waikato Region.

Table 4: Guidelines for contact recreation provide three status zones for monitoring and management actions.

Status	Enterococci count per 100 ml	Management action
Surveillance	<140	Continue weekly monitoring
Alert	140–280	Monitor daily
Action	>280	Monitor daily, erect warning signs and inform the community that a public health problem exists

Beach monitoring data from the Auckland Region were pooled and compared for the following three year periods: 2007–10, and 2011–13. Over half of the sites monitored in each of these periods exceeded the action guideline on at least one occasion, with 58% of 53 sites exceeding the guideline between 2007 and 2010 and 52% of 48 sites exceeding it between 2011 and 2013 (*Figure 6-24*). At most sites, only 5% or less of the water samples exceeded the action guideline value. However, at the worst site (Te Atatu) around a fifth of the samples exceeded the guideline between 2007 and 2010. Exceedance levels were roughly similar between the two periods, indicating that microbiological contamination on Auckland’s beaches is relatively stable. Beaches in the North Shore, Central Waitematā and Howick areas tended to have the most frequent exceedances. The action guideline was also regularly exceeded in Whangapoua, Tairua, and in Whangamata prior to the ceasing of monitoring activities in the Waikato Region.



Photo: Waiheke Island

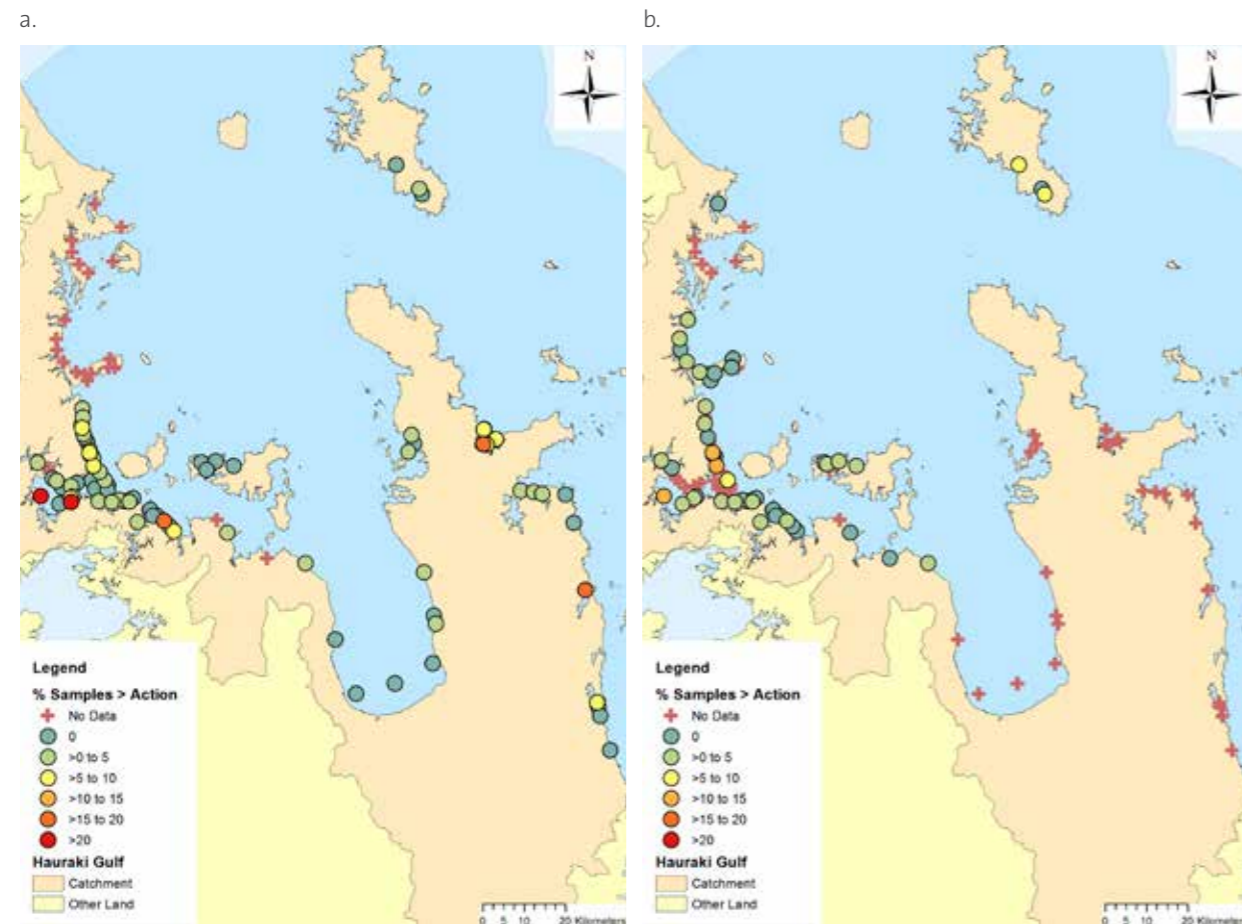


Figure 6-24: Percentage of beach monitoring samples exceeding the Ministry for the Environment and Ministry of Health's 'action' guideline for Enterococci levels between a) 2006–07 and 2007–08 summer seasons in the Waikato Region and the 2007–08 and 2009–10 summer seasons in the Auckland Region, and b) the 2010–11 to 2012–13 summer seasons in the Auckland Region. Note that beach monitoring has not been carried out in the Waikato Region since 2008.

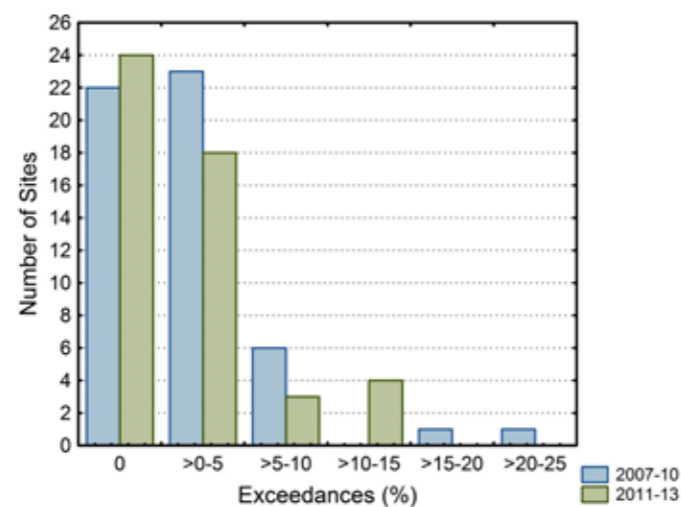


Figure 6-25: Proportion of samples that exceeded the 'action' guideline value for Enterococci concentrations at Auckland beach monitoring sites between 2007–10 and 2011–13

6.5 SEDIMENT

Overview

Sediment is a serious environmental contaminant that degrades coastal habitats.

Regular monitoring is picking up sediment-related effects at estuary sites scattered around the Auckland Region.

Patterns in intertidal communities vary among monitoring sites in the Firth of Thames, but few taxa have demonstrated trends that can be directly linked to recent (post 2007) variation in sediment texture.

Fourteen of the 19 water quality sites continually monitored by Auckland Council between 2004 and 2013, displayed deteriorating trends in concentrations of total suspended solids.

The Waikato Regional Council does not monitor coastal total suspended solids concentrations, but modelling by NIWA suggests that rivers draining to the southern Firth of Thames dominate sediment inputs to the Gulf, and that their footprint extends across the Firth of Thames and into Tāmaki Strait.

Modern sediment accumulation rates are typically greater than natural sedimentation rates in the Gulf.

The expansion of mangroves is a natural response to sediment runoff, warming temperatures, and other human actions. Mangrove cover in five estuaries with long term data is now greater than it was prior to the 1970s (albeit very slightly for Lucas Creek), but cover has only increased in one of these estuaries since the 1990s.

Mangrove cover in three estuaries examined with shorter term data has been relatively stable or declined slightly since the 1990s.

Mangrove forests in the southern Firth of Thames expanded from the 1950s, but ongoing observations indicate that the subsidence of the tidal flats (caused by the consolidation of deep sediments) coupled with sea-level rise is likely to impede further seaward expansion.

Sediment is a serious environmental contaminant that degrades coastal habitats and is toxic to many marine organisms (Airoldi 2003, Thrush *et al.* 2004). The environmental significance of increasing sediment loads has led to it being ranked the third highest¹⁰ of 65 identified threats to marine habitats in New Zealand respectively¹¹ (MacDiarmid *et al.* 2012). Deposited sediments accumulate in sheltered estuaries or deep coastal areas, where the energy from waves and currents is too weak to remobilise them. In estuaries, thick (>2 cm deep) deposits of land-derived sediment rapidly kill most animals buried beneath them (Norkko *et al.* 2002). Thin deposits (1–7 mm) also lead to a reduction in species' diversity and abundance, even in muddy areas where animals are expected to be adapted to high sediment loads (Berkenbusch *et al.* 2001). Recovery tends to occur slowly after depositional events and can take in excess of a year (Norkko *et al.* 2002). Sediments suspended in the water column also affect marine plants and animals by reducing water clarity, light levels, food quality and the feeding ability of animals. Consequently, the condition and survival of marine species frequently declines as suspended sediment concentrations increase (e.g. Hewitt *et al.* 2001, Nicholls *et al.* 2003, Ellis *et al.* 2002, Morrison *et al.* 2009).

¹⁰ The threat posed by increasing sediment loads is ranked equal to the threat posed by bottom trawling.

¹¹ Ocean acidification and climate change were ranked greatest and second greatest threats.

6.5.1 CHANGES IN MUD CONTENT AND BENTHIC ECOLOGY

Auckland Council and Waikato Regional Council monitor sediment characteristics and seabed communities in a number of harbours and estuaries in the Hauraki Gulf (**Figure 6-26**). Key results from these programmes are summarised below. The results of benthic health monitoring (which assesses the combined effects of contaminants and sediment) should also be referred to ([Section 6.2.2](#)).

In 2000, the Auckland Regional Council initiated an estuary monitoring programme that was specifically designed to detect sediment-related changes in the composition of intertidal communities in Okura Estuary. Between 2002 and 2004, this programme was expanded to include Puhoi, Waiwera, Orewa, Mangemangeroa, Turanga and Waikopua Estuaries, which were all facing an increase in development pressure and an associated risk of increasing sedimentation. Whangateau Harbour was subsequently added in 2009, due to specific concerns about ecological degradation in that estuary. Since 2005, there has been an increasing trends in the proportion of very fine and muddy sediments (i.e. sediments <125 µm) at upper estuary sites in Mangemangeroa, Okura, Puhoi and Turanga Estuaries, and in an outer Waiwera Estuary site (*Hewitt & Gibbs 2012*). Ecological changes consistent with increased sedimentation have occurred in all of the estuaries monitored since 2004, but trends at some sites have varied over time (*Hewitt & Simpson 2012*).

Sediment characteristics and macrofaunal community composition have been monitored in the central Waitematā Harbour since 2000. Sediment characteristics in Hobsonville and Whau River have been relatively stable between 2000 and 2012, but changes have occurred in species' abundances. These changes do not appear to be related to sedimentation or contaminant effects. Rather, they may reflect natural long-term cycles in species' abundances. However, Shoal Bay sediments have shown increasing trends in mud and gravel/shell hash. This is reflected in ecological changes consistent with sediment effects. These include a decrease in the abundance of some bivalve species (nut shells (*Linucula hartvigiana*) and wedge shells (*Macomona lilana*)) and an increase in polychaetes (*Halliday et al. 2012*).

Similarly, sediment characteristics and macrofaunal community composition have been monitored in the Mahurangi Harbour since 1994. A marked increase in the proportion of fine sand occurred at all sites between April 1996 and April 1997, which was followed by abrupt stepwise declines in the populations of five species that are sensitive to mud (wedge shells, cockles (*Austrovenus stutchburyi*), nut shells, a gastropod (*Notoacmea scapha*) and a polychaete (*Scoloplos cylindriker*)), particularly at the muddiest intertidal site (Hamilton Landing). Only the nut shell is showing any sign of population recovery at Hamilton Landing, with the other four species continuing to decline (*Halliday & Cummings 2012*).

The Waikato Regional Council has conducted a Regional Estuary Monitoring Programme in the Firth of Thames since 2001. Changes in muddiness are most noticeable at Miranda, Kuranui Bay and Kaiaua (**Figure 6-27**), while the Gun Club site showed an increase in the percentage of fine sand. However, community patterns have varied among the monitoring sites, with very few taxa demonstrating trends in the same direction at more than one site. The Miranda site has shown the greatest change, with decreases in the abundance of the mud-sensitive anemone (*Anthopleura aureoradiata*) and worm (*Aonides trifida*), and increases in mud-tolerant worms (*Capitellidae* and *Nerididae*). This site is highly dynamic due to an active chenier plain (shell bank), and changes in sediment characteristics and community composition may be driven by natural processes rather than any anthropogenic influence.

6.5.2 TOTAL SUSPENDED SOLIDS (TSS)

Auckland Council (and its predecessor the Auckland Regional Council) have collected total suspended solids (TSS) data from 20 sites in the Hauraki Gulf over a 20- to 26-year period from 1987–1993 (depending on the site) to the present day. Highest concentrations of TSS occur in the upper reaches of the Waitematā Harbour, Tāmaki River and Mahurangi River (**Figure 6-28**). Fourteen of the 19 water quality sites continually monitored by Auckland Council between 2004 and 2013, displayed deteriorating trends in TSS concentrations (i.e. increasing concentrations), with two of these trends being statistically significant. Four sites had improving TSS concentrations, with two of these trends being statistically significant (Chelsea and Mahurangi Heads), while concentrations at one site were stable (**Figure 6-28**). In comparison, the 2011 State of our Gulf report indicated that 18 of the 20 sites monitored showed an improvement in TSS between 1987–1993 and 2007 (*based on data from Scarsbrook 2008*). High TSS concentrations are known to be associated with a range of adverse effects. For example, TSS concentrations of above 4 mg/l were found to increase the mortality of snapper larvae, with 50% of larvae dying at TSS concentrations of 157 mg/l (*Partridge & Michael 2010*). Water quality monitoring data across 27 inshore sites around Auckland show that the median TSS concentrations were between 10 and 20 mg/l (*Scarsbrook 2008*), which indicates that there are likely to be some adverse effects on snapper larvae at these locations.

The Waikato Regional Council do not monitor coastal water quality, so empirical TSS data is not available for the Firth of Thames and Coromandel Peninsula. However, modelling by NIWA suggests that sediment loads from rivers draining the Hauraki Plains dominate sediment inputs to the Gulf (**Figure 6-29**, *Hadfield et al. 2014*). The sediment footprint of the Hauraki Plains rivers extends across the Firth of Thames and into Tāmaki Strait. Wairoa and Mahurangi Rivers are the most significant sediment sources in the Auckland Region, but their coastal footprints are relatively small. At the Gulf-wide scale, inputs from other streams and rivers are relatively minor. However, as indicated elsewhere in this section, the localised effects of sediment can still be significant.



Figure 6-26:
Sediment texture
and ecological
monitoring sites.



Photo: Child snorkelling at Browns Island (Motukorea)

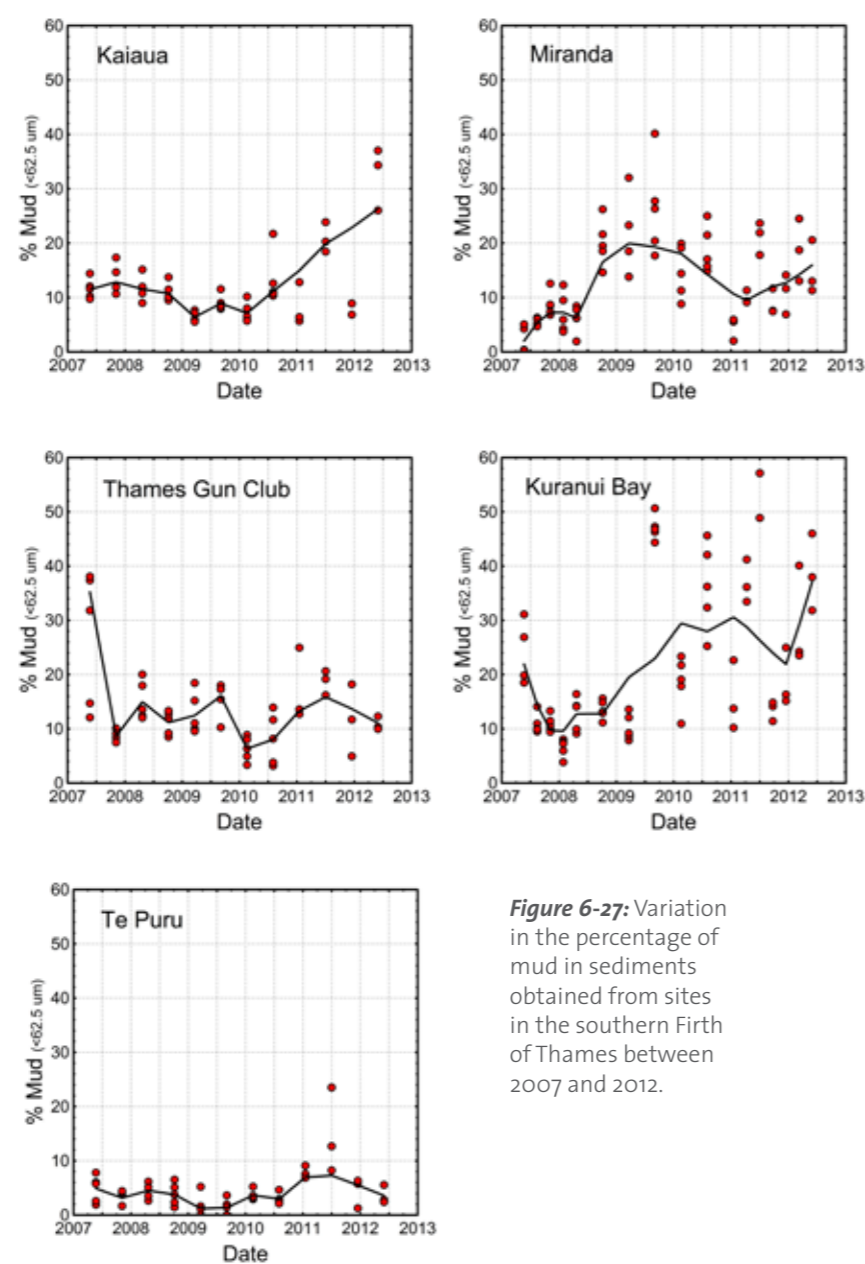


Figure 6-27: Variation in the percentage of mud in sediments obtained from sites in the southern Firth of Thames between 2007 and 2012.

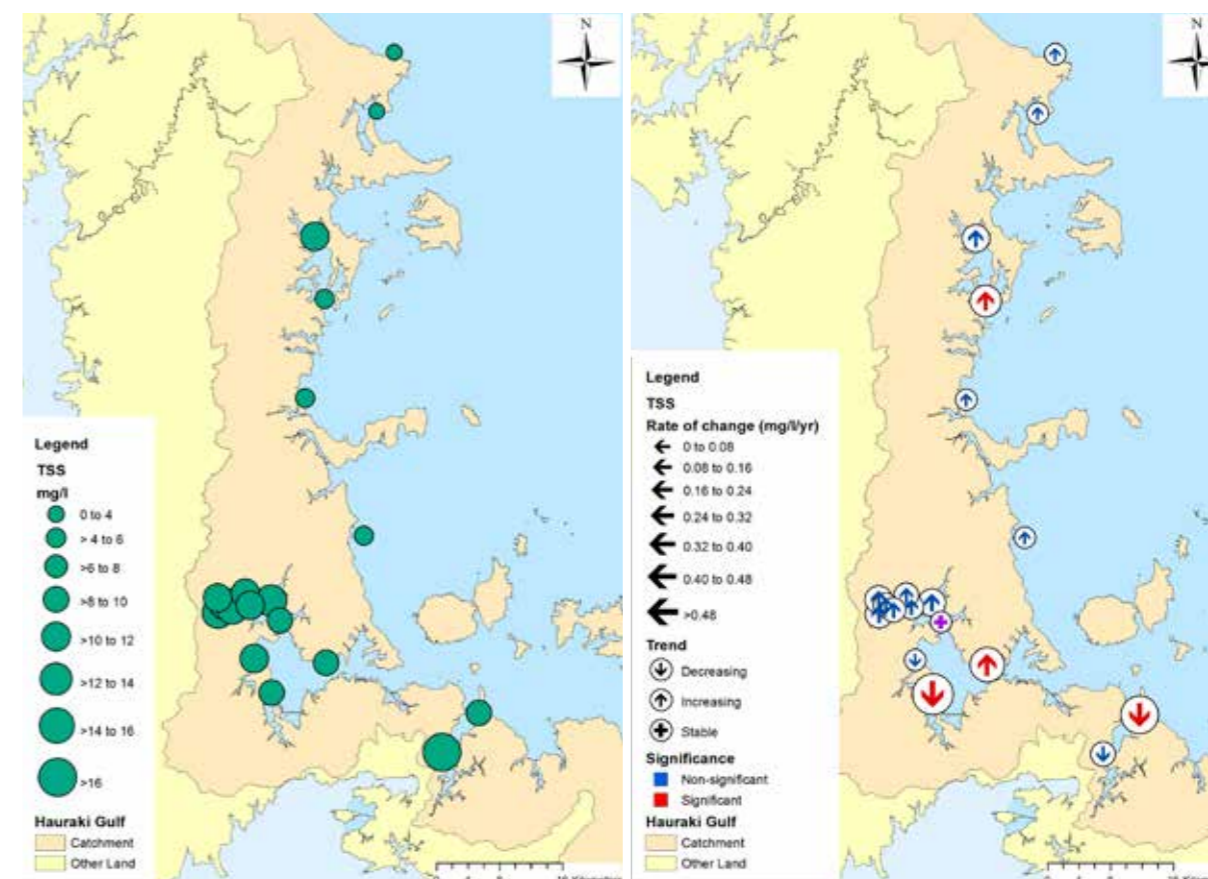


Figure 6-28: Auckland Council monitoring results showing a) median monthly concentrations of total suspended solids (TSS) (mg/l), and b) TSS trends (mg/l/yr) in coastal water samples obtained between January 2004 and December 2013. Arrow size is proportional to the rate of change and arrow colour indicates whether trends were statistically significant (red) or not (blue). Crosses indicate stable concentrations.

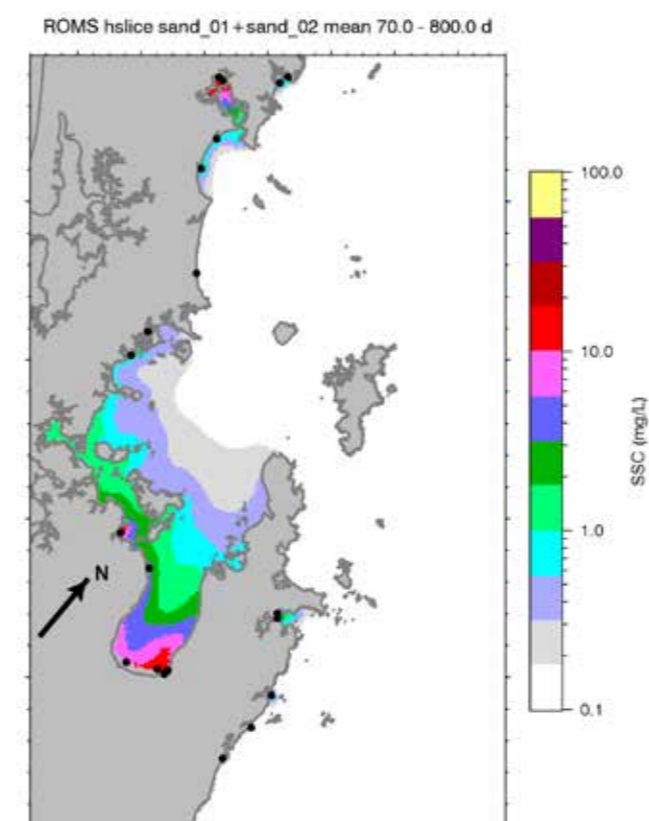


Figure 6-29: Model simulation showing two-year, averaged coastal suspended sediment concentrations arising from rivers and streams draining to the Hauraki Gulf (image courtesy of Mark Hadfield, NIWA Hamilton, Hadfield et al. 2014).

6.5.3 COASTAL SEDIMENTATION

Obvious long-term impacts of sedimentation in the coastal environment are the infilling of estuaries and the associated expansion of mangroves. Sedimentation rates are known to vary among harbours and estuaries, and also among locations within harbours and estuaries. In the Auckland Region the height of sand and mud flats is monitored in a number of estuaries. However, the high level of variation in the data, means that this method is unsuitable for measuring estuary infilling over reporting timescales (*see Hewitt & Simpson 2012*). The Waikato Regional Council uses a different method to monitor sediment accumulation in the southern Firth of Thames. Data from that monitoring has not been reported recently, but earlier analyses demonstrated that sediments at the monitoring sites were mobile, and displayed both accretion and erosion over relatively short time scales (*Felsing et al. 2006*).

Despite this, research carried out in and around the Gulf has shown that modern sediment accumulation rates on the coast are typically greater than natural sedimentation rates, particularly following large-scale changes in land-use and land disturbance activities, such as forest clearance and urbanisation (*Swales et al. 2002, Jones 2008*). Sediment run-off from rural land and forest harvesting can make a significant contribution toward the overall amount of sediment deposited in estuaries (*Gibbs 2006*), while loads from forested and developed urban areas tend to be lower (*Hicks et al. 2009*).

6.5.4 MANGROVES

Mangroves prefer soft, muddy, waterlogged sediments, and colonise areas of suitable elevation where sediments accumulate. Other factors such as warmer temperatures, elevated nutrient levels, wind and wave directions, and in some cases, hydrological obstructions (e.g., causeways) may also enhance mangrove growth and survival (*Craggs et al. 2001; Morrissey et al. 2007; Lovelock et al. 2010*). The offshore extent of mangroves is limited by tidal elevation because seedlings are intolerant of continuous submersion and must be exposed to the air for part of each tidal cycle (*Morrissey et al. 2007*). The expansion of mangroves is therefore a natural response to sediment runoff, warming temperatures, and other human actions, but the offshore extent of mangrove forests is ultimately constrained by tidal depths.

The expansion of mangroves invariably leads to a change in the extent of estuarine habitats and to ecological functioning. As open sand and mud flats are replaced by a vegetated habitat, seabed communities shift from being dominated by sediment dwelling filter and deposit feeders (like worms and shellfish), to being dominated by microscopic decomposers that survive by breaking down mangrove leaves (*Oñate-Pacalaoga 2005*). Mangroves provide a habitat for a limited number of fish species, particularly yellow-eyed mullet (*Aldrichetta forsteri*) and grey mullet (*Mugil cephalus*). However, none of these fish are solely dependent on mangroves, and most are equally abundant in other habitats (*Morrissey et al. 2010*). Mangroves also provide roosting, feeding, and breeding habitat for some bird species, e.g., the banded rail (*Gallirallus philippensis*), and a number of terrestrial invertebrates and reptiles (*Morrissey et al. 2010*). This includes an eriophyid mite, *Aceria avicenniae*, and the larvae of the moth, *Planotortrix avicenniae*, which only live on mangroves. Pacific and forest geckos (*Hoplodactylus pacificus* and *H. granulatus*) are also common in northern mangrove forests (*Morrissey et al. 2007*).

Conversely, mangrove expansion can decrease the extent of roosting habitat for birds that require open sand and mudflats. For instance, dense stands of mangroves spreading into the Firth of Thames have reduced the extent of roosting areas used by a variety of waders. Displacement has been particularly noticeable for wrybills (*Anarhynchus frontalis*), golden plovers (*Pluvialis fulva*), red knots (*Calidris canutus*) and whimbrels (*Numenius phaeopus*) (*Battley & Brownell 2007*).

Updated estimates of mangrove cover in the nine estuaries examined in the 2011 State of our Gulf Report (**Figure 6-30** and **Figure 6-31**) indicates that:

- Historic estimates of percent cover in Puhoi are considerably higher than current estimates. The reasons for this are uncertain, but it could be due to the misclassification of saltmarsh as mangroves in earlier aerial photographs, roading related changes to the estuary, or another analytical issues. Reference maps are now available for future comparisons.
- In the five other estuaries with long term records:
 - the cover of mangroves now is greater than it was prior to the 1970s in all of these estuaries (albeit very slightly for Lucas Creek),
 - percent cover has been relatively stable or declined slightly since the 1990s in four of these estuaries (Lucas Creek, Okura, Whangapoua, and Whangamata),
 - percent cover has only increased in one estuary (Mangamangaroa) since the 1990s.
- in the remaining three estuaries (Whitianga, Tairua, and Wharekawa) percent mangrove cover has been relatively stable or declined slightly since the 1990s. The reduction in Wharekawa is consistent with consented clearance activities that have been ongoing for some years.

The southern Firth of Thames also experienced significant infilling after the 1940s, with a corresponding expansion of mangrove forests (*Swales et al. 2008*). However, ongoing observations are also showing that the subsidence of the tidal flats will impede the ongoing expansion of mangrove forests in that area. Data obtained using a variety of methods indicates that tidal flats and mangrove forest are now subsiding at a near constant rate of 7 mm per year. When combined with climate driven sea-level rise, the relative rate of change is close to 10 mm/yr. Unless sediment deposition keeps pace, this is likely to limit the seaward expansion of mangrove forests in that area (*Swales 2012*).

Although the expansion of mangrove forests appears to be slowing, public views about mangroves remain divided, with some groups supporting protection and others advocating for clearance. Since 2011, consents have been granted to

- clear 0.21 hectares of mangroves in Millon Bay (Baddeleys Beach) in the Auckland Region,
- clear mature mangroves from 22.91 hectares in Whangamata Harbour and remove seedlings from both Whangamata and Otahu harbours, and
- clear mature mangroves from 21.81 hectares in Tairua Harbour, and remove seedlings from the whole harbour.

Waikato Regional Council and the Thames Coromandel District Council are also preparing to obtain a district-wide mangrove seedling removal consent, while the Proposed Auckland Unitary Plan classifies seedling removal and the removal of mature mangroves back to the 1996 line as permitted activities.

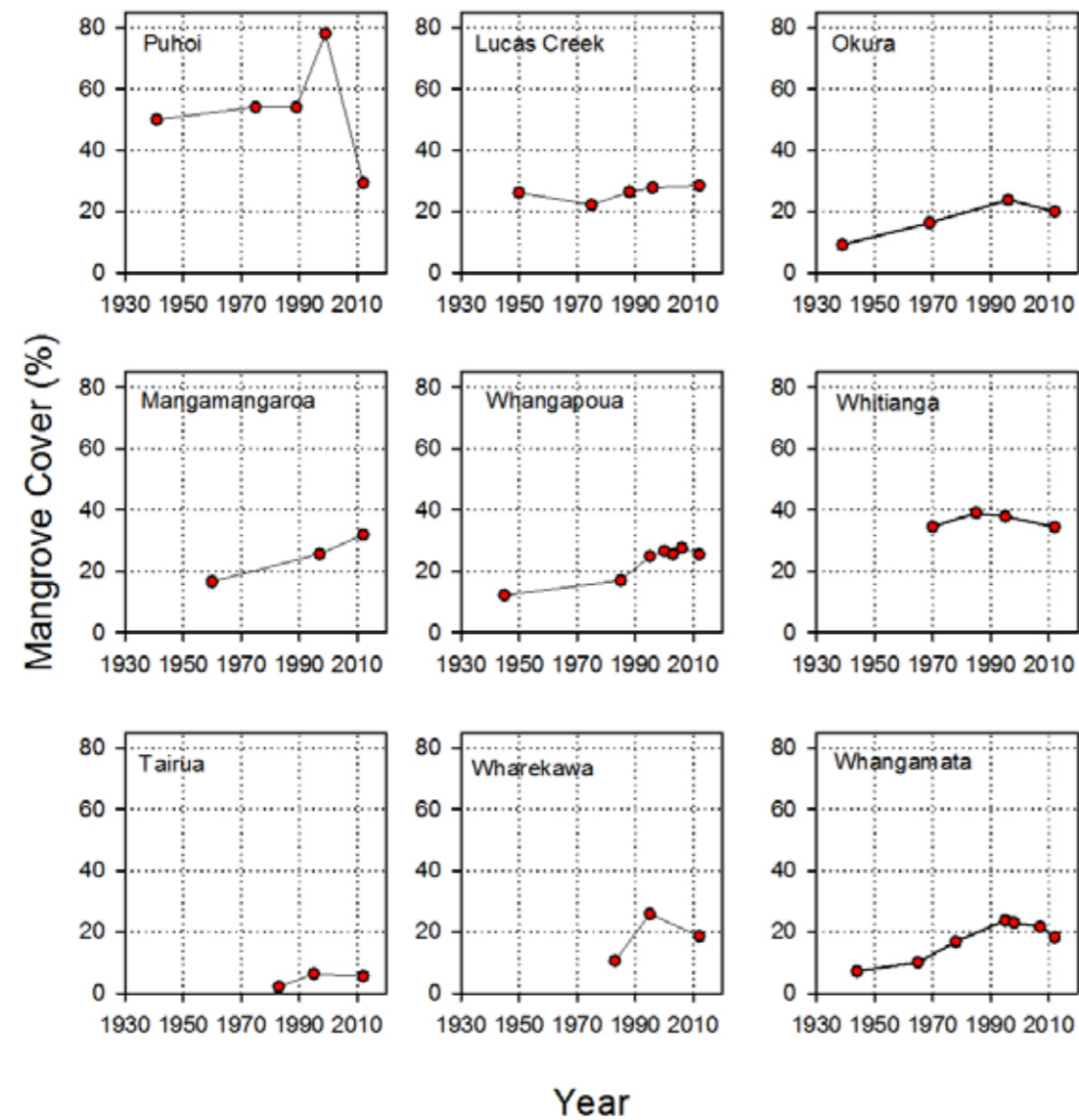


Figure 6-30: Variation in mangrove cover (as a percent of estuary area) over time. Historic data was collated from Jones 2008 and Morrissey *et al.* 2007. The latest data was obtained by mapping mangroves using aerial photographs obtained between 2010 and 2012. Note that historic figures for Puhoi appear to be inflated.

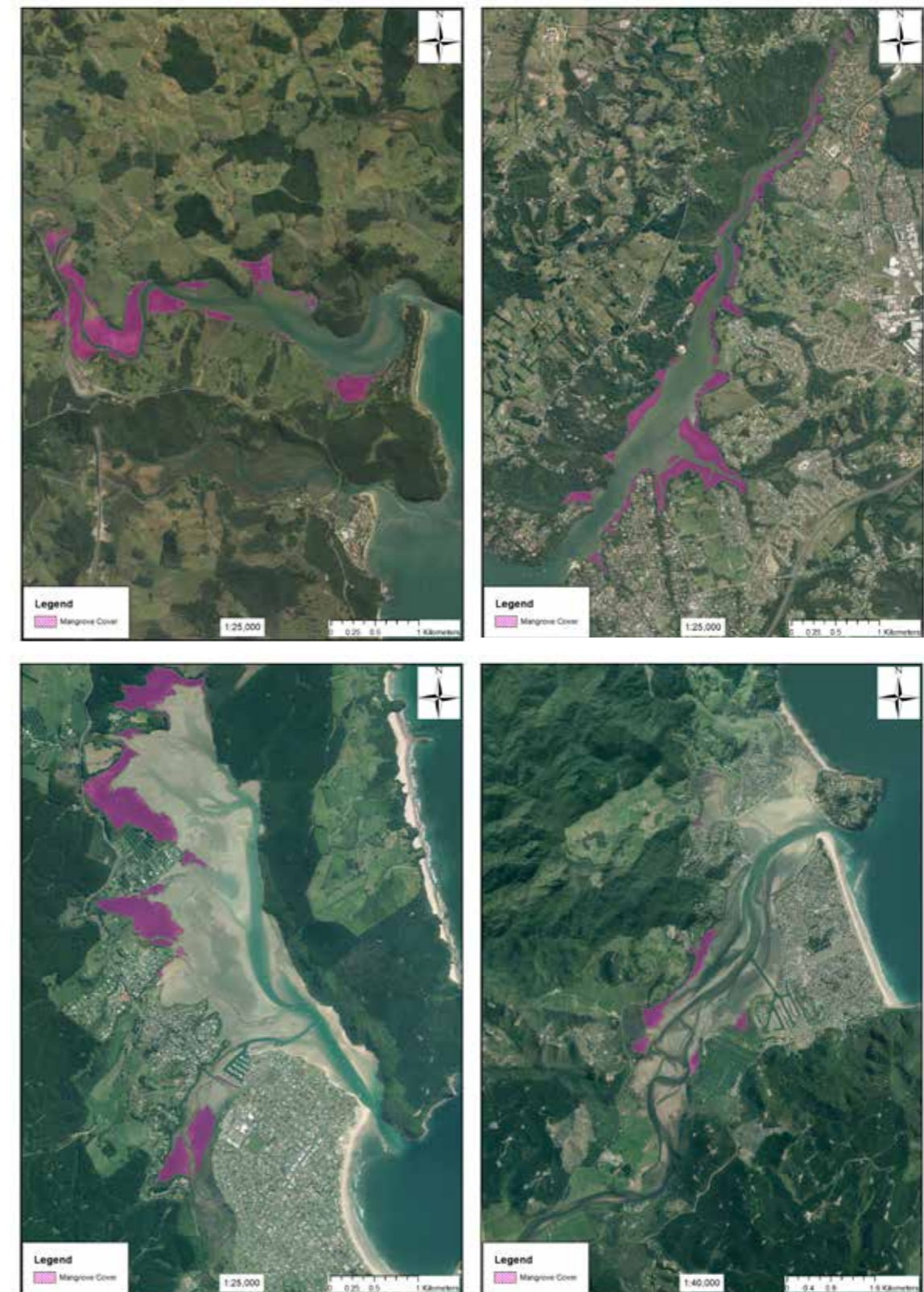


Figure 6-31: Mangrove cover in four of the nine indicator estuaries: a) Puhoi, b) Lucas Creek, c) Tairua, and d) Whangamata. Mangroves were mapped using aerial photographs obtained between 2010 and 2012.

6.6 INTRODUCED (NON-INDIGENOUS) MARINE SPECIES

Overview

Once established, the eradication of non-indigenous marine species is extremely difficult or impossible, and very expensive. There have been no successful complete eradications of marine pest species in New Zealand. Therefore, more stringent control measures are required to prevent non-indigenous marine species from entering the country.
The Port of Auckland is a high-risk area in terms of its capacity to facilitate the introduction, establishment and spread of introduced species and at least five high-risk species have arrived in the Hauraki Gulf over the past 15 years.
Since 2011, four marine species have been detected that are new to the Hauraki Gulf, one of which is a significant threat.
The large amount of boating, aquaculture and other marine-based activities in the Gulf increases the risk that introduced species will flourish and spread.
Effective control methods for marine pest species cannot always be identified. Often, elimination programmes rely on manual removal, which is rarely effective.
Little is known about the potential long-term impacts of high-risk non-indigenous species on the native plants and animals.

Introduced marine species have the potential to cause significant ecological and economic impacts on our marine environment by:

- competing with native species for food, space and other resources,
- consuming native and aquaculture species,
- fouling natural and artificial surfaces,
- spreading disease, and
- releasing toxic compounds.

Most introduced marine species arrive accidentally through ballast water, or attached to vessel hulls, and marine equipment (Hayden et al. 2009). They are spread unintentionally or intentionally through activities such as commercial and recreational vessel movements, aquaculture, fisheries and the aquarium trade (Hewitt et al. 2004). Not all introduced species are capable of surviving in New Zealand, and many have relatively little impact on the marine environment (Ministry for Primary Industries 2013g).

About 260 non-indigenous marine species have been identified in New Zealand (Acosta & White 2011), of which, 141 species are known to occur in the Hauraki Gulf (Figure 6-32). Many of these species appear to be well established in the Port of Auckland and have widespread distributions in other ports and marinas nationwide (Figure 6-33). It is possible that other non-indigenous species also occur in the Hauraki Gulf but have not been detected or formally identified in the biosecurity surveillance surveys or through MPI’s passive surveillance systems (T. Riding, Ministry for Primary Industries, pers. comm.).

Once established, the eradication of non-indigenous marine species is extremely difficult or impossible, and very expensive (Bell et al. 2011a). Management is therefore focused on preventing the introduction and spread of species to new locations. In order to minimise the risk of incursions

of non-indigenous species, MPI requires all international ships to exchange at least 95% of their ballast water mid-ocean (>200 miles from shore) before entering New Zealand waters (Ministry for Primary Industries 2013e). A new ‘Import Health Standard for Vessel Biofouling’ will also be phased in over the next four years. This standard requires all vessels arriving into New Zealand to have a ‘clean’ hull and demonstrate that it has been cleaned shortly before arriving in New Zealand. Non-compliant recreational vessels will be hauled out and cleaned at the owner’s expense (Ministry for Primary Industries 2013l).

Ports and marinas are recognised as high-risk areas because of their high volume of shipping traffic. These are the most likely entry points for non-indigenous marine species, and may also facilitate the spread of invasive species around the country. Consequently, biosecurity surveillance is focussed on these areas. Between 2001 and 2006, Biosecurity New Zealand (now MPI) conducted a series of baseline surveys to document the occurrence of non-indigenous species in New Zealand’s major ports and marinas (Inglis et al. 2005; Inglis et al. 2006). Routine surveillance of New Zealand’s busiest ports and marinas (including Auckland) is now carried out at six monthly intervals, to detect incursions and spread of non-indigenous species that present a significant risk to New Zealand’s marine environment. The primary objective of this surveillance is the early detection of the five species listed on the Unwanted Organisms Register, which are not known to be present in New Zealand:

1. Northern Pacific seastar (*Asterias amurensis*)
2. European shore crab (*Carcinus maenas*)
3. Marine aquarium weed (*Caulerpa taxifolia*)
4. Chinese mitten crab (*Eriocheir sinensis*)
5. Asian clam (*Potamocorbula amurensis*)

A secondary objective of the surveillance is to detect range extensions of pest species that are already here, and which have the potential to cause significant adverse impacts on New Zealand’s marine environment. In 2012-13 there were four secondary target species (Morrisey et al. 2013):

1. Mediterranean fan worm (*Sabella spallanzanii*)
2. Clubbed sea squirt (*Styela clava*)
3. Asian bag mussel (*Arcuatula senhousia*)¹²
4. Droplet tunicate (*Eudistoma elongatum*)

The surveillance surveys are also used to detect incursions of other species that have not been recorded in New Zealand. Any collected specimen that is unknown or suspected of being a newly arrived species is sent to the Marine Invasive Taxonomic Service (MITS) for identification. Marine biosecurity surveillance data is now directly available to the public at www.marinebiosecurity.org.nz. This website aims to convey marine biosecurity information to key stakeholders in a timely and cost-effective manner. MPI also supports passive surveillance, through the identification and recording of unusual specimens provided by members of the public.

At least six non-indigenous species with the potential to cause serious harm to the marine environment have already become established in the Hauraki Gulf, of which five have arrived since the late 1990s. Control measures and the potential long-term impacts of these species are discussed below.

12. This species was formally known as the Asian date mussel (*Musculista senhousia*)



Photo: Mediterranean fan worm (*Sabella spallanzanii*)

1. The Mediterranean fan worm (*Sabella spallanzanii*) was first discovered in Lyttelton Harbour, New Zealand in 2008. This unwanted organism is a large (up to 50 cm in length) tube-building polychaete that can form dense, habitat-modifying mats, which results in a change in a species composition of the benthic community. It has a high filtering capacity and has the potential to remove significant nutrients from the ecosystem (Ross *et al.* 2013), which may reduce the growth of native species. Dense beds could become a problem for marine farmers and fishers, through the clogging of dredges and the fouling of equipment. When the fan worm was first discovered in New Zealand, MPI spent \$1.3 million trying to manually eradicate the fan worm using divers, first in Lyttelton and subsequently in Auckland's Viaduct Basin (Read *et al.* 2011). However, by 2010, the fan worm was widespread throughout the Waitematā Harbour and total elimination of the species was no longer considered feasible (Biosecurity New Zealand 2010b). The worm is currently distributed along the north-eastern coastlines of the North and South Island (Figure 6-33). Range expansions continue to be monitored and localised elimination programmes are still underway in areas where the fan worm is not firmly established, e.g. Coromandel.
2. The clubbed sea squirt (*Styela clava*) (Figure 6-34) was first discovered in Auckland's Viaduct Basin in 2005, and was subsequently found to be present throughout the Hauraki Gulf and Lyttelton Harbour. It is thought that the sea squirt entered New Zealand attached to the hulls of vessels, and has been present in the country since at least 2002 (Kluza *et al.* 2006; McFadden *et al.* 2007). This unwanted organism commonly grows on natural and man-made structures such as wharves, boats and aquaculture equipment, where it can reach densities of 500–1000 individuals per m². Complete eradication of the sea squirt was determined by a group of marine experts to be technically unfeasible, and in 2008 MAF and Biosecurity NZ made a decision to cease work on it. However, local elimination or control of small populations appears to be feasible and work is still being conducted to prevent the sea squirt from becoming established in Picton and Marlborough. The sea squirt has caused major fouling problems for the aquaculture industry in Auckland and Waikato, and is estimated to have cost the country up to \$9.4 million between 2006 and 2011 (Deloitte 2011).
3. The droplet tunicate (*Eudistoma elongatum*) is a colonial ascidian that has white, cylindrical heads that are up to 1.5 m long. The ascidian typically grows on hard surfaces such as rocks and man-made structures. It was first discovered in New Zealand in 2005 but was not initially considered a pest species. However, in 2007–08 it was found in high densities in several Northland locations associated with oyster farms, and in 2013 it was discovered at Sandspit Beach in the Hauraki Gulf (Anon, 2013). The ecological impacts of the droplet tunicate are unknown, though it has the potential to become a significant nuisance to marine farming in northern New Zealand. Currently, it accounts for up to 50% of the biofouling waste removed from oyster farms during summer in northern New Zealand. In 2009, MAF/Biosecurity NZ funded an investigation into potential control methods for the droplet tunicate. Concentrated acetic acid was found to be effective in killing intertidal populations of the ascidian, but no effective control method was found for subtidal populations (Morrissey *et al.* 2009). The ascidian currently has no legal status and eradication is considered unfeasible by MPI. It is likely that the tunicate was transferred around the country with oyster stock. Disinfecting stock and equipment prior to transfer may help control the spread of the tunicate (Page *et al.* 2011).

4. The Asian paddle crab (*Charybdis japonica*) was probably introduced to New Zealand in the late 1990s by international shipping, and was first discovered in Waitematā Harbour in 2000. By 2002 it was widely distributed in the Waitematā Harbour and was found also in Weiti and Tāmaki Estuaries. The Asian paddle crab is an aggressive species that could out-compete native crabs for food and space. It primarily consumes shellfish making it a threat to the aquaculture industry and native species such as pipis, scallops and mussels. The crab currently has no legal status in New Zealand but is recognised as a pest species. In 2008 MAF/Biosecurity NZ funded an investigation on using trapping as a control method for Asian paddle crab in southeast Auckland. However, trapping was not found to be an effective population control measure (Golder Associates (NZ) Ltd. 2008).
5. The Asian kelp (*Undaria pinnatifida*) was detected in the Port of Auckland in 2004, but was first discovered in Wellington Harbour in 1987. This invasive seaweed originates from temperate regions of Japan, China and Korea, where it is farmed as a food crop (commonly known as wakame). The seaweed rapidly colonises bare space following environmental disturbances, forming a dense canopy that prevents other seaweeds from gaining a foothold. It out-competes native species through rapid growth, early maturity and large reproductive output. It is easily spread by human activities and has a hardy microscopic stage that is difficult to eradicate. Between 1997 and 2004, a \$2.8 million government funded control programme was conducted to try and control the spread of the kelp from Bluff Harbour and Stewart Island. Control methods involved manual removal by divers, heat and chemical treatments, and wrapping with plastic. While controls methods did reduce the local population of Asian kelp, it had become widespread outside of the control areas, and in 2009 control efforts in these areas ceased (Forrest & Hopkins 2013). In 2010, MAF revised its policy on the Asian kelp to allow it to be farmed in heavily infested areas (Wellington, Marlborough, Lyttelton and Bank's Peninsula) and commercially harvested from artificial surfaces or when cast ashore (Biosecurity New Zealand 2010a). The kelp will still remain as an unwanted organism and local eradication programmes are still underway in high-value areas e.g. Fiordland (Ministry for Primary Industries 2013m).
6. The Asian bag mussel (*Arcuatula senhousia*) was accidentally introduced into New Zealand in the 1970s and is now widespread throughout the upper North Island (Figure 6-33). It can dominate benthic communities forming dense mats over the sea bed of up to 16,000 mussels per m². These mats modify the habitat by trapping fine sediment, which results in an increase abundance of worms (polychaetes) and a loss of burrowing molluscs such as pipis, cockles and scallops (Creese *et al.* 1997; Hayward *et al.* 2008) (Figure 6-35). The bag mussel has a short life span (1–2 years) and beds are often ephemeral. Once a bed disappears it takes 2–3 years before the original seabed community returns (Hayward *et al.* 1999). The Asian bag mussel has no legal status and no attempts have been made to control or eradicate it from New Zealand.

Four new species have been reported since the publication of the 2011 State of our Gulf Report.

1. A bryozoan (*Amathia semiconvoluta*) was found in the Port of Auckland in 2010 that had not previously been found in New Zealand. It is not known to be a pest species.
2. A seaweed (*Vaucheria sp.*), which had previously been found in Kawhia Harbour was found in the Port of Auckland. It is not known to be a pest species.
3. A polychaete (*Polydora cornuta*) was found in Port of Auckland. It had previously been recorded from the Manukau Harbour. It is not known to be a pest species.
4. The droplet tunicate (*E. elongatum*) has extended its range down to the Warkworth region. Initially, it was predicted that the tunicate would not spread south of Auckland (below 37°S) because it was thought to be unable to survive below 16°C (Smith *et al.* 2007). However, subsequent research has shown that the tunicate can survive and reproduce at temperatures down to 14°C (Page *et al.* 2011).

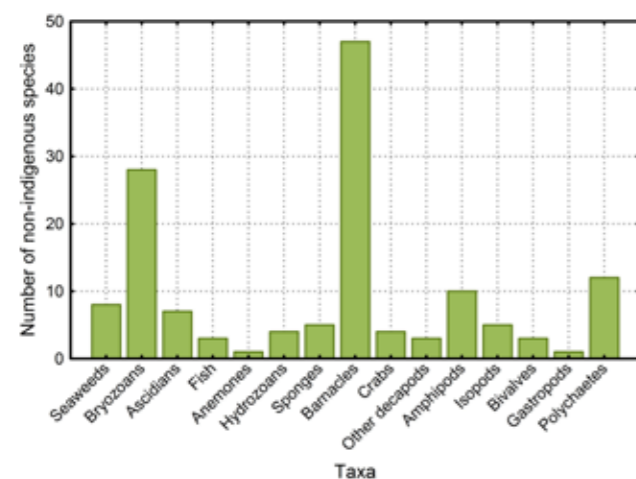


Figure 6-32: Number of non-indigenous marine species recorded in the Hauraki Gulf through Biosecurity New Zealand's baseline and surveillance surveys, and specimens obtained through passive surveillance. Since the 2011 Hauraki Gulf State of our Gulf Report, four new non-indigenous species have extended their range into the Hauraki Gulf (a bryozoan, a seaweed, a polychaete and an ascidian). The status of one crab and one ascidian that were previously listed as non-indigenous have now been changed to cryptogenic (*origin unknown*).



Figure 6-34: The clubbed sea squirt (*Styela clava*) growing on a horse mussel around Rotorua Island. *Styela clava* now appears to be a dominant species in this area (*S. Kelly pers. obs.*).

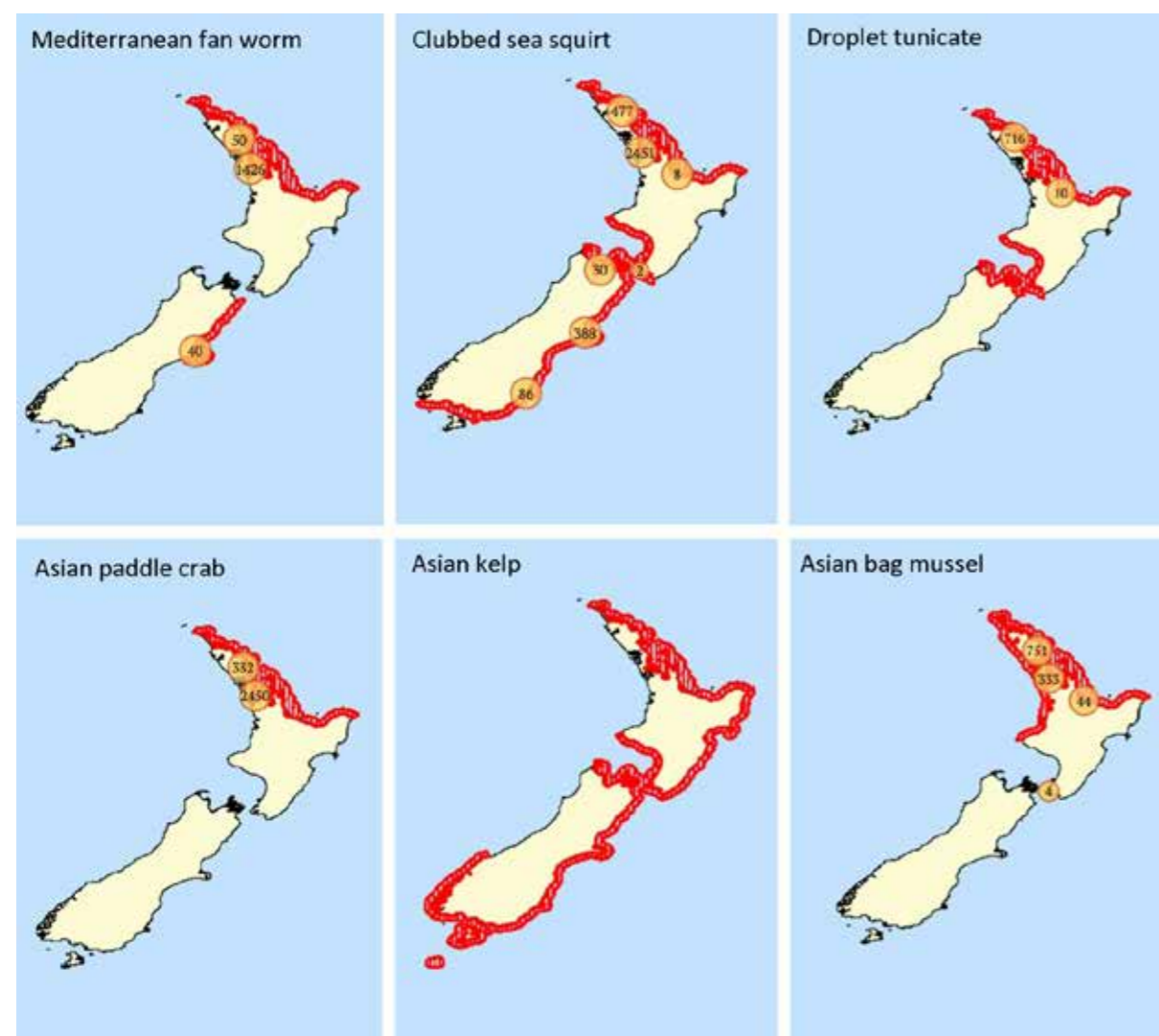


Figure 6-33: Current regional distribution of the six non-indigenous marine pest species around New Zealand. The numbers indicate the number of specimens collected from a particular site (*data from www.marinebiosecurity.org.nz*).



Figure 6-35: The Asian bag mussel (*Musculista senhousia*) (right) forms dense mats in soft sediments that have the potential to exclude native species, such as scallops, which share the same habitat (*photo of a single dredge sample collected in Kaipara Harbour*).

6.7 HARMFUL ALGAE, PATHOGENS AND MASS MORTALITIES

Overview

Harmful algae and pathogens in the Hauraki Gulf occasionally cause the mass mortality of marine species, and produce poisoning risks for humans.

Shellfish and water quality monitoring for marine biotoxins is conducted by the government and the aquaculture industry, and MPI investigates any reports they receive about unusual mortalities of marine species.

Since 2011, the outbreak of OsHV-1 virus has continued to affect the oyster farming industry, high concentrations of paralytic shellfish poisons were found in shellfish from Whangamata in 2011, and unusually high mortalities of tuatua and cockles were observed for 4–6 months in the Long Bay-Okura Marine Reserve (thought to be due to environmental conditions or sediment).

Occasional dog deaths linked to naturally-occurring toxic sea slugs have continued to be reported, and low levels of the toxin involved have been detected in kai moana from Whangapoua. However, concentrations in kai moana were too low affect people.

Harmful algae and pathogens are commonly linked to mass mortalities of individual or multiple marine plant and animal species. Harmful algae also pose a serious health risk for humans who consume affected seafood or who live in coastal areas. Little is known about the historical occurrence and ecology of harmful algae and pathogens in New Zealand, so it is not possible to determine whether human activities have exacerbated their occurrence. Outbreaks could possibly be promoted by creating favourable environmental conditions for the survival and growth of harmful species, or by facilitating their spread among locations. There is good evidence that extensive algae blooms (both harmful and harmless species) are more common in the Hauraki Gulf region during extended periods of north-westerly winds, which result in upwelling and increased nutrient availability in the water (Zeldis *et al.* 2005; Chang *et al.* 2008). The susceptibility of marine plants and animals to the effects of harmful algae and pathogens could also be increased, if ecological resilience is already compromised by human activities such as fishing or pollution (Hsieh *et al.* 2010, Österblom *et al.* 2008).

Shellfish in New Zealand have been monitored for the presence of harmful algae since January 1993 when shellfish toxicity was first detected in New Zealand. Shellfish monitoring is conducted by both the government and the aquaculture industry (Ministry for Primary Industries 2013k). The Ministry for Primary Industries conducts a weekly monitoring programme at around 100 sites throughout the country for recreational shellfish gatherers. If marine biotoxins are detected in water samples, then shellfish flesh samples are required. If biotoxin concentrations exceed the limits specified by the NZFSA (2006) the local District Health Board is informed, who issue public warnings in association with the local authorities. In addition, the aquaculture industry is required under the Animal Products (Regulated Control Scheme–Bivalve Molluscan Shellfish) Regulations 2006 to monitor shellfish growing areas for the presence of marine biotoxins, bacteria and heavy metals, at least weekly. If marine toxins are detected in shellfish flesh samples above the specified limits then a growing area must be closed and not reopened until the area is free of biotoxins for at least 48 hours. If human pathogens are detected in the samples then the growing areas must be closed for at least 28 days after the end of the pollution event (New Zealand Food Safety Authority 2006).

The Ministry for Primary Industries also investigates any reports they receive about unusual mortalities of marine species. The occurrence and likely causes of these events are published in their quarterly ‘Surveillance’ report.

Events occurring since the 2011 State of our Gulf Report was published are listed below:

- The outbreak of the OsHV-1 virus continues to affect the Pacific oyster farming industry. OsHV-1 arrived in New Zealand in 2010, initially killing 80 to 90 percent of young oysters in many northern New Zealand farms (Barratt-Boyes 2012). The industry is continuing to adapt farm practices to reduce the impact of the virus, and research on the development of virus-resistant oyster stock is also being carried out.
- In December 2010 and December 2011, high concentrations of paralytic shellfish poison were present in shellfish from Whangamata.
- Occasional dog deaths linked to naturally occurring toxic sea slugs have continued to be reported (e.g. Mason 2013). Low levels of the toxin involved have also been detected in kai moana from Whangapoua, including: pipi (*Paphies australis*); one individual tio repe or Pacific oyster (*Crassostrea gigas*); one tio or rock oyster (*Saccostrea commercialis*); and, one pūpū or cat’s eye (*Turbo smaragdus*). However, concentrations were too low affect people consuming these species (Ogilvie *et al.* 2012).
- Unusually high mortalities of tuatua and cockles were observed for 4–6 months in the Long Bay-Okura Marine Reserve. No primary pathogen could be detected from dead shellfish, so it is thought that the mortalities may be a result of environmental conditions or sediment (Bingham 2011).



Photo: Child collecting shells

6.8 RUBBISH

Overview

Man-made rubbish is a widespread issue for the Hauraki Gulf.
Rubbish ending up on the Gulf’s beaches is dominated by plastics, which are environmentally persistent, disperse widely and cause a wide range of impacts.
The bulk of rubbish near Auckland mainly comes from land-based sources, while fishing related material dominates further afield.
The Watercare Harbour Clean-up Trust continues to remove large amounts of rubbish from coastal areas around Auckland. Rubbish volumes have been declining since 2008.
The decline in collected rubbish volumes is generally consistent with a reduction in the amount of rubbish in the coastal environment, but the effects of moving collection effort from high to low yielding areas also needs to be taken into account.

Man-made rubbish is a ubiquitous and on-going issue for the Hauraki Gulf. Marine pollution by litter, especially plastics, is a global concern due to their environmental persistence, large volumes involved, and their wide dispersal by ocean currents (Gregory 2009). Plastic litter:

- fouls beaches,
- entangles marine life and kills by drowning, strangulation, creating drag and reducing feeding efficiency,
- is often ingested by marine and bird life,
- is the source and sink for xenoestrogens and persistent organic pollutants (POPs) in aquatic environments,
- acts as a vector for the dispersal of invasive species,
- can degrade nursery habitats, and
- fouls vessel intake ports, keels and propellers, putting crews at risk.

Over 260 species, including invertebrates, fish, seabirds and mammals, have been reported to ingest or become entangled in plastic debris, resulting in impaired movement and feeding, reduced reproductive output, lacerations, ulcers and death (Gregory 2009). Plastics weaken and may kill seabirds through starvation and false feelings of satiation, irritation of the stomach lining, and failure to put on fat stores necessary for migration and reproduction. For example, prions (seabirds), which feed on small prey near the surface, can mistakenly ingest plastic pellets floating on the water. In New Zealand, an increasing trend was found in the number of plastic pellets in the gizzards of five prion species washed up dead on Wellington beaches between 1958 and 1977. There was also an inverse relationship between the number of pellets found and the body weight of birds (Harper & Fowler, 1987).

Plastics become brittle when exposed to sunlight, atmosphere, and seawater, and subsequently fragment into smaller and smaller pieces. Consequently, plastic fragments are widespread in the oceanic and sedimentary habitats. The wide distribution of plastic pellets on New Zealand beaches was first reported by Gregory (1977). Pellet abundance was highly variable, but tended to be greatest close to major urban centres.

Plastics provide a direct and indirect pathway for the uptake of toxic organic contaminants by

wildlife. In seawater, plastics absorb and concentrate contaminants such as polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethylene (DDE), nonylphenol, and phenanthrene. These can become several orders of magnitude more concentrated on the surface of plastic debris than in the surrounding seawater (Barnes et al. 2009, also see Rios 2007). Microscopic plastic fragments are likely to pose a greater risk than large plastic items because of their greater surface area to volume ratio, which increases absorption capacity. A range of chemicals are also used as additives in the manufacture of plastics. Some of these, such as phthalate plasticisers and brominated flame retardants, are potentially harmful and have been associated with carcinogenic and endocrine-disrupting effects (Teuten et al. 2009).

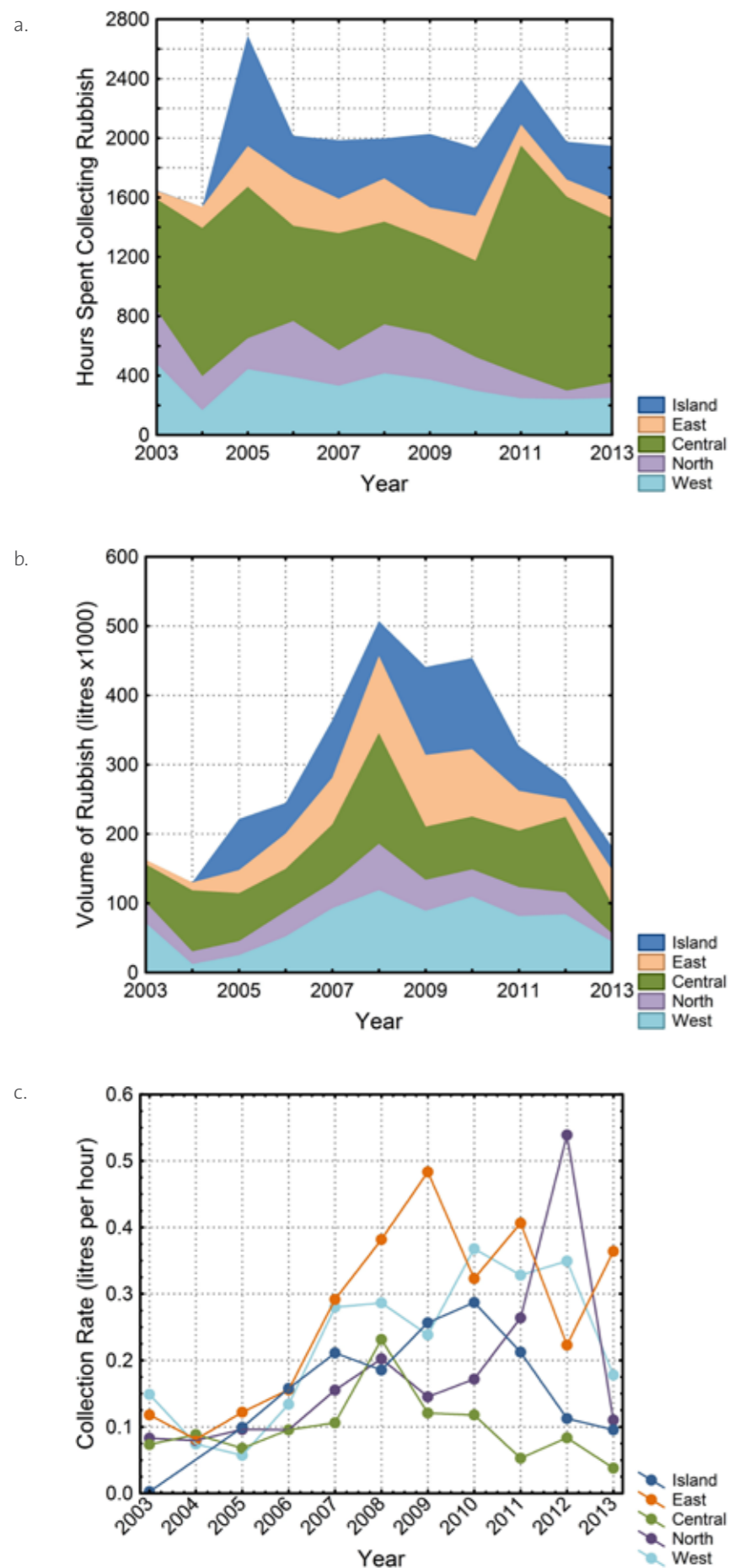
The rubbish ending up in the Gulf originates from a variety of sources. Data obtained from community-based beach clean-ups conducted by Sustainable Coastlines, indicates that plastic materials dominate beach rubbish. The bulk of rubbish ending up on beaches near Auckland comes from food packaging, household and personal items, and uncategorised sources of material, including plastics and polystyrene, cardboard packaging, glass bottle fragments, and organic waste. However, rubbish collected from beaches that are further afield contains a high proportion of fishing related-material (Hauraki Gulf Forum 2011).

6.8.1 TRENDS IN RUBBISH

The Watercare Harbour Clean-up Trust (previously called the Waitematā Clean-up Trust) was established in 2002 in response to the increasing amounts of rubbish entering the Waitematā Harbour. The trust employs two skippers and has a purpose-built boat, the Phil Warren 2, which it uses for collection. The skippers work in conjunction with volunteers to clean the shoreline, estuaries and mangrove areas of the Waitematā Harbour, Tāmaki Estuary and islands in the Auckland region. Kayaks and a flat-bottomed punt are also used to access the shallow waters around the shoreline.

Data on rubbish volumes obtained from the Watercare Harbour Clean-up Trust indicates that with the exception of 2011 (when the Rugby World Cup was on), the amount of effort put into rubbish collection has been fairly steady since 2006 (Figure 6-36a). In contrast, the annual volume of rubbish collected by the trust’s staff (Figure 6-36b), and the areas where clean-up efforts have been focussed have changed (Figure 6-36a). The Trust has continued to remove large amounts of rubbish from coastal areas around Auckland, but volumes have been declining since 2008. Between 2001 and 2013, the Trust removed around 788 m3 of rubbish, compared with around 1400 m3 in the three years preceding this period. The decline in rubbish volumes since 2008 is generally consistent with a reduction in the amount of rubbish in the coastal environment, but the effects of redirecting effort from high to low yielding areas also needs to be taken into account (Figure 6-36c). Since 2010, more effort has been directed at the lower yielding central Auckland areas, and less effort has been directed at the higher yielding northern and eastern areas.





6.9 ISLANDS OF THE GULF

Overview

The islands of the Gulf are critical sanctuaries for endangered species, and many are being restored to protect and enhance native and endemic biodiversity.

Large islands with more than 80% native forest cover include Aotea (Great Barrier) Hauturu (Little Barrier), Kawau, Rangitoto, Whakau (Red Mercury) and Kawhitu (Stanley Island).

Significant progress is being made in re-vegetating other large islands including Motuora, Tiritiri Matangi, Motutapu, Motuihe, and Rotoroa Islands. Much of this work has been community led.

Mammalian pests have been eradicated from 36 islands in the Gulf, and progress is also being made towards eradicating Argentine ants on Kawau, Aotea (Great Barrier), and Tiritiri Matangi Islands.

Rainbow skinks are well established on Waiheke, Rangitoto, and Motutapu Islands. Eradication of these populations is currently deemed to be unfeasible by the regional councils and DOC. Rainbow skinks have also made it to Aotea (Great Barrier) and a survey is being conducted to determine if eradication is feasible.

Introduced weed species are an issue for some islands.

Kauri dieback has been present on Aotea (Great Barrier) since at least the 1970s, and has recently been found in the Coromandel. Islands with kauri have recently been surveyed for signs of disease and the results are expected in the near future.

Endemic birds, reptiles and insects are increasingly being translocated among the islands that are free of mammalian pests.

6.9.1 ISLAND BIODIVERSITY

The islands of the Gulf provide vital sanctuaries for New Zealand's terrestrial biodiversity. The Hauraki Gulf is estimated to contain 425 'islands', including reefs, stacks and sandbars (Lee 1999). Most have been modified by human activities, with many of the larger islands being almost totally cleared of indigenous vegetation at some stage. Probably the least modified island is Hauturu (Little Barrier Island), which contains the largest remaining area of relatively unmodified northern New Zealand forest that is protected from alien mammals. The island is sufficient large and high enough to provide a diverse mix of forest types, and forests at various stages of maturity. It is therefore capable of supporting species with very specific habitat requirements. Almost all (98%) of Hauturu is now covered in native forest. Its mountainous landscape is dominated by broadleaf forests near the coast, with northern rata (*Metrosideros robusta*) and tawa (*Beilschmiedia tawa*) occurring on the slopes. Mixed kauri (*Agathis australis*) forest occurs extensively on ridges from 50 to 500 m, with forests of towai (*Weinmannia silvicola*) and tawa further up. These give way to summit vegetation dominated by quintinea (*Quintinea acutifolia*), tawari (*Ixerbia brexioides*) and southern rata (*Metrosideros umbellata*). Although much of the island's original forest cover remains intact at higher altitudes, lowland forest was cleared for timber and farming and is now dominated by dense pioneer growth of manuka (*Leptospermum scoparium*) and kanuka (*Kunzea ericoides*) in varying stages of transition to broadleaf and kauri forest communities (Rayner *et al.* 2007b).

Hauturu is one of New Zealand's first offshore sanctuaries and has played a critical role in

species conservation in New Zealand. It was originally established as a nature reserve in 1895 and for many years, landing on the island has been prohibited without special permits. Introduced mammals have been gradually eliminated from the island with pigs removed in the early 1900s, cats in 1980, and kiore in 2004 (*Rayner et al. 2007b*). In the 1880s, Hauturu was home to the only surviving population of the nationally vulnerable hihi (*Notiomystis cincta*) (*Taylor et al. 2005*), and it was among the first islands to be used for bird translocations, with brown kiwi (*Apteryx mantelli*) and great spotted kiwi (*A. haastii*) being moved to the island between c. 1903 and c. 1919 (*Bellingham et al. 2010*). Hauturu has been instrumental to the population recoveries of the North Island saddleback (*Philesturnus rufusater*) and kokako (*Callaeas wilsoni*). The last 500 saddleback were transferred to Hauturu from Hen Island¹³ between 1984 and 1988. Saddlebacks have thrived on predator-free islands and the estimated national population is now around 7000 (*Miskelly 2013*). Similarly, 32 kokako were transferred to the island between 1980 and 1988, and the island is now home to one of the largest kokako populations in the country (*Innes & Flux 1999*). Hauturu is the only known breeding location for the nationally endangered NZ storm petrel (*Fregetta Māoriana*); it is one of only two breeding grounds for black petrel (*Procellaria parkinsoni*) (the other being on Aotea (Great Barrier Island)), and it is the most important breeding location for Cook's petrel (*Pterodroma cookii*) in the world (*Rayner et al. 2007a*). In addition, the nationally vulnerable chevron skink (*Oligosoma homalonotum*) is only known to occur on Hauturu and Aotea (*Towns et al. 2002*), and Hauturu is an important sanctuary for tuatara (*Sphenodon punctatus*) and wetapunga (*Deinacrida heteracantha*).

Other large islands with more than 80% native forest cover include Great Barrier, Kawau, Rangitoto, Whakau (Red Mercury and Kawhitu (Stanley Island) (**Figure 6-38**). Rangitoto Island is the youngest cone in the Auckland volcanic field, having erupted only about 600 years ago, and is one of the least modified. It is an iconic landscape feature in the Hauraki Gulf, dominating the local seascape. Rangitoto's bare lava fields, lava caves, pillars and tunnels are all obvious features of the island's volcanic landscape. Its lava rocks host nearly 170 species of native trees and flowering plants, including many species of orchid and more than 50 kinds of fern. The vegetation on Rangitoto is internationally significant as an area of forest naturally colonising young basaltic lava flows. The island contains the largest area of pōhutukawa (and pōhutukawa-rata hybrid) forest in New Zealand. Its unique indigenous ecosystem and vegetation have been recognised by its status as a separate and entire ecological district.

Restoration of a number of islands in the Hauraki Gulf is underway. Motuora and Tiritiri Matangi have a long history of human occupation and grazing, and most of the original forests on these islands had been cleared. Over the past 25–30 years, mammalian predators have been eradicated from the islands and they have been revegetated with community assistance, producing extensive areas of regenerating coastal shrubland. Restoration of Tiritiri Matangi into an open bird sanctuary was initiated by two researchers at Auckland University, John Craig and Neil Mitchell in the 1970s. The project was initially funded by World Wildlife Fund and between 1984 and 1994 around 280,000 trees were planted by volunteers. Translocations of birds, reptiles and invertebrates on to the island began in 1984¹⁴. Reproduction of some bird species on Tiritiri Matangi has been so successful that they have been translocated off Tiritiri Matangi to re-populate other areas. For example, 80 whitehead (*Mohoua albigilla*) and 91 hihi were translocated onto Tiritiri Matangi in the 1990s and 518 and 453 birds, respectively, were translocated off the island between 2002–2013 (*Supporters of Tiritiri Matangi (Inc) 2013*). The island is now 74% forested, and the remaining 26% is being left as open grassland for species that prefer an open habitat. Tiritiri Matangi is now co-managed by the Supporters of Tiritiri Matangi Inc. and DOC.

Restoration of Motuora by volunteers began in 1990 and the island is now jointly managed by the Motuora Restoration Society and DOC. Over 300,000 native seedlings have been planted out over the past 25 years and around 60% of the island is now planted with native trees. Twenty one early successional species were initially planted out, which was followed by 12 main secondary successional species (once the scrub canopies had established). Currently about 5000 seedlings are planted out per annum, including some threatened plant species. The revegetation project is due to be completed in 2015 and species translocations of geckos (*Hoplodactylus pacificus*, *H. duvaucelii* and *H. maculatus*), shore skinks (*Oligosoma smithii*), diving petrels (*Pelecanoides urinatrix*), grey-faced petrels (*Pterodroma macroptera*), Pycroft's petrels (*Pterodroma pycrofti*), whiteheads and wetapunga onto Motuora have occurred since 2006. Motorua has also been used as a crèche site for kiwi since 1999 (*Motuora Restoration Society 2014*).

Motutapu and Motuihe have also been partially revegetated. The Motutapu Restoration Trust has planted around 95 ha of native forest on the island since 1994, however, this only accounts for around 6% of the total area. The vast majority of the island is currently open pasture that supports 3500 sheep and 1000 cattle. The island was declared predator-free in 2011 and is now inhabited by bellbirds (*Anthornis melanura*) and kākārīki (who returned naturally), and translocated populations of brown kiwi, takahe (*Porphyrio mantelli*), saddleback, whiteheads, and shore plover (*Thinornis novaeseelandiae*) (*Motutapu Restoration Trust 2013*). Restoration of Motuihe commenced in 2000 with the establishment of the Motuihe Trust. The trust has currently planted around 67% of the island and aims to reach 75%. Note that **Figure 6-37** shows that only 13% of the island was covered in native forest in 2008, but a lot of planting has occurred over the past 5 years. Motuihe became predator-free in 2005 and saddleback, kākārīki, little spotted kiwi (*Apteryx owenii*), Duvacel's gecko and tuatara have been translocated to the island (*Motuihe Trust 2014*).

Rotoroa Island was used as a rehabilitation facility for alcoholics between 1911 and 2005. The 92 ha island had facilities to accommodate up to 120 people and was largely self-sufficient, with extensive vegetable gardens and orchards. In 2009, the Rotoroa Island Trust was established to restore the island and reopen it to public. Volunteers have removed 20,000 pine trees and planted around 350,000 native seedlings. Native forest cover on the island has increased from 20% in 2008 (**Figure 6-38**) to 65% in 2013 (regenerating coastal broadleaf and manuka/kanuka). The island became predator-free in October 2013 and the trust is currently working with Auckland Zoo to create a wildlife conservation sanctuary on the island, with the first translocations of brown kiwi, saddleback and Duvacel's gecko planned for 2014. The trust aims to increase the diversity and abundance of native species on the island, initiate an education and training programme for students, and enable the public to experience island restoration in action (*Rotoroa Island Trust 2011*; *Fraser et al. 2013*, see “Case Study: Application of non-regulatory tools” in [Section 5.3](#)).

Many other islands in the Hauraki Gulf remain highly modified by urban development or farming activity, including Pakatoa, Browns Island (Motukorea), Kawhitu (Stanley Island), Rakino Island and Ahuahu (Great Mercury Island) (**Figure 6-38**). While most islands have showed a small increase or no change in native forest cover between 2001 and 2008 (**Figure 6-39**), Pakihi Island showed a 6% decrease. Pine planting and severe storms in 2007 and 2008 (which caused significant die-back of planted puriri on the island (*Cameron 2009*)) may have contributed to the decrease in native forest cover.

13. via Cuvier Island.

14. Kākārīki (*Cyanoramphus novaeseelandiae*) was transferred to Tiritiri Matangi before restoration began in 1974.

6.9.2 HARMFUL PESTS

Islands are particularly important for conservation because they can be kept free of pest species. Certain introduced plants, animals and pathogens are key threats for the survival of native New Zealand species. Plant and animal pests in the Hauraki Gulf Marine Park are managed by the Auckland and Waikato Councils, and DOC. Thirty-six islands in the are currently free of mammalian herbivorous and predatory pests (**Figure 6-40**). A pest eradication programme is also underway for Ahuahu (Great Mercury Island) to make it mammalian pest-free. Maintenance of the pest-free status of these islands is important, and this is managed by active surveillance (traps, bait, and detector dogs), a “*Treasure Islands*” public awareness campaign (www.treasureislands.co.nz), and a “*pest-free warrant*” programme for commercial vessel operators in the area.

Introduced non-mammalian species can also threaten native species, and rainbow skinks and Argentine ants are emerging pest issues for the Hauraki Gulf. Eradication of Argentine ants is currently underway on Kawau, Aotea (Great Barrier), and Tiritiri Matangi Islands, with eradication on Tiritiri Matangi nearing completion. Argentine ants and rainbow skinks are well established on Waiheke Island, and rainbow skinks are well established on Rangitoto, Motutapu and Waiheke Islands. Eradication of these established populations is deemed unfeasible by the regional councils and DOC. A more recent rainbow skink incursion on Aotea is currently being surveyed to determine whether eradication is feasible.

Pest management on Hauraki Gulf islands has tended to focus on animal pests. However, introduced weed species, particularly moth plant (*Araujia sericifera*), buckthorn (*Rhamnus alaternus*), boneseed (*Chrysanthemoides monilifera*), woolly nightshade (*Solanum mauritianum*) and *Pampas spp.*, are becoming an increasing issue for some islands. The removal of grazing mammals has, in some cases, exacerbated weed problems. For instance, following the control of wallabies on Kawau Island there was an increase in cover of boneseed, moth plant and woolly nightshade. The relationship between weeds and animal pests highlights the need for integrated multi-species pest control.

Kauri dieback disease is another biosecurity issue for the Hauraki Gulf. The disease was only identified in 2007, but it has been present on Aotea since at least the 1970s, and has recently been found on the Coromandel Peninsula. Current management has largely been directed towards surveying and minimising the spread of the disease. Aerial surveillance has recently been undertaken across islands in the Gulf where kauri are present. Results will be available soon for Pōnui, Waiheke and Hauturu. Public awareness signage and shoe cleaning stations have been deployed at key sites to minimise the spread of the disease by island visitors (*Kauri Dieback Management Team 2014*). Research is currently underway to development treatment and management options for the disease.

Pest-free islands represent valuable conservation opportunities and many have threatened species translocation programmes underway. Translocations are used to: reduce the risk of threatened species being eliminated by natural disasters or disease; increase the genetic diversity of island populations; and, contribute to ecosystem restoration. Tiritiri Matangi Island has received the highest number of translocated species (16), followed by Tawharanui Open Sanctuary on the mainland (eight species) and Motuihe Island (seven species). Among the translocated species in the Gulf there has been one nationally critical bird species (takahe), four nationally vulnerable bird species (black petrel, hihi, North Island weka and North Island brown kiwi), and one nationally endangered reptile (Whitaker’s skink) (**Table 5 to Table 7**).

Key: NZ threat codes used in Table 5 to Table 7.

- Threatened:**

 - Nationally critical (NC)
 - Nationally endangered (NE)
 - Nationally vulnerable (NV)
- At Risk:**

 - Rapid decline (RD)
 - Moderate decline (MD)
 - Slow decline (SD)
 - Relict (R)
 - Recovering (Rec)
- Not threatened: (NT)**

Table 5: Hauraki Gulf islands and adjoining mainland sanctuaries (MS) where native bird species have been translocated. The conservation status of birds is from Robertson *et al.* (2013).

	NC	Nationally vulnerable		RD	MD	Relict	Recovering				Not threatened							
	Takahe	Black petrel	Hihi (Stitchbird)	North Island brown kiwi	North Island weka	Rifleman	North Island fernbird	Red-crowned kakariki	Common diving petrel	Kokako	Little spotted kiwi	Tieke (North Is. saddleback)	Pateke (Brown teal)	Pycroft's petrel	North Island tomtit	North Island robin	Bellbird	Whitehead
Hauturu (Little Barrier Island)																		
Aotea(Great Barrier Island)																		
Tawharanui Open Sanctuary (MS)																		
Kawau Island																		
Motuora Island																		
Wenderholm Regional Park (MS)																		
Tiritiri Matangi Island																		
Rangitoto Island																		
Motutapu Island																		
Motuihe Island																		
Waiheke Island																		
Rotoroa Island																		
Whanganui Island																		
Cuvier Island																		
Whakau (Red Mercury) Island																		
Kawhitu (Stanley Island)																		

Table 6: Hauraki Gulf islands where native invertebrate species have been translocated. The conservation status of invertebrates is from the Department of Conservation (2013).

	Relict	Recovering		Not Threatened	
	Wetapunga	Mercury Is- land tusked weta	Mahoenui giant weta	Auckland tree weta	Large darkling beetle
Tiritiri Matangi Island					
Cuvier Island					
Motuora Island					
Whakau (Red Mercury) Island (Mercury Group)					
Kawhitu (Stanley Island) (Mercury Group)					
Double Island (Mercury Group)					
Korapuki Island (Mercury Group)					
Ohinau Island					
Mahurangi Island					

Table 7: Hauraki Gulf islands and adjoining mainland sanctuaries (MS) where native reptile species have been translocated. The conservation status of reptiles is from Hitchmough *et al.* (2013).

	NE	SD	Relict					Rec	NT	
	Whitaker's skink	Auckland green gecko	Forest gecko	Duvaucel's gecko	Egg-laying gecko	Marbled skink	Northern tuatara	Pacific gecko	Robust skink	Shore skink
Hauturu (Little Barrier Island)										
Tawharanui Open Sanctuary (MS)										
Motuora Island										
Tiritiri Matangi Island										
Motuihe Island										
Crusoe Island										
Whakau (Red Mercury) Island (Mercury Group)										
Kawhitu (Stanley Island) (Mercury Group)										
Korapuki Island (Mercury Group)										

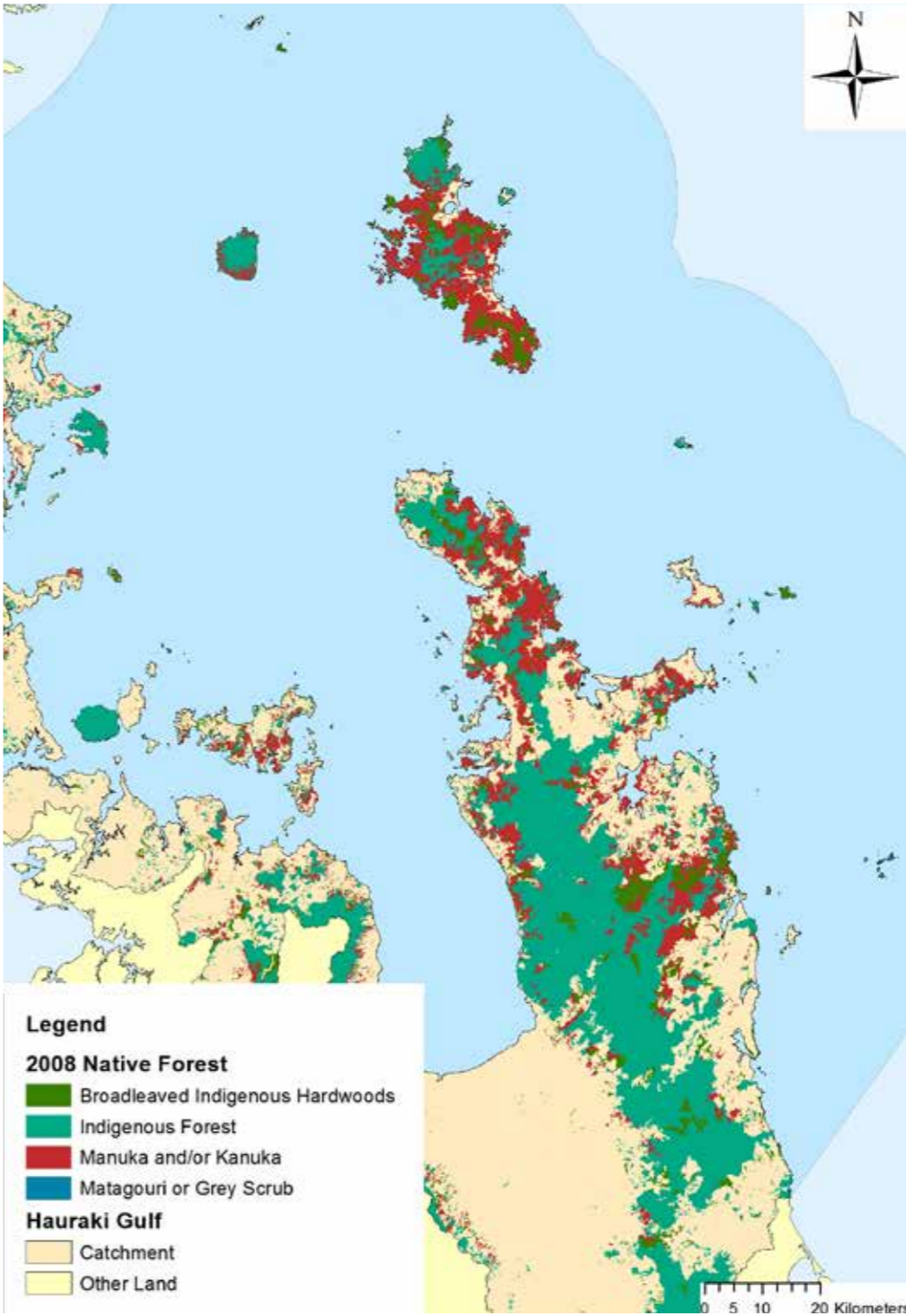


Figure 6-37: Extent of native forest cover on Islands of the Hauraki Gulf in 2008 (*data source LCDB3*).

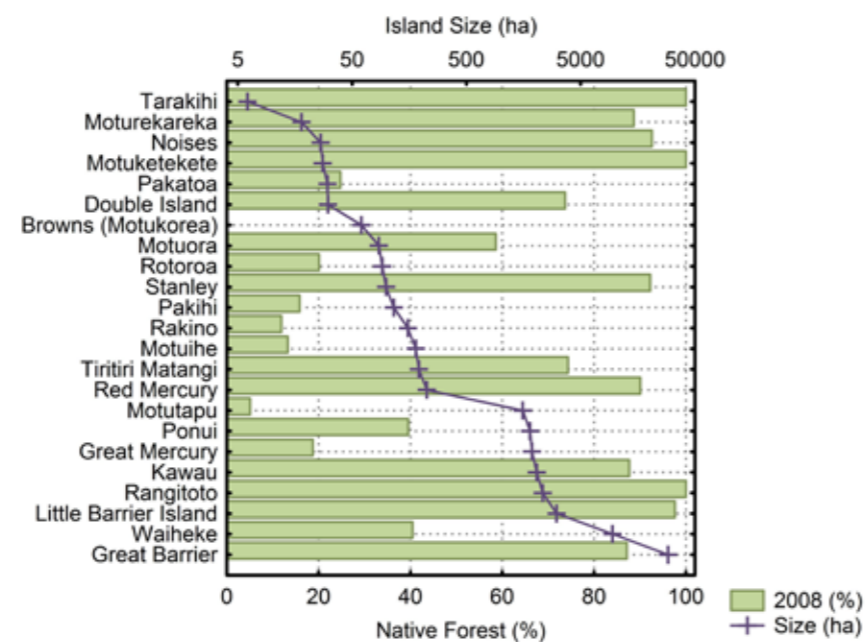


Figure 6-38: Proportion of land on Hauraki Gulf islands covered in native forest in 2008 and island size. Most area estimates were obtained using the land cover databases LCDB₃, with native forests defined as indigenous forest, broadleaved indigenous hardwoods, matagouri or grey scrub, and manuka/kanuka vegetation classes. The exception is Motuora Island, which was estimated using aerial photos obtained between 2010 and 2012 (due to misclassification in LCDB₃).

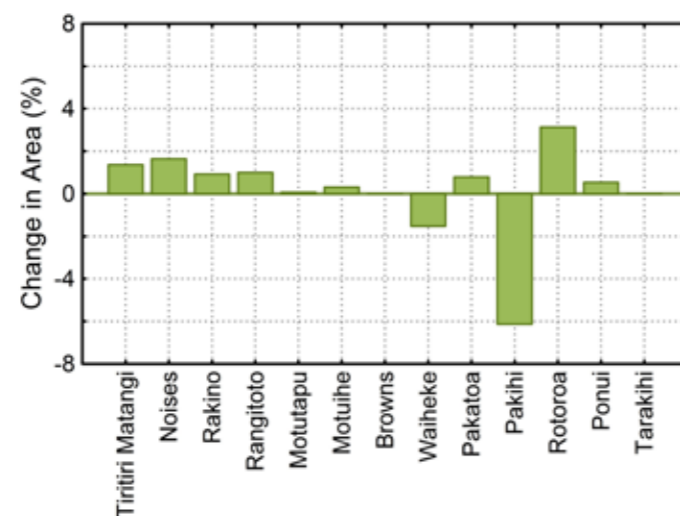


Figure 6-39: Change in the proportion of land on Hauraki Gulf islands covered in native forest between 2001 and 2008. Most area estimates were obtained using the land cover databases LCDB₂ and LCDB₃, with native forests defined as indigenous forest, broadleaved indigenous hardwoods, matagouri or grey scrub, and manuka/kanuka vegetation classes. The exception is Motuora Island, which was estimated using LCDB₂ and aerial photos obtained between 2010 and 2012 (due to misclassification in LCDB₃).

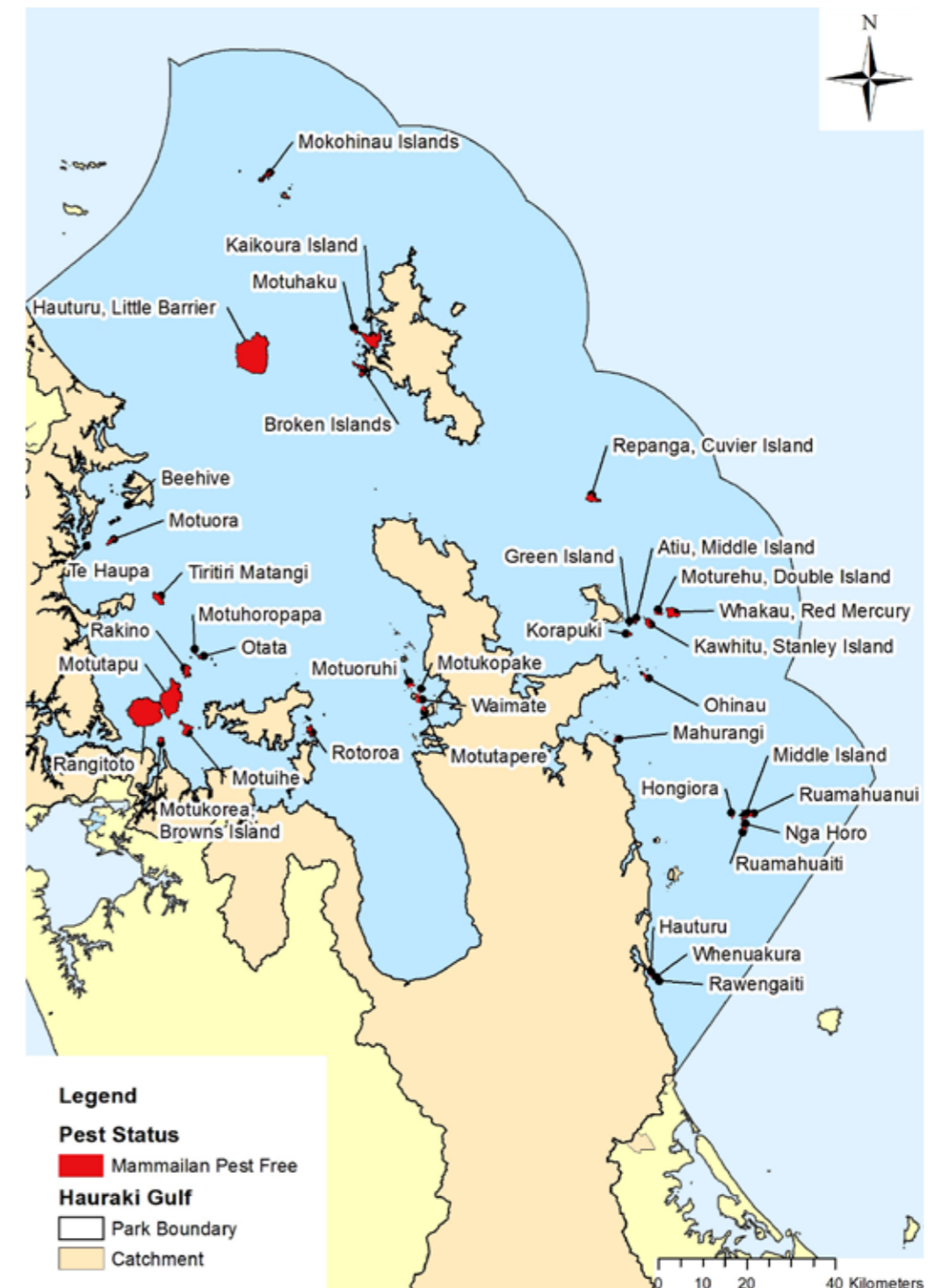


Figure 6-40: Mammalian pest-free islands in the Hauraki Gulf.

6.10 BRYDE'S WHALES

Background

The Hauraki Gulf contains one of the few known resident populations of Bryde's whales in the world. The national population is estimated to be less than 250 mature individuals, with around 46 of these residing in the Gulf.

Bryde's whales are listed as a nationally critical species.

Since 1989, there were 44 recorded fatalities of Bryde's whales in the greater Hauraki Gulf. Four whales have been killed since 2011.

17 (85%) of the 20 whales whose cause of death was determined were killed by ships and three (15%) died from entanglement in fishing or aquaculture equipment.

Habitat availability or exclusion may become an issue, if activities such as aquaculture start moving into areas they utilise.

Scientists, regulators and stakeholders are working together to reduce the impacts of ship strike on whales.

Bryde's whales are listed as a nationally critical species (i.e. threat status 1) in New Zealand because of their small population size, with fewer than 250 mature individuals nationwide (*Baker et al. 2010*). Unlike most other baleen whales, Bryde's whales do not undergo long-distance migrations, but prefer to remain in waters between 15 and 20°C. The Hauraki Gulf is a particularly important habitat for Bryde's whales, containing one of the few known resident populations in the world. The Gulf has a resident population of around 46 Bryde's whales, and another 159 whales are thought to utilise the Gulf for part of the year (*Wiseman et al. 2011; Constantine et al. 2012*).

The Hauraki Gulf is one of the busiest waterways in New Zealand with the Ports of Auckland handling around 1500 commercial ship calls and 100 cruise ship calls per year (*Ports of Auckland 2013b*). Bryde's whales spend more than 90% of their time in surface waters that are less than 12 m deep (*Constantine et al. 2012*). Consequently, there is a high risk of collision between whales and ships, which is a serious concern for the sustainability of the Bryde's whale population in New Zealand. Whales struck by ships travelling more than 13–15 knots are likely to be killed or suffer severe injury (*Laist et al. 2001*). From 1989 to 2014, there were 44 recorded fatalities of Bryde's whales in the greater Hauraki Gulf region, of which 23 (52%) died of undetermined causes (data on the cause of death were not collected) and one died of an unknown cause. Of the 20 whales that died of known causes, 17 (85%) were most likely killed by ship strike and three (15%) died from entanglement in fishing (2 whales) or aquaculture (1 whale) equipment (**Figure 6-41**). The average fatality rate of Bryde's whales from ship strike in the Hauraki Gulf is 0.9 whales per year, and there is no particular trend in fatalities over time (**Figure 6-42**) (*R. Constantine, University of Auckland, pers. comm.*). Scientists, regulators and stakeholders are working together to reduce the impacts of ship strike (see [Case Study: A shared goal for Bryde's whales](#)).

Consideration also needs to be given to other human activities that pose a risk to whales. For instance, habitat availability or exclusion may become an increasing issue for the whales, if activities such as aquaculture start moving into the areas they utilise. For instance, a new 300 ha zone for fish farming has been established in an area that is known to be used by the whales (see **Figure 5-10** and **Figure 6-43**).

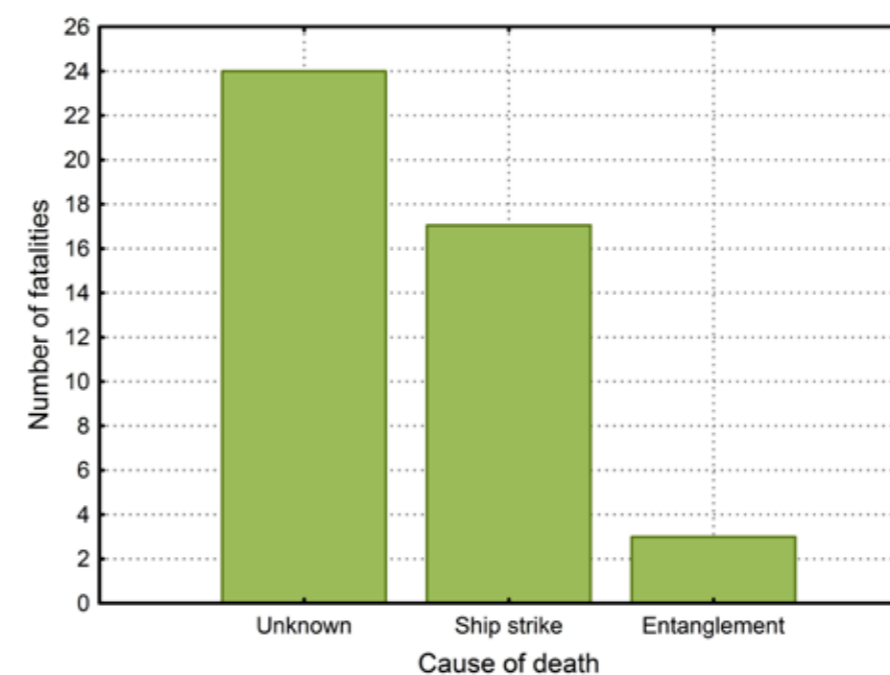


Figure 6-41: Causes of Bryde's whale fatalities in the great Hauraki Gulf between 1989 and 2014.

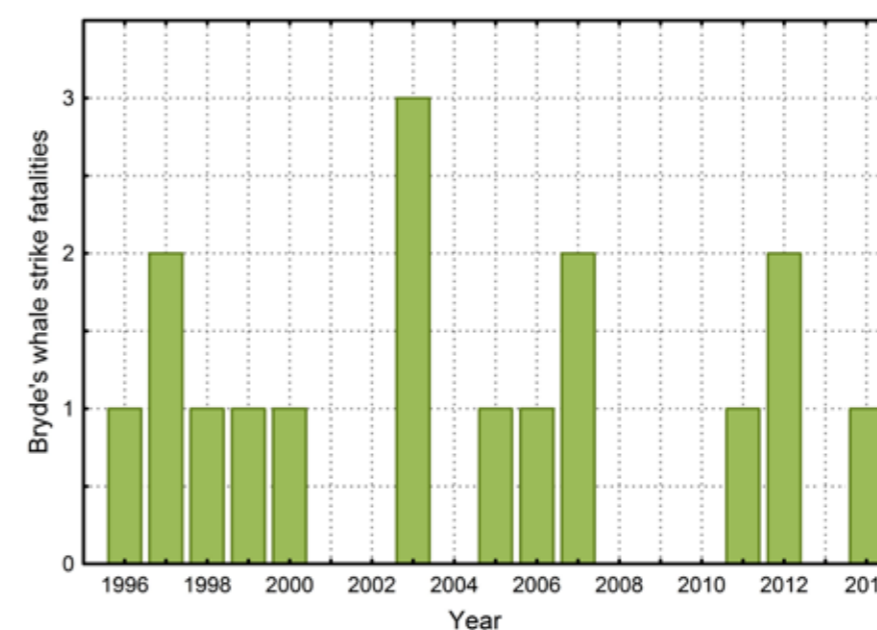


Figure 6-42: Number of known and probable ship strike fatalities of Bryde's whales between 1996 and 2014.

6.10.1 CASE STUDY: A SHARED GOAL FOR BRYDE'S WHALES

Given the extremely small size of the Bryde's whale population in New Zealand, an average of one fatality per year from ship strike is a very serious concern for the sustainability of the population. In response, a Bryde's whale working group was formed in 2011 to discuss ways of reducing the number of ship-whale collisions in the Hauraki Gulf. The working group consisted of a mix of interested parties including Auckland University researchers, DOC, the Environmental Defence Society, Ports of Auckland, the shipping industry, local iwi and the Hauraki Gulf Forum. The group has worked toward understanding why Bryde's whales are so susceptible to ship strikes, and developing methods to minimise collisions between ships and whales.

Research showed that shipping lanes cut across areas frequently utilised by whales and there is no evidence that they avoid approaching ships. Unlike many other whales, Bryde's whales spend more than 90% of their time in shallow surface waters (<12 m deep), which increases their risk of being hit. The whales appear to spend most of their day feeding on krill, other plankton, and small fishes, whereas they spend the majority of the night resting nearer the surface. The behaviour of Bryde's whales therefore makes them highly vulnerable to ship strikes, particularly at night when they are on the surface and may be slower to react.

A number of options have been, or are being explored to try and minimise the risk of ship strikes including:

1. **Trying to identify “safe” shipping lanes that avoided areas that were most frequently used by Bryde's whales.** Data on individual commercial shipping routes¹⁵ were overlaid on the distribution of Bryde's whale sightings¹⁶ in the inner Hauraki Gulf to try and determine whether shipping lanes could be established that avoided the areas predominantly used by Bryde's whales. However, it was found that there was a broad overlap between whale distribution and vessel traffic (*Figure 6-43*), and therefore, no “safe” shipping lanes could be recommended (*Riekkola 2013*).
2. **Using acoustic detectors to warn ships when Bryde's whales are nearby.** Acoustic detectors that pick up whale vocalisations have been successfully used overseas to provide warnings to ships when whales are nearby (*Lippsett 2009*). However, Bryde's whales were found to rarely vocalise, and therefore, acoustic detectors would be of limited use for detecting Bryde's whales (*Constantine et al. 2012*).
3. **Lowering the average speed of commercial ships in the inner Gulf. Currently, commercial shipping vessels travel through the Hauraki Gulf at an average speed of 13 knots.** Based on international research, lowering the speed to a maximum of 10 knots is estimated to reduce the probability of a lethal ship strike from 51% to 16% (*Riekkola, 2013*). The commercial shipping industry has roughly estimated that lowering the speed limit to 10 knots would cost the industry around \$5–8 million per annum (*R. Constantine, Auckland University, pers. comm.*). However, given the large reduction in the likelihood of a ship strike if shipping speeds are lowered, the shipping industry and Ports of Auckland have recently agreed upon a voluntary protocol to minimise ship-whale collisions (*Ports of Auckland 2013a*). The main points of the protocol are:
 - a. reduce speed in the Hauraki Gulf to 10 knots whenever possible,
 - b. stick to the recommended shipping routes to minimise the area covered by ships,
 - c. keep a watch out for whales when in the Hauraki Gulf during the day,
 - d. report all whale sightings to harbour control,
 - e. slow down if a whale is spotted and do not pass less than 1 km from a whale.

Shipping companies are also provided with report cards designed to encourage awareness and compliance with the voluntary protocol. The report cards are provided by the International Fund for Animal Welfare and contain details on ship speed through the Hauraki Gulf, the percentage of time a ship is above the voluntary speed limit, and additional travel time required if a ship stayed within the speed limit.

It is hoped that the voluntary protocol will reduce the number of whale-ship collisions in the Hauraki Gulf in future years.

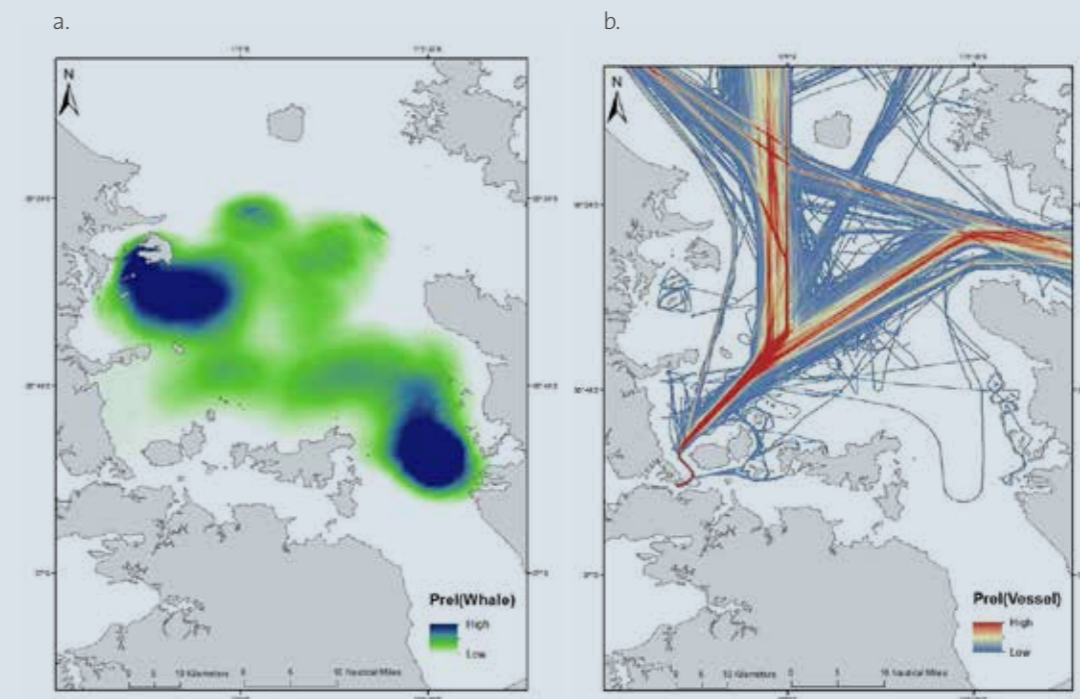


Figure 6-43. Relative probability of observing a) a Bryde's whale and, b) a vessel (>70m) in the Hauraki Gulf during July 2012–June 2013 (*from Riekkola, 2013*). Note that while a) shows two hotspots in whale distribution in the Hauraki Gulf for 2012–2013, the location of hotspots varies from year to year.

¹⁵ Automatic Identification System Vessel data provided by Kordia Ltd.

¹⁶ Mainly provided by commercial whale-watch companies.

6.11 SEABIRDS

Overview

The Hauraki Gulf is an internationally important biodiversity hotspot for seabirds.

The conservation status of three seabirds species has declined, and one species improved since 2011:

- New Zealand storm petrel changed from data deficient to nationally endangered,
- flesh-footed shearwater changed from near-threatened to nationally vulnerable,
- black-billed gull changed from nationally endangered to nationally critical, and
- little shag changed from naturally uncommon to not threatened.

There are serious concerns about the long term survival of four seabird species in the Gulf.

- The New Zealand fairy tern is this country's most endangered species, with only around 40 individuals and 12 breeding pairs estimated to remain.
- The NZ storm petrel was thought to be extinct for 108 years, until it was rediscovered in 2003. Very little is known about its biology or population size.
- The black petrel population is estimated to be declining by 2.5% per year and longline capture rates are of grave concern. Nationally, this seabird is at the most risk from commercial fishing activity, with an average of 1,440 estimated fatalities per year.
- The flesh-footed shearwater population in New Zealand has been rapidly declining from 50,000–100,000 pairs estimated in 1984 to less than 12,000 pairs currently. They are the most common species incidentally captured by north-eastern snapper longline fishery.

The Hauraki Gulf region is a globally significant seabird biodiversity hotspot. Its productive waters and multiple predator-free islands provide safe breeding sites that have good access to food. Over 70 seabird species (c. 20% of the world's seabird species) utilise the region and 27 species are known to breed in the region, of which, 59% are endemic to New Zealand. Five seabird species: Buller's shearwater, New Zealand fairy tern, Pycroft's petrel, black petrel, and NZ storm petrel, breed exclusively in the wider Hauraki Gulf region (*Gaskin & Rayner 2013*).

Seabirds extend island ecosystems by feeding exclusively within the marine environment and in a range of different marine habitats. Short-ranging species (such as terns, shags and blue penguin) forage within coastal habitats less than 10 km from their breeding sites, whereas other species (including smaller shearwaters, prions, storm petrels, diving petrels and gannets) prefer to forage near the continental shelf, and may travel considerable distances from their breeding colony on a single trip (<100 km). For the larger shearwaters and pelagic petrels, foraging areas may extend to hundreds, and in some cases thousands of kilometres away on highly productive shelf-break areas, eddies and upwellings. Seabird droppings add nutrients, particularly nitrogen and phosphorus, to the terrestrial environment, and can lower the pH of the soil. These high nutrient, low pH conditions are favoured by some endemic plant species (*Bellingham et al. 2010*). As a result, the Hauraki Gulf's influence as a breeding site for seabirds extends well beyond its boundaries.

The health of seabird populations is dependent on the wider oceanic environment, and as top predators, seabirds are useful indicators of change in the marine environment. Changes in the abundance of plankton and small fish caused by climatic changes, pollution or overfishing, are

frequently reflected in changes in the size of seabird populations, their behaviour or chemical composition (*Furness & Camphuysen 1997; Piatt et al. 2008*). The Hauraki Gulf is a dynamic environment in which food for seabirds is patchy in distribution and ephemeral by nature. There is a strong need to understand natural spatial and temporal patterns within the Gulf environment, so that changes caused by human activities can be better understood and effectively managed.

There have been several changes in the threat status of a number of seabirds since the 2011 State of our Gulf Report was published. These include:

- New Zealand storm petrel changed from data deficient to nationally endangered with the discovery of a breeding colony in Little Barrier Island in 2013. Birds in breeding condition have also been captured at-sea in the Hauraki Gulf.
- Flesh-footed shearwater changed from near-threatened to nationally vulnerable. The long-term stability of the NZ population is uncertain as recent population estimates indicate a rapidly declining population. Long-term monitoring of this species is required as it is the most common species incidentally killed by commercial fishers in the Hauraki Gulf.
- The little shag changed from naturally uncommon to not threatened as it appears that the population is increasing in the lower half of the North Island. However, populations in the Auckland region have decreased markedly.
- Black-billed gull changed from nationally endangered to nationally critical. Breeding colonies are mainly on mainland river beds and sandspits, which are threatened by predators, vehicles, flooding and extreme weather events.

Four species, the NZ fairy tern, the NZ storm petrel, the black petrel and the flesh-footed shearwater, deserve special mention because of their threatened conservation status and the importance of the Hauraki Gulf to their survival. Protection of known breeding sites is critical to the survival of these species. The New Zealand fairy tern is this country's most endangered species, with only around 40 individuals and 12 breeding pairs estimated to remain (*Department of Conservation 2014b*). Recruitment into the breeding population has slowly increased from 3–4 breeding pairs in 1983, when a DOC protection programme commenced, to 12 current breeding pairs. Fairy terns are only known to breed in four mainland sites, Waipu, Mangawhai, Pakiri and South Kaipara Head, of which, only the Pakiri site lies within the Hauraki Gulf Marine Park. Breeding birds and chicks are carefully monitored by DOC, with the help of the New Zealand Fairy Tern Trust, Te Uri O Hau and other community groups and volunteers. In the 2013–14 breeding season 12 chicks were successfully reared, the majority in Mangawhai Harbour, which is just outside the northern boundary of the Hauraki Gulf Marine Park. Only one pair bred at Pakiri, producing two chicks in the 2013–14 season (*Department of Conservation 2014a*).

The NZ storm petrel is a critically endangered species that was thought to be extinct for 108 years. It was rediscovered in the Hauraki Gulf in 2003 and 31 birds have been captured within the Gulf between 2005 and 2012. It was suspected that the birds breed within the Hauraki Gulf based on at-sea capture of birds in breeding condition (*Rayner et al. 2014*) and in February 2013 two breeding sites were found on Hauturu (Little Barrier Island) (*Forest & Bird 2013*). Very little is known about the biology of the species or the current population size.

Black petrel are known to breed at only two sites: Mount Hobson (Hirakimata) on Aotea (Great Barrier Island); Hauturu (Little Barrier Island) (*Bell et al. 2013*). The largest breeding colony occurs on Aotea, with an estimated 3974–4233 birds and 1500 breeding pairs in 2012–13 (*Bell et al. 2013*). The breeding population on Mt Hobson has been monitored since 1995–96. Prior to the 2012–13 breeding season, the total population and number of breeding birds had been steadily decreasing (**Figure 6-44**). Estimated population size doubled in 2012–13, though it is thought that some of this increase is due to more accurate estimates and a higher number of birds returning to breed in 2012–13. The average breeding success rate over the last 15 years is 75%, with survival of chicks

to three years of age estimated to be 59%. This survival rate is thought to be too low to ensure population sustainability. Modelling studies estimate that black petrel chicks need a survival rate of at least 85% if the population is to remain stable or increase (Bell *et al.* 2011b). At the current survival rate, the population is estimated to be declining by 2.5% per year.

The distribution of black petrels during the breeding season has a high overlap with the snapper and big eye tuna longline fishing areas, putting birds at high risk of being caught. Black petrels are recognised as being the seabird species that is at the greatest risk from commercial fishing activity within New Zealand fisheries waters. An estimated 1,440 black petrels per annum are killed by the commercial fishing industry nationwide (Richard & Abraham 2013). They are the second most common species incidentally captured in the by the north-eastern snapper longline fishery, which is concentrated in the Hauraki Gulf (Figure 6-47). These capture rates are of grave concern for the sustainability of this species (Bell *et al.* 2013).

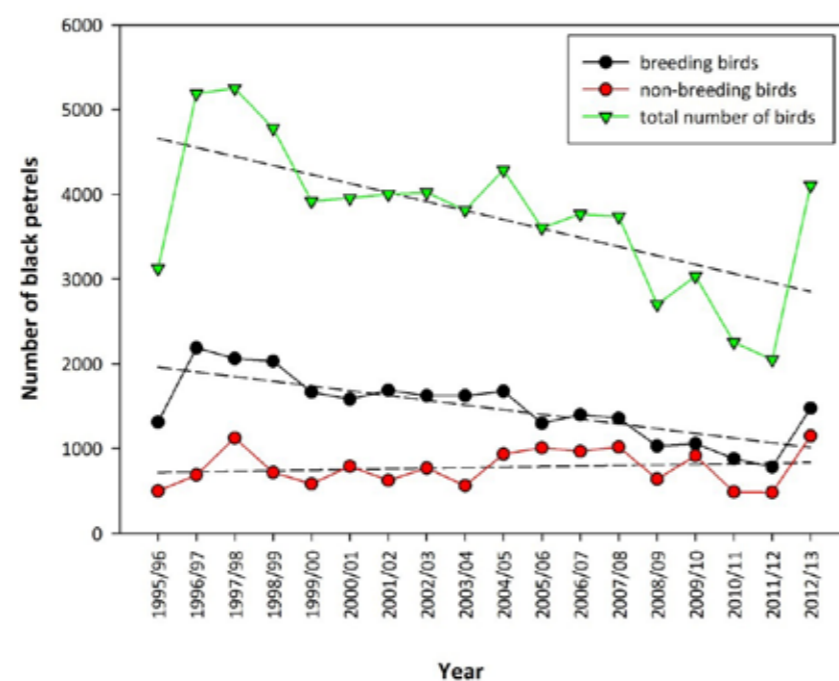


Figure 6-44: The estimated number of breeding, non-breeding and total black petrels on Mt Hobson, Aotea (Great Barrier Island) between 1995 and 2013. The dashed lines show the population trends over the monitored period. Data from Bell *et al.* (2013).

Flesh-footed shearwaters primarily breed on the Hen and Chickens Islands, Mercury Islands and Ohinau Island in the Hauraki Gulf Marine Park. Other significant breeding populations are located in the Bay of Plenty, Lord Howe Island, and islands off Western Australia. While the conservation status of overseas populations is rated by the IUCN as of least concern, the New Zealand population has recently been changed from near threatened to nationally vulnerable. New Zealand population estimates have been rapidly declining from 50,000–100,000 pairs in 1984 (Robertson & Bell 1984), to 25,000–50,000 pairs in 2000 (Taylor 2000b), to less than 12,000 pairs currently (Taylor 2013). Flesh-footed shearwaters are the third most at-risk species from commercial fishing, with 780 estimated fatalities per year nationwide (Richard and Abrahams, 2013). They are the most common species incidentally captured by the north-eastern snapper longline fishery (Figure 6-45).

6.1.1 CASE STUDY: THREATS TO NEW ZEALAND SEABIRD POPULATIONS



Photo: Buller's Shearwater (*Puffinus bulleri*)

Predators

The most serious threat to seabird populations is from introduced mammalian predators (e.g. cats, rats, pigs, mustelids, dogs, hedgehogs). All these animals are capable of killing adults and chicks, with the smallest seabird species e.g., terns and storm petrels and diving petrels, at the most risk. Other pest species such as goats, rabbits and wild sheep, can destroy habitat and trample nests. The eradication of mammalian pest species on NZ islands has been an important conservation tool for seabirds, and many NZ seabird species currently only breed on predator-free islands (Taylor 2000a). There are 36 mammalian-pest-free islands in the Hauraki Gulf (see Section 6.9.2). Maintaining these islands as free of pests is crucial for the conservation and management of seabirds. Recently, DOC and Auckland Council have launched the “Treasure Islands” campaign to increase public awareness of the importance of island biosecurity, and to help prevent pest re-invasion of pest-free islands. Predator control on mainland breeding sites is more difficult, and the status of many species that primarily breed on mainland sites (e.g. NZ fairy tern, black-billed gulls, Caspian tern) is nationally critical or vulnerable.

Fishing

Incidental capture of seabirds in lines, gill nets and trawl nets by both commercial and recreational fishers is a major conservation concern. Around 50,000 seabirds were estimated to have been caught by the New Zealand fishing industry between 2002–03 and 2011–12, with numbers decreasing over this period from around 7500 in 2002–03 to 3900 in 2011–12 (Figure 6-45, Ministry for Primary Industries 2013a). The vast majority of seabirds captured by commercial fisheries were not from the Hauraki Gulf because the majority of NZ's commercial fishing activity does not occur in the Gulf. Despite this, seabird mortalities around the country still have implications for the Hauraki Gulf ecosystem because most seabirds are highly mobile and forage over a large area of the country. The main commercial fishery that occurs in the Hauraki Gulf is for snapper. An estimated 673 seabirds were caught by the north-eastern (SNA1) snapper longline fishery in 2008–09, decreasing from around 1500 birds in 2000–01 (Figure 6-46, Abraham & Thompson 2011). Of great concern, are the seabird species captured by the snapper fishery in north-eastern NZ. Observed seabird captures suggest that the most common species caught by the snapper longline fishery are the nationally vulnerable flesh-footed shearwaters (42%) and black petrels (16%), and the naturally uncommon grey petrels (13%) and Buller's shearwaters (7%) (Figure 6-47). Estimated capture numbers of flesh-footed shearwaters and black petrels are higher than these populations can sustain.

Significant numbers of seabirds are also captured by recreational fishers, and it is estimated that recreational fishers catch 11,500 birds per year from the north-eastern coast of the North Island, alone. However, 77% of birds captured were reported to be released unharmed. The most common types of seabirds caught by recreational fishers are petrels (45%) and seagulls (29%) (Abraham *et al.* 2010). Suggested methods of reducing the incidental capture of seabirds by recreational fishers including: promoting the use of barbless hooks; using heavier weights so that the bait and hook sinks rapidly away from the surface; and, informing the public on the best methods of removing hooks from seabirds

(Abraham *et al.* 2010).

Loss of breeding habitat and human disturbance

Loss of breeding habitat through farming, clearing of forestry and coastal development can displace seabird colonies. Ironically, the removal of grazing animals can initially cause problems for some seabird species that are unable to move through dense, regenerating scrub. These birds are forced to find other breeding sites until the scrub is replaced by more mature, open forests.

Birds, such as black-billed gull, that nest on braided riverbeds in spring-summer and return to the Hauraki Gulf for autumn-winter, are vulnerable to irrigation schemes or hydro dams that reduce water flow and prevent flooding. Regular flooding of the river beds clears out vegetation providing more breeding habitat for birds.

Human distance of breeding seabirds, mainly through the recreational use of beach nesting areas, may cause the death of eggs or chicks or cause birds to abandon the nests (Taylor, 2000). Fairy tern are particularly vulnerable to such disturbance.

Marine pollution

Marine pollution (e.g., oil spills, heavy metals, pesticides, plastic debris) pose a threat to seabirds. Seabirds forage over huge distances so the potential impacts of a localised pollution event are likely to be widespread. For example, at least 1400 seabirds from 23 species were killed in the Rena oil spill in Tauranga in 2011, which released >300 tonnes of heavy fuel oil into the sea. These birds came from breeding sites as far as the Poor Knights Islands and East Cape. The actual mortality rate from the Rena spill is likely to be much higher than recorded because birds that died out at sea and were not washed ashore could not be counted (Gaskin & Rayner 2013; Towns *et al.* 2012). There is also the potential for long-term mortality caused by pollution events through the bioaccumulation of pollutants in the food web, however, very little is known about any long-term pollution effects.

Current seabird management actions

Seabird research and management is carried out by numerous organisations and individuals including DOC, councils, MPI, universities, NIWA, Manaaki Whenua Landcare Research, museums, trusts and societies, and community groups. The management of most critical seabird breeding sites is the responsibility of DOC and councils, though many community groups assist with management of breeding sites.

A National Plan of Action (NPOA) for Seabirds has been recently released by MPI in April 2013 (Ministry for Primary Industries 2013h). The plan was developed by MPI and DOC in consultation with the fishing industry, tangata whenua and environment groups. The NPOA-Seabirds contains a long-term strategic approach to reduce the incidental by-catch of seabirds in NZ fisheries. The NPOA-Seabirds seeks to ensure that:

1. Awareness of the problem and known mitigation methods are heightened
2. Relevant mitigation methods are applied by all NZ fisheries and vessels on the high seas
3. Capture rates are reduced to negligible in all NZ fisheries
4. Priority is given to species that are most at risk
5. Co-operation is established with other countries whose vessels interact with seabirds, particularly those that breed in NZ.

Several community groups and trusts also make a significant contribution to the conservation of seabirds, both in financial contributions and volunteer labour. For example:

- Forest and Bird helped fund NZ storm petrel surveys in the Gulf and they are currently developing an additional people-free, predator controlled breeding site for the NZ fairy tern in

the Kaipara Harbour (Forest & Bird 2014).

- Tawharanui Open Sanctuary Inc. have been assisting Auckland Council with bird monitoring, predator trapping, creating artificial burrows and installing seabird sound systems to attract seabirds to nest in the Tawharanui Open Sanctuary (Tawharanui Open Sanctuary Society Inc. 2014).
- Southern Seabird Trust run workshops for recreational and commercial fishers teaching them methods for reducing incidental catch rates of seabirds (Southern Seabird Solutions Trust 2014).
- The Motuora Restoration Society have been assisting DOC with the restoration of Motuora Island and the translocation and monitoring of diving petrels to the island (Motuora Restoration Society 2014).

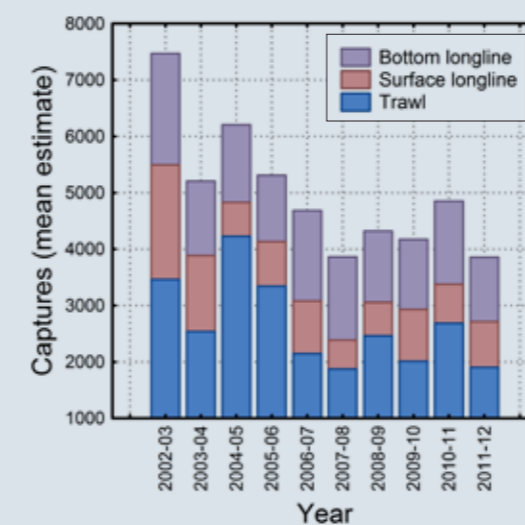


Figure 6-45: Mean estimates of the national number of seabirds caught by New Zealand's trawl and longline fisheries between 2002–03 and 2011–12 (Ministry for Primary Industries 2013a).

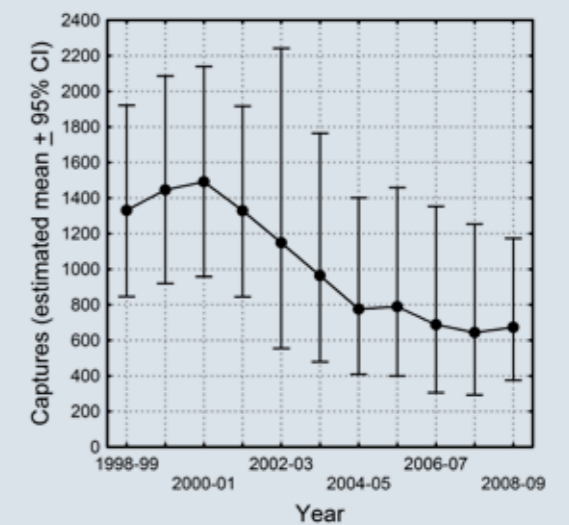


Figure 6-46: Mean estimates (+ 95% CI) of the number of seabirds caught on snapper long lines between 1998–99 and 2008–09 (Abraham & Thompson 2011).

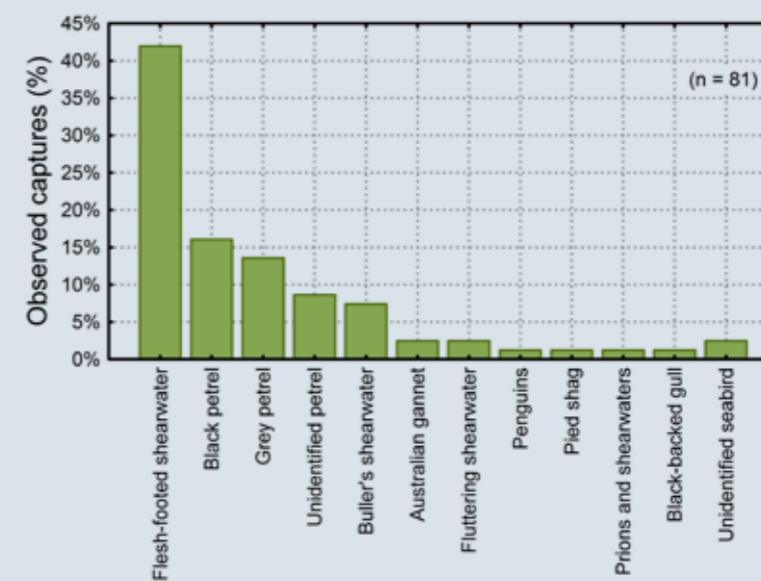


Figure 6-47: Proportions of seabird species that fisheries observers recorded being caught in the north-eastern snapper longline fishery between 1998 and 2008 (Abraham & Thompson 2011).

6.12 SHOREBIRDS

Overview

The international importance of the Firth of Thames for waders is recognised through its designation as a Ramsar wetland.
Wader counts have been made by the New Zealand Ornithological Society since 1960.
Trends of 16 wader species counted between 1960 and 2013 have varied, with: <ul style="list-style-type: none">• three endemic species and two native species increasing in number• two migratory species displaying cyclical fluctuations, but overall their counts have been relatively stable• two migratory and one endemic species generally displaying declining trends• one migratory species displaying cyclical counts, with an increasing frequency of zero or low counts since 1990• three migratory and one endemic species displaying increasing counts for a number of years after 1960, followed by a decline in more recent years.
At least one of the endemic species that is increasing in number (New Zealand dotterel) is conservation dependent with populations either stable or declining where they are unmanaged, and increasing where they are managed. Other species such as variable oystercatcher also appear to benefit from this management action.
International migratory species are likely to be affected by both local and overseas pressures and changes in habitat quality.
Recent declines in South Island pied oystercatcher are possibly related to habitat modification, water extraction and dairy conversions in their South Island breeding areas.

The Firth of Thames is an internationally important feeding area for waders, and is recognised through its designation as a wetland of international importance under the ‘Convention on Wetlands of International Importance Especially as Waterfowl Habitat’ (commonly called a Ramsar site). Migratory shorebirds utilise a number of sites over the course of a year, including winter feeding grounds, breeding grounds and, often, refuelling sites during long migrations. The Firth of Thames and Manukau Harbour are terminal points for the East Asian-Australasian flyway, which is used by shorebirds that migrate from winter in Siberia and Alaska to summer in the southern hemisphere, and later return between March and June to their northern breeding grounds (*Battley and Brownell 2007*). A total of 132 bird species have been recorded in the Firth of Thames with approximately 35,000 waders utilising the area each year. This includes endemic species (i.e. species only found in New Zealand), native species (i.e. self-introduced species that have become established in New Zealand) and overseas migrants. The latter group includes around 11,000 Arctic breeders from Siberia and Alaska, which come to forage on the extensive and highly productive intertidal sand and mudflats of the Firth of Thames each year (*Battley and Brownell 2007*).

The New Zealand Ornithological Society has been routinely counting birds at a number of sites in the Firth of Thames since 1960. Information summarised in the 2011 State of our Gulf Report, indicated that between 1960 and 2005, four of the most common wader species increased in

number, four species maintained relatively stable numbers, and seven species displayed declining trends. This information was updated for this report using combined summer and winter census data collected from the Firth of Thames by volunteers of the Ornithological Society of New Zealand (*Figure 6-48*). The following patterns are apparent:

- Three endemic species and two native species have increased in number since 1960.
 - Spur winged plover are a relatively recent native species, which has flourished since it was first recorded breeding near Invercargill in 1932. Counts have increased rapidly in the Firth of Thames since they were first recorded in the mid-1980s. Spur winged plover have gone from a fully protected native, to having that protection removed in 2010 (*Woodley 2013b*).
 - Annual variable oystercatcher counts in the Firth of Thames have increased from zero to 200-300 per year over the past 25 years. Nationally, there were estimated to have been about 2000 variable oystercatchers in the early 1970s, and numbers built to about 4000 in the mid-1990s. There have been no nationwide surveys in recent years. The breeding success of variable oystercatchers is often low, mainly because of egg and chick predation, tidal flooding of nests and human disturbance. No specific conservation measures are undertaken for variable oyster catchers, but some birds benefit from protection programmes for New Zealand dotterels (*Dowding 2013b*).
 - New Zealand dotterel counts in the Firth of Thames have steadily increased from annual counts of generally less than 30 birds between 1960 and 1990, to a count of 92 in 2013. New Zealand dotterel is an endemic species that is classified as nationally vulnerable, with a total of 2175 northern New Zealand dotterels counted during the 2011 breeding-season census. Northern New Zealand dotterels usually have poor breeding success at unmanaged sites, due to the loss of eggs and chicks to mammalian and avian predators, disturbance from human activities on beaches, loss of nests to big tides, and, the loss or degradation of habitat from development. Protection programmes began in the 1980s and around 20–25% of the population is now managed. These programmes typically include predator control, fencing of nesting areas, appointment of wardens to reduce disturbance, and advocacy. The northern New Zealand subspecies is conservation dependent with populations either stable or declining where they are unmanaged, and increasing where they are managed (*Dowding 2013a*).
 - Banded dotterel counts have generally increased in the Firth of Thames since around 1990. However, the national population of around 50,000 birds has been declining, and the species is classified as nationally vulnerable. The decline in banded dotterel numbers is primarily due to predation, but habitat loss and human disturbance has also contributed to the displacement of birds at some sites (*Pierce 2013*).
 - Pied stilt counts have been displaying a gradually increasing trend since 1960. Pied stilts are numerous and not considered threatened in New Zealand (*Adams 2013*).



Photo: New Zealand dotterel (*Charadrius obscurus*) making a nest in a tire track at Langs Beach

- The counts of two migratory species have displayed cyclical fluctuations, but overall, have been relatively stable since 1960:
 - Sharptailed sandpiper, which mainly migrate from breeding sites in northern Siberia to Australia. They are only observed in low numbers in the Firth of Thames and other parts of New Zealand (*Walker 2013*).
 - Red knot, which breed in far-eastern Russia and the east Siberian Islands. There is extreme concern about the effect that reclamation in Bohai Bay, within the western Yellow Sea of China, will have on migrating red knots. The conservation status of this species was changed from vagrant to nationally vulnerable in 2013 (*Battley 2013*).
- Two migratory and one endemic species have generally displayed declining trends since the 1960s:
 - Counts of the migratory eastern bar-tailed godwit have fluctuated since the 1960s, but the long-term trend is one of reducing numbers. This is possibly due to foraging areas being reduced by the expansion of mangroves (*Battley and Brownell 2007*). Eastern bar-tailed godwits breed on the western rim of Alaska, and face a real threat from habitat loss, particularly at critical migration stopover sites in the Yellow Sea region. Climate change is also likely to be a threat. The conservation status of this species was changed from migrant (safe overseas) to recovering (threatened overseas) in 2013 (*Woodley 2013a*).
- Counts of the endemic wrybill slowly declined in the Firth of Thames between the mid-1960s and 2010, and then increased between 2011 and 2013. The national population size of wrybills is uncertain, but it is possibly in the order of 5000–5500, and is thought to be declining. Wrybills breed exclusively on braided riverbeds and are classified as nationally vulnerable (*Dowding 2013c*).
 - Counts of the migratory eastern curlew dropped from relatively low numbers in the 1960s (maximum of 30 birds), and have been only occasional counted since 2000.
- The migratory Pacific golden plover has displayed cyclical counts, with an increasing frequency of zero or low counts since 1990. Only 300–1200 birds from a global population of around 190,000 to 250,000 individuals migrate to New Zealand each year (*Szabo 2013a*).
- Three migratory and one endemic species displayed increasing counts for a number of years after 1960, followed by a decline in more recent years.
 - Curlew sandpiper counts peaked around 1980 and subsequently declined. The global population of curlew sandpipers is estimated at 1.8–1.9 million, but the East Asian-Australasian Flyway population is probably in decline. Less than 40 have reached New Zealand each summer since 2000, with rarely more than 2–3 overwintering (*Riegen 2013*).
 - Turnstone counts peaked around 1980 and have subsequently declined. Turnstone have a global population of around 460,000–800,000. Of this, 4,000–7,000 birds reach New Zealand each summer, with between 100 and 1,500 birds overwintering (*Szabo 2013b*).
 - Whimbrel counts increased from low numbers in the 1960s and early 1970s. Since that time counts have fluctuated. However, less than five birds have been counted in 11 of the 38 years that have been surveyed since 1975. This includes the five most recent years from 2009 to 2013. Only around 70 whimbrel are estimated to migrate to New Zealand each year from an East Asian-Australasian Flyway population that is estimated to contain 55,000 birds (*Melville 2013*).
 - South Island pied oystercatcher counts increased from very low numbers in 1960 to peak at around 32,500 birds in 1998. Counts have been declining since 1998, with the 2013 surveys recording a combined total of around 5900 birds. The reasons for the recent decline in the counts have not been determined, but habitat modification, water extraction and dairy conversions in their breeding areas are commonly highlighted as potential causes (*Sagar 2013*).

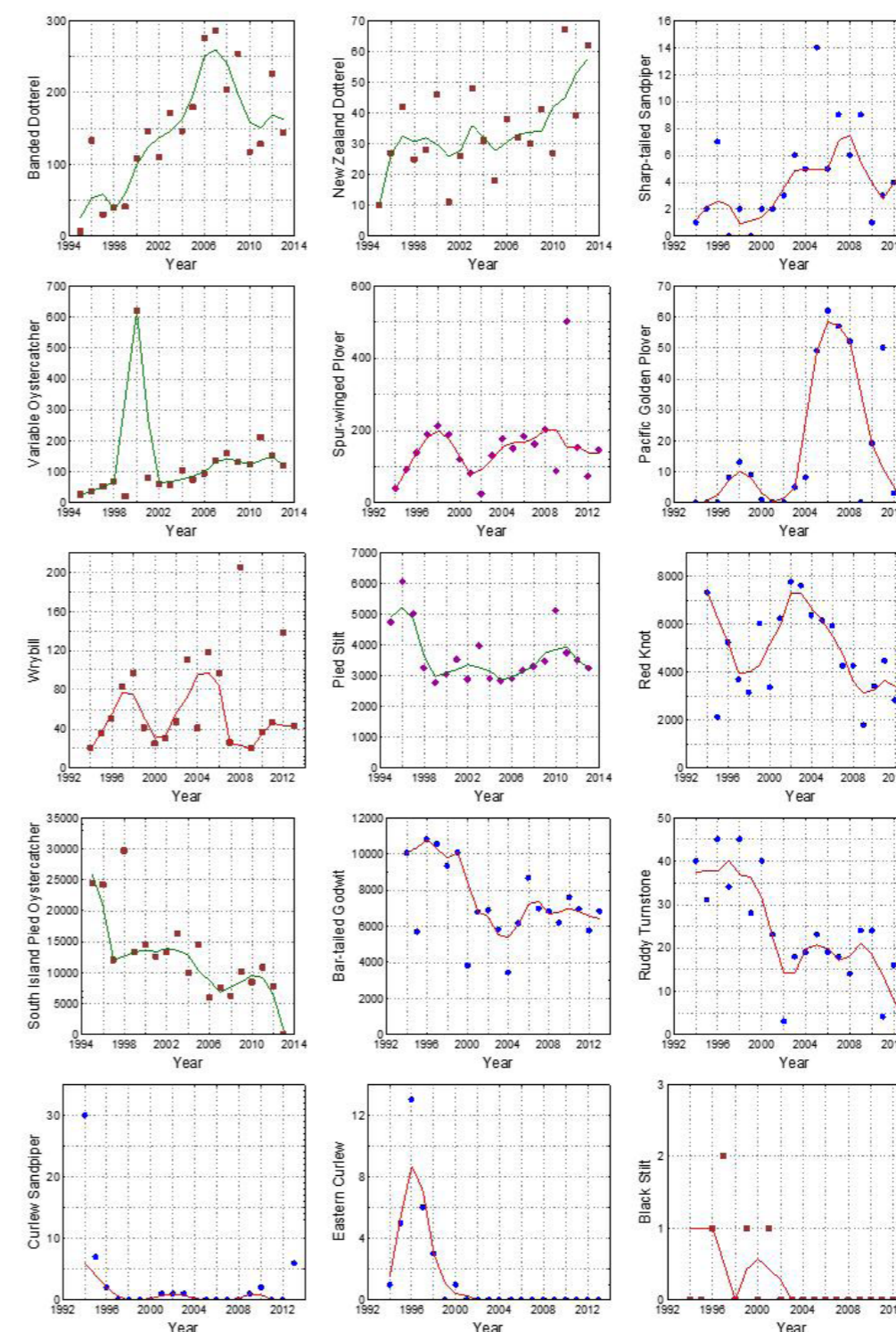


Figure 6-48: Trends in the combined number of shorebirds counted during summer and winter surveys undertaken by volunteers of the Ornithological Society of New Zealand in the Firth of Thames (data provided by OSNZ). Lowess trend lines are fitted, with endemic species having blue circles and red trend lines, native species have brown circles and orange trend lines, and migrants have green circles and grey trend lines.

6.13 COASTAL DEVELOPMENT

Overview

Coastal development causes a variety of environmental impacts which tend to be cumulative and unidirectional.

Most of the mainland coast in the Auckland Region is adjoined by land with relatively small land parcels.

Large coastal land parcels remain in many parts of the Coromandel Peninsula, along the southern Firth of Thames and southern Kaipara coasts, Pakiri, Mahurangi South, Tawharanui Peninsula, the Clevedon coast and around Orere Point.

Popular holiday areas such as Matheson Bay, Omaha, Pauanui, Te Rerenga (Northern Coromandel) and Whangamata tend to have more dwellings than usual residents, and this pattern has persisted since 2001.

Since 2001 the number of dwellings has tended to grow faster than the resident population in popular holiday areas.

Coastal development is a growing issue in terms of its environmental cost, with effects that tend to be unidirectional and cumulative (*Kelly 2009*). Among other factors, these impacts can include:

- the degradation of natural landscapes and wilderness features
- modification of the natural coastline through reclamation and the construction of marinas, seawalls, wharves, boat ramps and other coastal structures
- habitat loss through direct or indirect physical disturbance during land development and the construction and maintenance of coastal structures
- the release of stormwater, wastewater, anti-foulants and other contaminants into the environment
- increased biosecurity risks for marine biota and coastal vegetation
- growing threats to coastal birds through direct disturbance, habitat loss and increased numbers of mammalian predators (including cats and dogs)
- increased pressure on fish and shellfish resources.

In addition, coastal development can destroy or degrade sites that have important historical or cultural values and reduce visitor access to the Gulf by decreasing the number of camping grounds.

Two indicators are used to examine patterns and trends in coastal development.

1. Spatial variation in the size of primary land parcels (number of primary parcels per square km) based on data downloaded from LINZ in March 2013.
2. Statistics NZ census data showing trends in resident population and dwelling numbers in nine representative areas (three beaches north of Auckland, three intensively developed urban areas in Auckland, and three popular holiday areas on Coromandel Peninsula).

Most of the islands of the Gulf only have less than five lots per square kilometre (*Figure 6-49*). The exceptions are the western side of Kawau Island, the southern end of Great Barrier Island, and the western end of Waiheke Island. On the Coromandel Peninsula, highest lot densities occur along the Thames coast, around Coromandel, between Whangapoua and Opito, between Whitianga and



Photo: Omaha, Auckland. October 2012

Hahei, around Tairua and Pauanui, and around Onemana, Whangamata and Whiritoa. However, lot densities remain relatively low in many parts of the Coromandel Peninsula. Lot densities are also low along the southern Firth of Thames and southern Kaipara coasts, but slightly greater densities are found from Kaipara north. In contrast, very little of the mainland coast has low lot densities in the Auckland Region. Those areas that do are Pakiri, Mahurangi South, Tawharanui Peninsula, the Clevedon coast and the coast on either side of Orere Point.

Locations in Auckland's urban area differ markedly from those in holiday spots on Coromandel Peninsula and beaches north of Auckland (*Figure 6-50*). Auckland has a high proportion of usual residents to dwellings, whereas in five of the other six locations assessed there are more dwellings than usual residents. These patterns have been reasonably consistent over time. In the 2013 census:

- Matheson's Bay had 69 more dwellings than usual residents
- Omaha had 540 more dwellings than usual residents
- Pauanui had 1398 more dwellings than usual residents
- Whangamata had 1026 more dwellings than usual residents
- Te Rerenga (Northern Coromandel) had 1815 more dwellings than usual residents.

Trends through time also differ. In Auckland, usual residents are increasing faster than the number of dwellings, whereas the number of dwellings has been increasing faster than the number of usual residents at five of the other six locations. Between 2001 and 2013 censuses the number of dwellings increased by:

- 15 more than the increase in the number of usual residents at Algies Bay
- 129 more than the increase in the number of usual residents at Omaha
- 1344 more than the increase in the number of usual residents at Te Rerenga (Northern Coromandel)
- 120 more than the increase in the number of usual residents at Pauanui
- 948 more than the increase in the number of usual residents at Whangamata.

These changes are likely to reflect the high demand for holiday homes over that period.

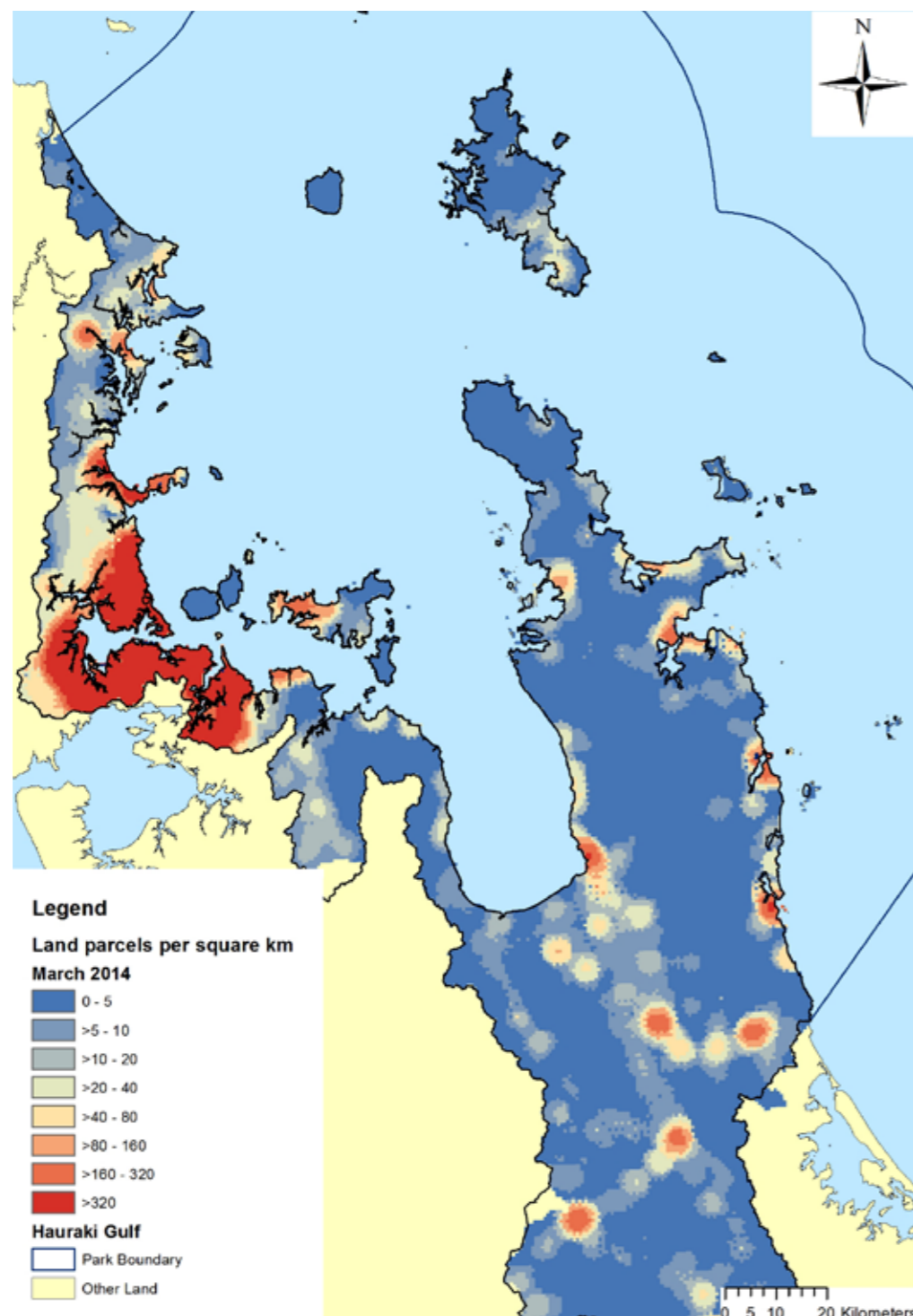


Figure 6-49: Variation in lot density based on the number of primary land parcel per square kilometre (LINZ Data Service, NZ Primary Land Parcels, 18 March 2014). The number of parcels was determined by counting parcel centroids (i.e. the central position of each parcel).

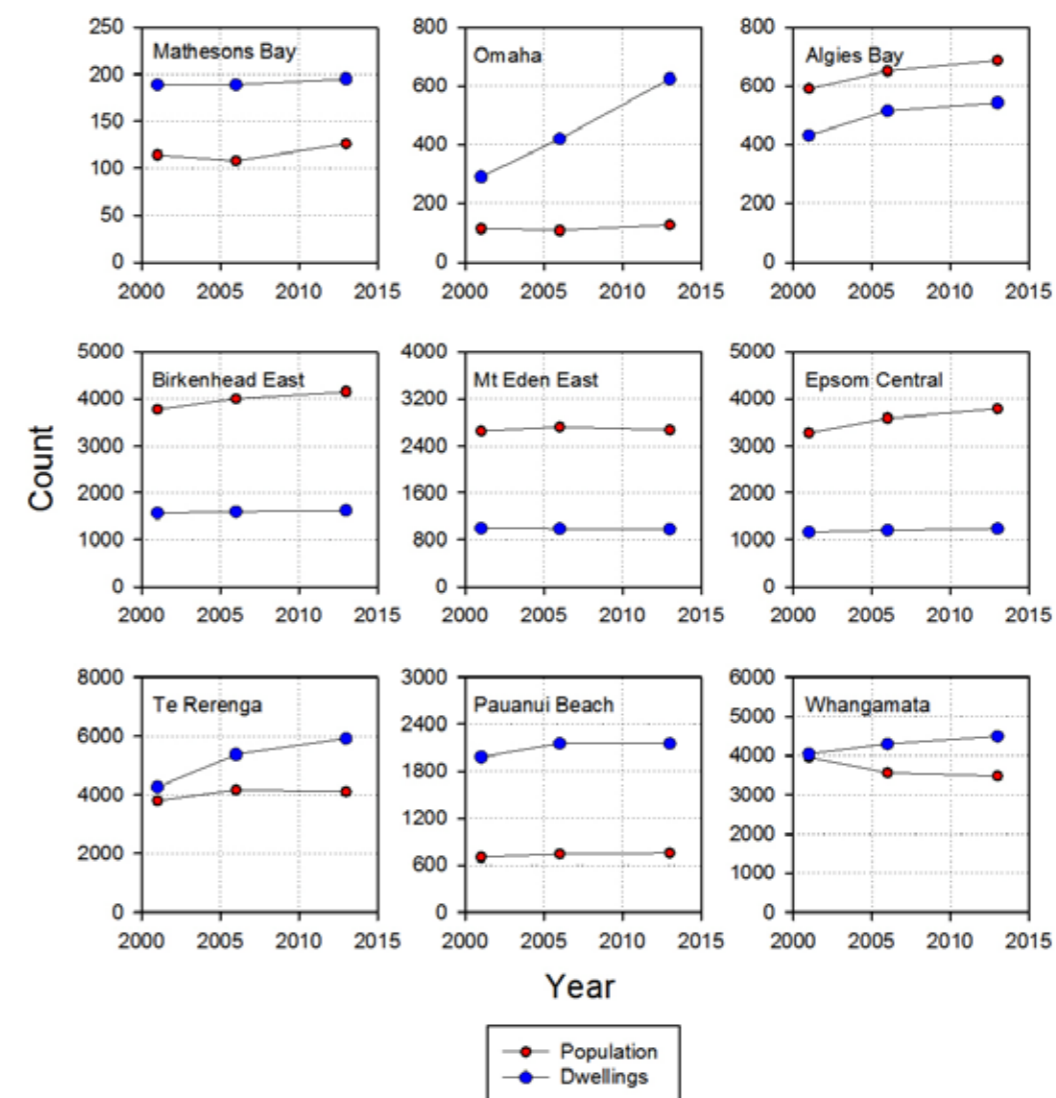


Figure 6-50: Usually resident populations and numbers of dwellings in representative coastal and urban areas. The top three graphs are northern Auckland beaches, the middle three graphs are inner Auckland suburbs, and the lower three graphs are areas or settlements on Coromandel Peninsula.

7.

Adequacy of the response

Whāia te pe tawhiti kia tata, whāia te pae tata kia maua – Pursue the distant pathways of your dreams, so they may become your reality.

Overview

<p>The initiation of the Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari in 2013 is a significant step towards better integration of management of the Gulf. The final plan is due to be delivered in September 2015.</p>
<p>Auckland Council and Waikato Regional Council intend to implement Sea Change – Tai Timu Tai Pari through variations or changes to their plans and policies. The Department of Conservation has also signalled its intent to implement the plan in its draft Conservation Management Strategies for Auckland and Waikato. MPI is also supporting the process, but they are uncertain about how they will implement the plan.</p>
<p>Over the past three years, progress has been made in a number of areas that match the Forum’s strategic framework for action: island restoration, involvement of mana whenua in decision making, marine biosecurity, management of fishing impacts on seabirds and sharks, and improvements in knowledge.</p>
<p>Progress has been slower in the areas of enhancing fisheries and the creation of a network of marine protected areas. Progress on active land management to reduce pollutants is mixed. Pending consent applications for large-scale aquaculture development, and recent zoning to provide for the aquaculture of fed species could also add to high riverine nutrient loads and alter the intrinsic values of the Firth of Thames.</p>
<p>There is broad alignment between MPI’s overarching policy for managing fisheries (<i>Fisheries 2030</i>) and the objectives of the Hauraki Gulf Marine Park Act, but this is not reflected in fisheries management decisions made since 2011.</p>
<p>In most cases, the lowest acceptable target allowed for under Section 13 of the Fisheries Act (1996), has become the default target. The Forum’s vision, and the strategic issues the Forum is seeking to address in relation to fisheries are unlikely to be realised unless this practice is changed.</p>
<p>Until recently, progress on growing the network of marine protected areas in the Gulf had stalled. The Great Barrier Local Board is now leading an initiative to investigate the creation of a marine protected area around Aotea (Great Barrier Island), and Friends of the Hauraki Gulf have also proposed the development of a marine reserve off the northern coast of Waiheke Island.</p>
<p>Existing marine reserves have largely developed through <i>ad hoc</i> processes. The Sea Change – Tai Timu Tai Pari Plan may enable a network of marine protected areas to be considered in a more structured and strategic manner.</p>
<p>Efforts to restore marine habitats show early signs of success and could complement marine protected areas.</p>
<p>Major changes to regulatory frameworks for resource management (including land management) have been implemented, initiated or signalled over the past three years.</p>
<p>There are concerns that proposed changes to the Resource Management Act will weaken environmental provisions, while emphasising the benefits of use and development. If implemented, these changes would reduce the level of alignment between the Resource Management Act and the objectives of the Hauraki Gulf Marine Park Act, and could impede the realisation of the Forum’s vision and its work on addressing strategic priorities around land management.</p>

The National Policy Statement for Freshwater Management 2014 (NPSFM) seeks to maintain or improve the overall quality of fresh water within a region, while also providing councils the flexibility to offset deterioration in one area with improvements in another. The NPS also establishes bottom lines for some water quality parameters, but these have been set at very low levels in relation to the maintenance of ecosystem functions. Outcomes for the Hauraki Gulf will depend on how the framework provided by the NPSFM is applied by Regional Councils.

The 2011 aquaculture reforms increases the potential for water quality to worsen in the Firth of Thames, which emerging research shows, is already experiencing nutrient-related oxygen sags and acidification.

Changes to the purpose of local government may lead to lower cost options for stormwater and wastewater management, and increase the gap between policies and on-the-ground actions needed to shift Auckland from a “drainage city” to a “waterways city”.

The proposed Waikato Regional Policy Statement and Proposed Auckland Unitary Plan both seek to reduce the effects of land based activities on freshwater and coastal systems (including the Gulf).

The proposed Waikato Regional Policy Statement requires standards to be established for the management of coastal water quality.

The proposed Auckland Unitary Plan signals that Auckland Council is moving towards establishing environmental standards for the Gulf and that it is seeking to integrate its actions with those of the Waikato Regional Council.

The Sea Change – Tai Timu Tai Pari Plan process shifts the responsibility for allocating space for protection and use, and for setting targets, bottom lines and standards, to mana whenua and stakeholders, though backed by management agency commitments to implement the plan.

The Hauraki Gulf Marine Park Act requires the State of the Environment report to include information on progress towards integrated management and responses to the issues identified by the Forum (see Section 4.2). The initiation of Sea Change – Tai Timu Tai Pari Plan process in 2013 was a significant step towards better integration. The process is supported by mana whenua, DOC, MPI, the Hauraki Gulf Forum, Auckland Council and Waikato Regional Council. It seeks to deliver a mana-whenua and stakeholder-driven plan, which draws on the knowledge and capability of communities to solve pressing ecological problems. The core work is being carried out by a Stakeholder Working Group which was formed in December 2013. This group has the primary responsibility for developing and drafting the plan. The group is expected to compile and analyse evidence and work collaboratively to find innovative solutions to the problems facing the Gulf. The composition of the Stakeholder Working Group was decided by more than 130 people from a range of groups, from industry bodies to conservationists, and through mana whenua processes. Leadership of the Sea Change – Tai Timu Tai Pari process is provided by a steering group, comprising 16 representatives of management agencies responsible for the Gulf (DOC, MPI, councils, and the Hauraki Gulf Forum) and mana whenua (www.seachange.org.nz).

The final plan is due to be delivered in September 2015, and it would be reasonable to expect implementation to be well underway in time for the 2017 State of our Gulf report. The plan is intended to be non-statutory. However, the Auckland Council and Waikato Regional Council intend to implement the Sea Change – Tai Timu Tai Pari Plan through variations or changes to their plans and policies. The Department of Conservation includes supporting the implementation of the plan as an objective for management of the Hauraki Gulf Marine Park in its draft revised Conservation Management Strategies for Auckland and Waikato. At this stage, it is uncertain how the plan will be implemented by MPI.

In the interim, a range of other actions and measures have been taken, or are progressing. The analysis of current and emerging pressures, changing management, and key indicators shows that the alignment of actions with the strategic issues identified by the Forum (see Section 5), integration between and within organisations, and progress towards addressing the Forum’s issues has been mixed. Over the past three years, progress has been significant in areas including:

- island restoration
- strengthened involvement of mana whenua in decision making
- marine biosecurity measures
- development of more integrated management approaches for seabirds and sharks
- expanding the knowledge base available to guide and support management responses (although the limited extent of coastal monitoring in the Waikato Region hampers the measurement of environmental performance in eastern parts of the Gulf).

Less progress has been made on the enhancement of fish stocks and addressing the environmental effects of fishing, as well as the creation of new marine protected areas (although new tools have been developed to support the latter). Changes to land management have been signalled, but are yet to take effect. Pending consent applications for large scale aquaculture development (covering around 4800 ha), and recent zoning to provide for the aquaculture of fed species could fundamentally alter the natural and intrinsic values of the Firth of Thames (see Section 5). The level of integration in decision making, and the alignment between actions taken since 2011 with the Forum’s priorities are considered for each of these issues.

7.1 INTEGRATION IN DECISION MAKING, AND ALIGNMENT WITH PRIORITY ISSUES

7.1.1 Fisheries

Fishing occurs in most parts of the Gulf and has one of the greatest influences on the Gulf’s marine ecosystem. MPI’s overarching policy for managing fisheries is “*Fisheries 2030*” (*Ministry of Fisheries 2009a*). That policy seeks a range of outcomes, which are broadly aligned with the objectives of the Hauraki Gulf Marine Park Act. It aims to ensure that fisheries resources are used in a manner that provides greatest overall economic, social, and cultural benefit, while also sustaining the capacity and integrity of the aquatic environment, habitats, and species at levels that provide for current and future use. The key outcomes sought by Fisheries 2030 include:

- An internationally competitive and profitable seafood industry that makes a significant contribution to our economy.
- High-quality amateur fisheries that contribute to the social, cultural, and economic wellbeing of all New Zealanders.
- Thriving customary fisheries, managed in accordance with kaitiakitanga, supporting the cultural wellbeing of iwi and hapū.

- Healthy fisheries resources in their aquatic environment that reflect and provide for intrinsic and amenity value.
- Biodiversity and the function of ecological systems, including trophic linkages are conserved.
- Habitats of special significance to fisheries are protected.
- Adverse effects on protected species are reduced or avoided.
- Impacts, including cumulative impacts, of activities on land, air or water on aquatic ecosystems are addressed.

The policy is implemented through draft national inshore finfish and shellfish plans (*Ministry of Fisheries 2011b, Ministry of Fisheries 2011c*), which link the environment and use outcomes described in Fisheries 2030 and the management of particular fish stocks. These plans group fish stocks (as defined by target species and quota management areas) in relation to fishing pressure and biological vulnerability to facilitate combined objective-setting and service delivery. It is important to note that fisheries plans are an expression of management approaches and actions to be taken to implement legislative obligations. That is, fisheries plans do not supersede or modify any legislative requirements, but the Minister must take them into account when making sustainability decisions.

Annual operational plans sit below national fisheries plans. These outline specific actions to be taken in the year ahead, and the rationale for those actions. Those actions can cover any aspect of fisheries management including administration, stakeholder engagement, research, data collection, assessments, and enforcement (*Ministry for Primary Industries 2012a, b*).

Another key component of the framework relevant to management of the Gulf's fisheries is the harvest strategy standard (*Ministry of Fisheries 2008*). This standard is considered by MPI to be best-practice policy guidance for developing targets and limits with which to manage fish stocks in the Quota Management System (*Ministry for Primary Industries 2013j*). The harvest strategy standard is focused on single species fishery management, while noting the need to incorporate other matters in fisheries management decision-making, e.g., in accordance with the environmental principles of the Fisheries Act (*Ministry of Fisheries 2008*).

Comparing these strategic and planning documents to recent fisheries management decisions highlights how the different outcomes and objectives have been interpreted. Despite the apparent alignment between Fisheries 2030 and the Hauraki Gulf Marine Park Act, recent fisheries management decisions deviate from the Forum's vision of enhanced fisheries with improved environmental outcomes. For example, increased scallop harvests have been provided for, even though dredging is known to reduce habitat heterogeneity and biological diversity, and it will be used to catch scallops in areas known to contain sensitive marine habitats (see Section 6.1). For crayfish, catch limits were reduced to increase crayfish biomass and catch rates in accordance with the recommendations of the National Rock Lobster Management Group (*National Rock Lobster Management Group 2014*). However, the ecosystem functions of crayfish were not considered and provided for when the new biomass target was set. The restoration of those functions is likely to require a higher biomass target, or the use of complementary management methods. Finally, while the interim management target for SNA₁ was set higher than the previous biomass target, the final management decision diverged from both it and the harvest strategy standard (*Ministry of Fisheries 2008*). The harvest strategy standard states that stocks falling below the 'soft limit' should be rebuilt back to at least the target level in a time frame which is no longer than twice the time it would take if all harvesting ceased. This would have required the TAC for the Hauraki Gulf-Bay of Plenty snapper substocks to be cut by 56%.

All of these decisions adopted the lowest acceptable target allowed for under Section 13 of the

Fisheries Act (1996) (i.e. the total allowable catch that will maintain the stock at or above a level that can produce the MSY or a compatible reference point¹⁷, or at a level that allows the stock to move toward or above the MSY or a compatible reference point). This may make sense from a sustainable utilisation perspective, as the use of MSY based targets for preventing overfishing is regarded as a component of international best practice (*e.g. see Lodge et al. 2007*). Consequently, for most stocks MSY based targets are used as the default. However, they may not be suitable for maintaining important ecological functions, which potentially require larger stocks of some species. Best practice fisheries management organisations also include programmes to understand the trophic interactions and dependencies affected by fishing, and take these matters into account when setting reference points, catch levels and other fishery management measures (*Lodge et al. 2007*). Stock biomass also fluctuates naturally, and commonly falls well below target levels. The harvest strategy standard establishes the trigger for a formal, time-constrained rebuilding plan when the 'soft limit' is reached. The default soft limit is half the biomass that will produce the MSY or 20% of the unfished biomass (Bo), whichever is higher (*Ministry of Fisheries 2008*).

There are a number of reasons for the divergence between fisheries management decisions and the vision and strategic outcomes the Forum is seeking. The single species focus of fisheries management naturally leads to environmental considerations becoming secondary to the identification of a desired harvesting approach or goal. The lack of explicit criteria for the assessment of broader ecological effects and the absence of clear advice on these matters in recent catch reviews supports this conclusion (even though this is a key outcome identified in Fisheries 2030). For instance, regarding the effects of depleted snapper populations on the broader ecosystem processes, recent advice provided to the Minister stated that: "*Snapper are one of the most abundant demersal generalist predators found in the inshore waters of northern New Zealand, and as such are likely to be an important part of the coastal marine ecosystem. Localised depletion of snapper probably occurs within key parts of the fishery; this has unknown consequences for ecosystem functioning in those areas.*" (*Ministry for Primary Industries 2013j*). For crayfish, the final advice recently given to the Minister indicated that crayfish predation can influence the demography of other species, and has been linked to trophic cascades. However, the implications of this were not quantified and assessed against the catch options being considered. The advice simply concluded that "*Although there is uncertainty, the TAC options proposed are unlikely to have any significant effect on the interdependence of stocks.*" (*National Rock Lobster Management Group 2013*).

The national scale of fisheries management is also an issue. Fish stocks are managed at the scale of quota management areas, which tend to be much larger than the Gulf. Similarly, management of the effects of fishing on the aquatic environment may be integrated at a national (EEZ) scale, leading to suboptimal outcomes at the scale of the Gulf. While there is a legal requirement to consider parts of the Hauraki Gulf Marine Park Act when making fisheries management decisions under the Fisheries Act, there is no requirement to give effect to the Hauraki Gulf Marine Park Act. Although MPI is represented on the Gulf Forum and is therefore involved in identifying strategic issues for the Gulf, it is not legally required to respond to those issues in its strategies, policies or decision making, and to date has not done so. Finally, priorities simply differ, and the weighting given to the outcomes sought by the Forum tend to be lower than those given to other fisheries outcomes.

Central to the Hauraki Gulf Marine Park Act is the concept of integrated management that allows for conservation and development. However, integration is currently approached on a case by case basis rather than across uses and values. For example, integrated approaches to managing the impacts of fisheries are provided by the revised National Plans of Action (2013) for sharks

17. Such as the proxies used for crayfish and scallops.

and seabirds, which were jointly developed by central government agencies (*Ministry for Primary Industries 2013i, h*). Integration of fisheries and aquaculture is addressed through legislative provisions that include considering the effects of proposed aquaculture developments on fishing, and the potential for compensation where commercial fishing for QMS stocks is affected. Amongst other actions in the fisheries management arena, evidence for integration is more limited. For example, the Snapper Strategy Group was formed following the review of management regime in SNA1. During 2014 and into 2015, the scope of this group's discussions will include objectives and appropriate target levels for the SNA1 fishery, research priorities and monitoring, catch allocation, and the management of the impacts of fishing on SNA1 productivity, other fish stocks, and the marine environment (*S. Halley, pers. comm.*). Membership of this group comprises the commercial, recreational, and customary fishing sectors, and the group is convened by an independent Chair. Similarly, the National Rock Lobster Management Group includes representatives of customary, recreational and commercial fishing sectors and MPI. The group's role is to work together to develop rock lobster fisheries that benefit all (fishing) sectors while ensuring sustainability (*National Rock Lobster Management Group 2014*). Neither of these groups appear to contain the expertise needed to develop a more holistic approach to the management of these fisheries. Including environmental specialists and/or marine ecologists¹⁸ could assist in moving toward integrated, ecosystem based fisheries management.

Ecosystem-based management is accepted as current best practice fisheries management (*e.g., FAO 2008*). Approaches to ecosystem-based fisheries management vary across a spectrum (*Holliday & Gautam 2005*) that ranges from:

- Single species management, with issues such as protected species, non-target species, and habitat factors also incorporated into management decisions.
- Taking into account interactions among multiple species, and incorporating both natural and man-made factors in fisheries assessments and management decisions.
- Taking a comprehensive, multiple sector approach that takes into account human activities and values across all sectors that impact the condition and sustainability of ecosystems.

Most countries, including New Zealand are situated at the lower end of this spectrum. Shifting from this position would require establishing management goals in relation to the sustainable use of an interconnected ecosystem, rather than just the (sustainable) utilisation of target species (*FAO 2008*). This approach is inherent in the Hauraki Gulf Marine Park Act, and is not dissimilar from the approach of the Fisheries Act and fisheries policy documents such as Fisheries 2030 (*i.e., the conservation of biodiversity and the function of ecological systems*). While not at odds with current legislation and policy documents, it does require a significant shift in how fisheries management is implemented. If done effectively, the adoption of an ecosystem-focused, integrated management approach would represent significant progress towards achieving the Forum's vision.

In September 2014 it was announced the National Government would, if re-elected, introduce a recreational fishing park covering areas of the inner Hauraki Gulf as part of a wider reform of marine protection legislation (<https://www.national.org.nz/news/news/media-releases/detail/2014/09/07/national-to-create-two-recreational-fishing-parks>).

7.1.2 MARINE PROTECTED AREAS

In contrast to the progress made in protecting and restoring the islands of the Gulf, little progress has been made on creating new marine protected areas. Reserves created to protect marine biodiversity currently only cover around 0.3% of the Hauraki Gulf Marine Park. Cable protection zones are also considered by some to function as “*marine protected areas*” (*Department of Conservation and Ministry of Fisheries 2011*) and cover a larger area. However, ecological research has shown that there is no detectable difference between the amount of fish in the Gulf's cable zones and other fished areas (*Shears & Usmar 2006*). This is consistent with surveillance and fisheries data that indicates cable protection zones are regularly fished (*Mike McGrath, Telecom, pers. comm., Figure 5-9*).

The primary tool used to protect general marine biodiversity is the Marine Reserves Act (1971). This Act was originally created to provide no-take reserves for scientific research. The Act is now 40 years old, and its restricted scope has hindered progress on marine protection in recent years. As such, it is widely considered to be out of date and unduly restrictive. Several attempts have been made to address this situation. For example, in 2000 the Department of Conservation released a discussion document “*Tapui Taimoana: Reviewing the Marine Reserves Act 1971*” and a marine reserves bill was developed in 2002, but not progressed. A Marine Protected Areas Policy and Implementation Plan was subsequently produced by DOC and MPI (*Department of Conservation & Ministry of Fisheries 2005*). This was intended to (in part) give effect to the New Zealand Biodiversity Strategy, and was developed within the context of three key initiatives relating to marine management: New Zealand Oceans Policy (never completed), the Strategy for Managing the Environmental Effects of Fishing (*Ministry of Fisheries 2005*), and, the New Zealand Coastal Policy Statement (NZCPS)¹⁹.

The Marine Protected Areas Policy and Implementation Plan aims to protect examples of all of New Zealand's indigenous marine biodiversity through the establishment of a comprehensive and representative network of protected areas. To achieve this, the plan promotes the application of protection standards, the classification of marine habitats and ecosystems, and the consideration of all available management tools (potentially through the application of 10 Acts, which provide varying levels of protection, and through special legislation). Specific planning of marine protected areas is expected to occur through stakeholder and community-based “*Marine Protection Planning Forums*”, supported by DOC and MPI.

Progress towards implementing the Marine Protected Areas Policy and Implementation Plan has been slow, and no new fully protected areas have been established in the Gulf since its development²⁰. However since 2011, a national coastal habitat classification and gap analysis has been completed (*Department of Conservation and Ministry of Fisheries 2011*), and the Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari has been established. The Sea Change – Tai Timu Tai Pari Stakeholder Working Group is expected to function as a Marine Protection Planning Forum for the Hauraki Gulf. DOC and MPI anticipate that the Sea Change – Tai Timu Tai Pari process will identify areas for marine protection in accordance with the planning and design principles described in the Marine Protected Areas Policy and Implementation Plan.

Nationally, the lack of central or regional planning for marine protected areas has resulted in stakeholders taking the lead. For example, two processes were initiated prior to the development of the Marine Protected Areas Policy and Implementation Plan. These have been progressed through the use of special legislation, supported by DOC. The Fiordland (Te Moana o Atawhenua) Marine Management Act 2005 emerged from the actions of a group including fishers, environmentalists,

¹⁹. The New Zealand Coastal Policy Statement is a mandatory national policy statement that is required to be produced under the RMA. It was updated in 2010.

²⁰. Note that Tawharanui Marine Park was converted to a marine reserve in 2011, but this had no material difference on the level of protection.

¹⁸. Note that marine ecologists have different and complementary skills to fisheries modellers.

tourism operators, scientists and tangata whenua. This group realised that improved marine management was necessary in the Fiordland area given increasing usage pressures. The Act established eight marine reserves in Fiordland as part of a broader management framework, with conditions that permitted certain activities within each reserve. An advisory group was also established under the Act.

The Kaikōura (Te Tai ō Marokura) Marine Management Act 2014, which came into force in early August 2014, arose in a similar way. This includes a number of spatial tools for managing the Kaikōura coast (a marine reserve, sanctuaries for selected species, and customary fishing areas), as well as specific fishing regulations, and an advisory committee.

In the Hauraki Gulf, recent marine protection initiatives have included attempts to develop a marine reserve in the waters around Great Barrier Island. The prospect of a Aotea/Great Barrier Island marine reserve has been aired for approximately 20 years, and at one stage it progressed through most phases of an ultimately unsuccessful central government process. It was recently picked up by the Great Barrier Local Board, who are now leading an initiative to investigate the creation of a marine protected area around Aotea (Great Barrier Island) based on the following principles (*Great Barrier Environment Strategy Planning Committee 2013*):

- The banning of commercial fishing within an agreed coastal area.
- Local residents retaining the legitimate right to fish for the table with restrictions to be agreed, but including the ability to catch fish to supply local commercial outlets.
- The creation of some fishing exclusion/marine reserve areas within the above context in areas to be agreed and in discussion with Ngati Rehua Ngatiwai ki Aotea.

The Friends of the Hauraki Gulf have also proposed the development of a marine reserve off the northern coast of Waiheke Island (*Friends of the Hauraki Gulf 2013*). This has been controversial, including amongst island residents, and the future of that proposal is unclear.

To date, marine protected areas in the Hauraki Gulf have generally been developed through *ad hoc* processes. The Sea Change – Tai Timu Tai Pari process provides an opportunity to grow the network of marine protected areas in a more structured and strategic manner than has previously occurred. Efforts are also being made to restore marine habitats, with early signs of success (see [Revive Our Gulf](#)). If implemented effectively, these two initiatives could deliver on the Forum's concept of a regenerating network of marine protected areas.

In September 2014 it was announced the National Government would, if re-elected, introduce a recreational fishing park covering areas of the inner Hauraki Gulf as part of a wider reform of marine protection legislation (<https://www.national.org.nz/news/news/media-releases/detail/2014/09/07/national-to-create-two-recreational-fishing-parks>).



Photo: Kingfish (*Seriola lalandi*)

7.1.3 ACTIVE LAND MANAGEMENT

The past three years has seen major changes to regulatory frameworks for resource management (including land management) being implemented, initiated or signalled at both the central and regional government levels. These have a number of implications for the issues the Forum is seeking to address in relation to active land management.

A number of the actions taken since 2011 suggest that at the national level, the current direction is for the relaxation of environmental regulations of most relevance to the Gulf (including those related to active land management). For example, the Ministry for the Environment's discussion document on improving the resource management system notes that when the RMA was drafted, it was intended that some environmental values would be given greater weight in decision-making than other matters (*Ministry for the Environment 2013*). It goes on to indicate that that this may result in an under-weighting of the positive effects of certain economic and social activities, and proposes replacing the hierarchical approach currently applied through Sections 6 and 7 of the Act with a set of principles. These principles consist of a list of matters that decision-makers would be required to "*recognise and provide for*". The following matters, which are not currently included in Sections 6 and 7 of the Act are added as principles:

- The effective functioning of the built environment including the availability of land for urban expansion, use and development.
- The efficient provision of infrastructure.

The proposal also includes deleting the following matters, which are currently listed in the RMA as those that decision makers shall have particular regard to:

- the ethic of stewardship
- the maintenance and enhancement of amenity values
- intrinsic values of ecosystems
- maintenance and enhancement of the quality of the environment
- any finite characteristics of natural and physical resources.

The adoption of the proposed changes, would reduce the level of alignment between the RMA and the objectives of the Hauraki Gulf Marine Park Act, and may impede the realisation of the Forum's vision and its work towards addressing strategic issues around land management. The objectives in the Hauraki Gulf Marine Park Act clearly seek to:

1. Protect and where appropriate enhance the life-supporting capacity of the environment, and the natural, historic, and physical resources of the Hauraki Gulf, its islands, and catchments in general, and/or which tangata whenua have a relationship.
2. Maintain and where appropriate enhance the contribution of the natural, historic, and physical resources to the social and economic wellbeing of the people and communities, and their recreation and enjoyment.

The objectives therefore establish a particularly high standard (i.e. protect and where appropriate enhance) in relation to the management of the life-supporting capacity of the environment, and the natural, historic, and physical resources (including kai moana). It is also notable the Hauraki Gulf Marine Park Act does not specify that protection and enhancement only applies to significant features. Rather, the Act recognises the interrelatedness of individual elements and promotes the use of integrated management.

It is also noted that the Hauraki Gulf Marine Park Act does not seek to directly maintain and enhance the social and economic wellbeing of people and communities. Rather, it seeks to do this

indirectly by maintaining, and where appropriate, enhancing the natural, historic, and physical resources of the Gulf that contribute to social and economic well-being. This is an important distinction, which recognises the importance of the Gulf's resources to social and economic wellbeing. This distinction is particularly relevant to major industries in the Gulf. The production and value realised from aquaculture, fisheries, and tourism all depend on maintaining the life-supporting capacity of the environment and its natural and physical resources. Land management issues, such as nutrient and sediment runoff and chemical and wastewater contamination are among the key stressors that indirectly affect those industries by diminishing marine environmental quality and values.

Recent changes to the National Policy Statement for Freshwater Management 2014 (NPSFM) also have major implications for the Gulf. Those changes established a “*National Objectives Framework*” for freshwater management and provided national “*bottom lines*” to underpin management at the regional level. Among other things, the NPSFM seeks to maintain or improve the overall quality of fresh water within a region, while also providing regional councils with the flexibility to offset deterioration in one area by improving another.

National bottom lines are provided for human and ecosystem health, but other values can also be identified by regional councils. The changes do not specifically address effects on estuaries, which are more likely to be affected by overall contaminant loads than contaminant concentrations in individual rivers and streams. However, the changes do require Regional Councils to have regard for connections between freshwater bodies and coastal water when setting freshwater objectives.

The national bottom lines for freshwater quality set a particularly low benchmark. For example, median ammonia-N concentrations at the Waikato Regional Council's river monitoring sites on the Hauraki Plains range from around 14 to 60 mg/m³ (Vant 2011). In comparison, the national bottom lines for ammonia-N concentrations are 1300 mg/m³. Higher standards can be set, but the NPSFM provides councils with the flexibility to adopt values down to the national bottom lines.

The changes to fresh water management need to be considered within a broader context of other actions taken since 2011. When considered together, the flexibility provided by the NPSFM, additional nitrogen loads provided for under the 2011 aquaculture reforms (see [aquaculture case study](#)), and the changes being proposed to the Resource Management Act could allow nutrient effects to worsen in the Firth of Thames: an area already experiencing nutrient-related oxygen sags and acidification (see [Section 6.3.1](#)). Decisions made on these matters are therefore likely to have an important influence on future environmental outcomes for the Firth, and other parts of the Gulf.

Changes made to the purpose of local government may have implications for the Hauraki Gulf, particularly in relation to stormwater and wastewater impacts. Previously the purpose of local government was “*to promote the social, economic, environmental, and cultural wellbeing of communities, in the present and for the future*”. In 2012, this became “*to meet the current and future needs of communities for good-quality local infrastructure, local public services, and performance of regulatory functions in a way that is most cost-effective for households and businesses*” (*Local Government Act 2002*). These changes could lead to lowest cost options being taken, and increase the gap between the policies and on-the-ground actions needed to shift Auckland from a “*drainage city*” (with an emphasis on providing drainage services to protect people and property from flooding, as well as making land available for property development) to a “*waterways city*” (that manages both stormwater pollution and flooding impacts to improve the ecological health of waterways and enhance urban amenity) (Brown & Farrelly 2009).

The Proposed Auckland Unitary Plan (PAUP) and Proposed Waikato Regional Policy Statement (PWRPS) both include specific provisions to give effect to the objectives of the Hauraki Gulf Marine Park Act. However, the approaches taken to reducing contaminant and sediment effects through

active land management differ between councils, and from those used in previous policies and plans.

The PWRPS adopts a standards-based approach for the management of coastal water quality. Marine waters will be classified in the Waikato Regional Coastal Plan, based on their capacity to assimilate discharges. Water quality standards will be specified for each water class, with provisions being incorporated into regional plans to ensure that water quality is maintained at or above the standards, or improved to meet the standards. It is assumed that the standards will include limits for sediment discharges to sheltered coastal areas, given that sediment is a major stressor. This approach allows the parameters of concern and associated standards to vary among water classes. However, details on the water classes and their standards, and how the standards are going to be met, are yet to be worked through. Standards designed to give effect to the objectives of the Hauraki Gulf Marine Park Act would assist in achieving the vision of the Forum and addressing strategic issues around active land management.

In general, the PAUP seeks to manage coastal water quality through a variety of means. For identified areas with degraded water quality the plan seeks to halt declining water quality and ecological integrity, and over time, improve ecosystem functioning and water quality. However, specific standards, targets or “*bottom lines*” are not provided. The methods used to achieve these aims include objectives, policies and rules for: lakes, rivers and wetlands, earthworks, on-site wastewater, other discharges of contaminants, rural production discharges, stormwater management, vegetation management, wastewater network management, and keeping stock out of the coastal area. A variety of non-regulatory measures are also proposed.

The PAUP is more specific in relation to managing land use activities and the marine environment of the Hauraki Gulf. Policy 7.4.9 indicates that the Council “*will work with agencies and stakeholders to establish an ecological bottom line, or agreed target, for managing the Gulf's natural, historic and physical resources, which will*” (among other things):

- “*provide greater certainty in sustaining the Gulf's ongoing life-supporting capacity and ecosystem services*”,
- “*assist in avoiding incremental and ongoing degradation*”, and
- “*co-ordinate cross jurisdictional integrated management and effort to achieve agreed outcomes*”.

This signals that the Council is moving towards establishing ecosystem-based environmental standards for the Gulf, and that it is seeking to integrate its actions with those of the Waikato Regional Council.

In general, the proposed changes to the PWRPS and PAUP seek to reduce the effects of land based activities on freshwater and coastal systems (including the Gulf). Both documents include objectives, which provide general direction for how those effects will be managed, but at present, specific standards, targets or “*bottom lines*” are not provided. However, both councils have signalled their intent establish these for the Hauraki Gulf, and the PAUP signals Auckland Council's intent to work across jurisdictional boundaries to achieve this outcome. Sea Change – Tai Timu Tai Pari is likely to be an instrumental process for classifying water bodies, and for establishing appropriate management goals.

7.1.4 STAKEHOLDERS

Management authorities establish and enforce the ground rules for managing the Gulf's resources, but in general it is stakeholders that utilise and affect those resources. The activities and behaviours of stakeholders therefore have a significant influence on environmental outcomes. Stakeholders fish the Gulf, and build marine farms and marinas. They produce and discharge contaminants, drop litter, and intensify landuse. They accelerate erosion by allowing stock to enter streams, farming steep, erodible land, and clearing forests. They also enjoy the Gulf's waters, beaches and islands, and invest long hours and personal earnings in protecting and enhancing the things they love. Within this complex social, cultural, and economic environment, stakeholder interests and agendas are extremely diverse and often, at face value, incompatible.

In order to generate acceptable community outcomes and greater stakeholder buy-in, participatory approaches to governance and management are becoming more common in New Zealand. These often occur in partnership with tangata whenua. For example, the changes to the National Policy Statement for Freshwater Management arose through a stakeholder-led collaborative process undertaken by the Land and Water Forum (LAWF). LAWF members include representatives from non-governmental organisations, iwi, science, and industry groups (Land and Water Forum 2011). In the marine environment, stakeholder-led initiatives have included the development of local approaches to marine management, e.g., the Fiordland (Te Moana o Atawhenua) Marine Management Act 2005 and the Kaikōura (Te Tai-o-Marokura) Marine Management Act. These processes have all led to changes in management with (actual or potential) effects at the statutory level. Stakeholders also have a significant influence on decisions about individual activities. For example, the controversial review of the management of the Snapper 1 fishery resulted in the formation of the SNA1 Strategy Group. This group comprises fishing stakeholders only, but their remit has the potential to significantly affect the interests of other stakeholders (e.g. environmentalists and divers), as well as the interests of fishers targeting other species in the Gulf.

A burden of responsibility comes with stakeholders' increased ability to influence management authorities and outcomes. Constructive participation in decision making processes requires stakeholders to move beyond position-taking and lobbying, to find common ground and accommodation of other users and values. The role is more akin to stewardship, applying the concepts of guardianship and responsibility typically associated with kaitiakitanga. Agreed outcome states and behaviours should in turn be backed by management interventions that are integrated and effective. The Sea Change – Tai Timu Tai Pari process is an opportunity for all users of the Gulf to contribute to the development of a management plan that sustains the life-supporting capacity of the Gulf, the overarching goal of the Hauraki Gulf Marine Park Act.



Photo: Rowing in the Tāmaki Estuary

8.

Discussion

New ways of thinking

Ka pu te ruha, ka hao te rangatahi – Once the old fishing net is worn, it is cast aside to make way for the new fishing net.

Photo: Jewel anemone (*Corynactis australis*)

The 2011 State of our Gulf Report highlighted the incredible transformation the Hauraki Gulf, Tikapa Moana/Te Moananui a Toi has undergone in two human lifespans, and described how that transformation was continuing in the sea and around the coast. It suggested that the Forum's vision for the Gulf was unlikely to be achieved unless bold steps were taken to reverse the ongoing decline in the condition of the Gulf. The Forum responded by identifying five strategic issues and urged agencies to collectively work toward progress in:

- creating a regenerating network of marine protected areas and island sanctuaries,
- enhancing fisheries with improving associated environmental outcomes,
- ensuring mana whenua relationships are reflected in resource management practice,
- improving land management to minimise inputs of sediments, nutrients and contaminants, and
- building the knowledge needed to work toward ecosystem-based management.

This update indicates that the pressures on the Gulf are continuing to grow. A number of the indicators examined show that improvements are being made on some issues. However, many of the environmental indicators examined show that past and present actions are continuing to degrade the environment, or suppress and maintain environmental values in a degraded state.

The past three years have seen a range of management actions being taken, both in relation to the issues identified in 2011, and in relation to other matters that affect the Gulf. The initiation of the Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari is potentially the most promising development. That process will produce a mana whenua and stakeholder-driven marine spatial plan, which is due to be delivered in September 2015. The intention is for the plan to be implemented through variations or changes to regional plans and policies, and through government departments including MPI and DOC.

Other significant changes since 2011 include amendments to the Resource Management Act, and the implementation of reforms to aquaculture management. The National Policy Statement for Freshwater Management 2011 was also implemented and has subsequently been reviewed and updated. Auckland Council released its Auckland Plan and the proposed Auckland Unitary Plan, while the Proposed Waikato Regional Policy Statement was also adopted by the Waikato Regional Council (although it remains under appeal), and the proposed Thames Coromandel District Plan was notified. Annual operational plans have been produced for inshore finfish and shellfish fisheries, and national plans of action were updated for sharks and seabirds. Conservation Management Strategies are being reviewed for Auckland and Waikato, and the creation of the Aotea Conservation Park on Great Barrier Island has been approved. Changes have also been made to the biosecurity and maritime transport acts to reduce biosecurity risks throughout the country. A wide range of other non-statutory initiatives have also been implemented or continued, which will also affect outcomes for the Gulf.

The level of integration in management decisions, and progress towards addressing the strategic issues framework adopted by the Forum has been mixed. Over the past three years, significant progress has been made in island restoration; the involvement of mana whenua in decision making, marine biosecurity, and expanding the knowledge needed to guide and support management responses. Integrated management approaches have also been developed for managing seabirds.

There is broad alignment between MPI's overarching policy for managing fisheries (*Fisheries 2030*), and the objectives of the Hauraki Gulf Marine Park Act, but is not fully reflected in management decisions made since 2011. Obstacles appear to be a continued focus of largely managing individual species rather than ecosystems, and the practice of generally defaulting to the lowest acceptable target allowed for under Section 13 of the Fisheries Act (1996). This target is regarded as

international best practice for preventing the overfishing of individual species, but it is unlikely to be optimal for maintaining important ecological functions. An ecosystem-based management approach is inherent in the Hauraki Gulf Marine Park Act, and could be strengthened as an approach under the Fisheries Act. Targets for single species could be aligned with goals defined for ecosystem state, backed by integration between fisheries and resource management.

Apart from the conversion of Tawharanui Marine Park to a marine reserve²², no new marine protected areas have been approved since 2003. However, the Great Barrier Local Board is now leading an initiative to investigate the creation of a marine protected area around Aotea/Great Barrier Island. The Friends of the Hauraki Gulf have also proposed the development of a marine reserve off the northern coast of Waiheke Island and other areas have been mooted. The Sea Change – Tai Timu Tai Pari Plan provides an opportunity to take a more structured and strategic approach to marine protected areas and restorative activities.

Major changes to regulatory frameworks for resource management (including land management) have been made or signalled over the past three years. The NPSFM has been approved and updated, aquaculture regulation has been reformed, and changes to the RMA have been proposed. These actions have occurred at a time when pressure on the Hauraki Gulf is increasing, and its environmental condition has been significantly reduced. There are concerns that overarching environmental protections may be relaxed to provide for additional use and development. The Hauraki Gulf Marine Park Act seeks to indirectly maintain and enhance the social and economic well-being of people and communities, by maintaining and where appropriate, enhancing the natural, historic, and physical resources of the Gulf. This is particularly relevant to major industries in the Gulf, such as fishing, aquaculture, and tourism, which depend on the life-supporting capacity of the environment, and the quality of its natural and physical resources. Relaxing environmental regulations would likely affect the production and value realised from these industries in the long term. Decisions made in relation to the adoption and implementation of regulatory frameworks for resource management are therefore likely to have an important influence on both environmental outcomes, and the industries that depend on good environmental quality.

The Proposed Waikato Regional Policy Statement and Proposed Auckland Unitary Plan both seek to reduce the effects of land based activities on freshwater and coastal systems (including the Gulf). The Proposed Waikato Regional Policy Statement will require standards to be established for the management of coastal water quality. The Proposed Auckland Unitary Plan also signals that Auckland Council is moving towards establishing environmental standards for the Gulf, and that it is seeking to integrate its actions with those of the Waikato Regional Council. Targets, bottom lines, and standards could assist in achieving the Forum's vision and in addressing the strategic issues it has identified. However, as highlighted above, care needs to be taken to ensure that they are set appropriately, and that bottom lines and standards do not become targets.

The activities and behaviours of stakeholders also have a significant influence on environmental outcomes. Participatory approaches to governance and management are therefore becoming more common in New Zealand. The increase in stakeholder influence on management actions brings with it an increase in their burden of responsibility. Constructive participation requires stakeholders to move beyond just being interested parties, position taking, and lobbying, and into roles more analogous to stewards, applying the concepts of guardianship and responsibility typically associated with kaitiakitanga.

22. Tawharanui Marine Park was opened in 1981 and converted to a Marine Reserve in 2011. The change resulted in the offshore boundary being straightened, but otherwise had no material effect on protection status.

9.

Conclusions

Moving forward together

*Ehara taku toa i te toa takitahi, engari he toa takitini –
It's not the work of the individual that creates success,
but the work of the collective.*

The current state of the Hauraki Gulf, Tīkapa Moana/Te Moananui a Toi reflects the effects of past and present actions, which have greatly diminished its natural values, and fundamentally altered its characteristics. However, recent improvements are being seen in some areas. Coastal nutrient concentrations have been declining in the Auckland Region, and concentrations of metal contaminants are trending down at some sites. The amount of coastal rubbish collected around Auckland has declined, and planned sewer upgrades should reduce the discharge of wastewater to Waitematā Harbour. Advances are also being made in island restoration, pest control, and the translocation of endemic species.

Nevertheless, pressures on the Gulf continue to increase as the population grows and demand for resources rises. Historic features like the extensive mussel beds that once carpeted the inner Gulf have been already lost. Other features including some of the Gulf's seabirds, resident whales, kauri, and unmodified beaches and outstanding natural landscapes could also disappear if appropriate and sustained actions are not taken to protect them. Ecologically significant features that are sensitive to water quality and bottom fishing are also being impacted.

Halting further losses and improving overall environmental quality is likely to require the adoption of a more integrated ecosystem-based management approach. It will also require more ambitious targets and standards to be set. However, both legislative and institutional obstacles exist. For instance, the RMA specifically prohibits regional councils and the Minister of Conservation from undertaking actions aimed at enhancing fisheries resources. Proposed changes to the RMA, and changes to the NPS for Freshwater Management could also hamper the achievement of ecosystem outcomes. The Fisheries Act does not prevent the use of integrated, ecosystem-based management, but institutional practices appear to be an impediment. Current fisheries practices are largely geared towards single species management, and in most cases the lowest acceptable target has become the default. Stakeholder resistance is also likely to be a factor.

The Sea Change – Tai Timu Tai Pari project is a bold undertaking where stakeholders are being tasked with preparing a Marine Spatial Plan for the Gulf, based on strong community and mana whenua engagement. It provides an opportunity to take a fresh look at the management of the Gulf, and will hopefully produce the high environmental standards and integrated outcomes required to achieve the Forum's vision. However, the outcomes of this process remain uncertain. Other, complementary actions may also be needed.

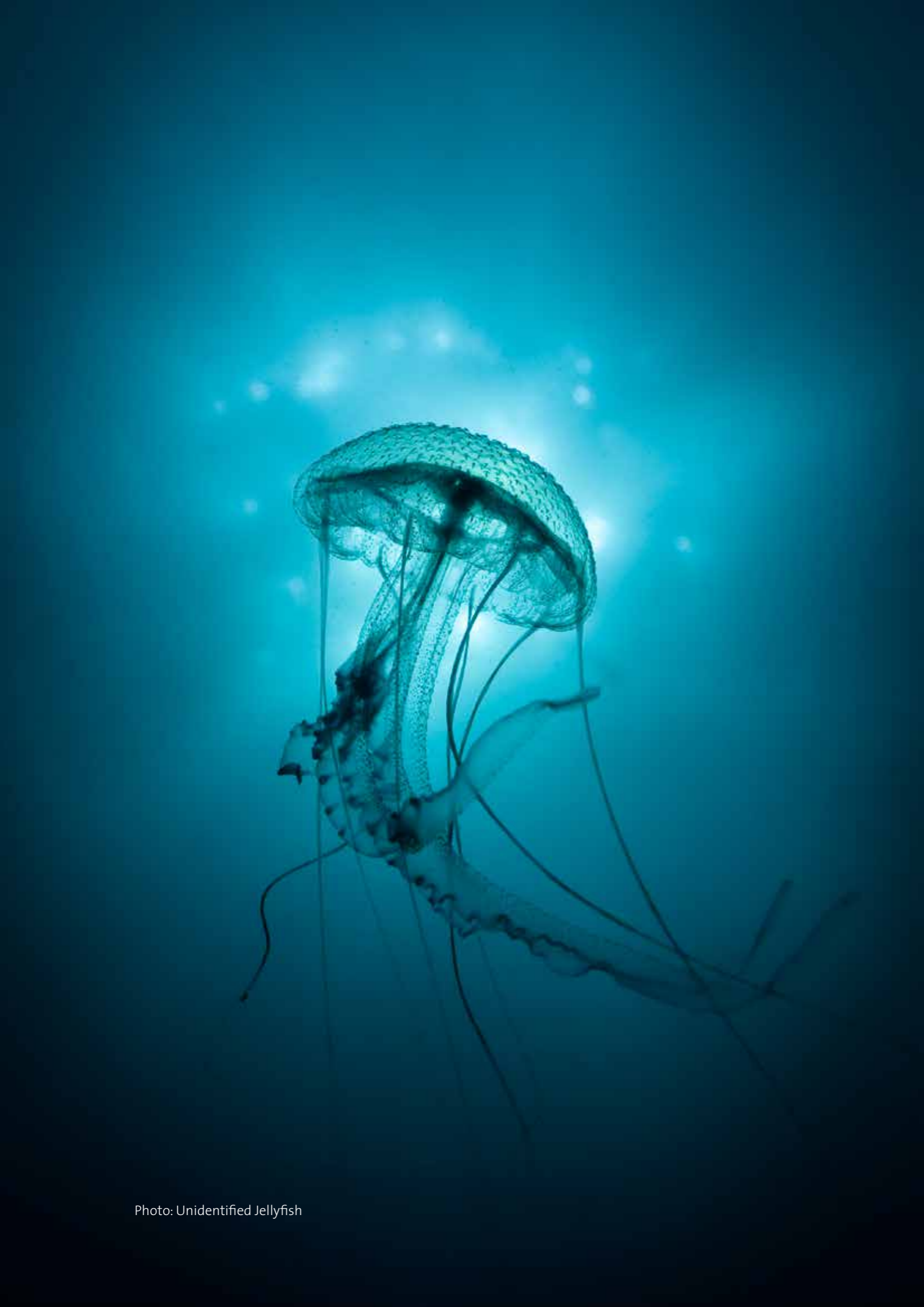


Photo: Unidentified Jellyfish

10. Glossary and abbreviations

ACE: Annual catch entitlements for commercial fishers.	Iwi: Tribe.
AMA: Aquaculture Management Areas	Kaitiaki: Guardian; ancestral, intergenerational responsibility to care for the environment.
Awa: Stream, river or creek.	LAWF: Land and Water Forum
Bo: Virgin or unfished biomass. This is the theoretical carrying capacity of the recruited or vulnerable biomass of a fish stock. In some cases, it refers to the average biomass of the stock in the years before fishing started. More generally, it is the average over recent years of the biomass that theoretically would have occurred if the stock had never been fished. Bo is often estimated from stock modelling and various percentages of it (e.g. 40% Bo) are used as biological reference points to assess the relative status of a stock.	MAF: Ministry of Agriculture and Forestry
Biological Reference Point (BREF): A benchmark against which the biomass or abundance of the stock, or the fishing mortality rate (or exploitation rate), or catch itself can be measured in order to determine stock status. These reference points can be targets, thresholds or limits depending on their intended use.	Mana whenua: Power associated with the possession and occupation of tribal land.
BMSY: The average stock biomass that results from taking an average catch of MSY under various types of harvest strategies. Often expressed in terms of spawning biomass, but may also be expressed as recruited or vulnerable biomass.	Maunga: Mountain
DOC: Department of Conservation	Maximum Sustainable Yield (MSY): Maximum sustainable yield is the largest long-term average catch or yield that can be taken from a stock under prevailing ecological and environmental conditions. It is the maximum use that a renewable resource can sustain without impairing its renewability through natural growth and reproduction.
Forum: Hauraki Gulf Forum	MfE: Ministry for the Environment
Gulf: Hauraki Gulf	MFish: Ministry of Fisheries
Hapū: Tribe, sub-tribe, kinship group.	MPI: Ministry for Primary Industries
Hard Limit: A biomass limit below which fisheries should be considered for closure.	NIWA: National Institute of Water and Atmospheric Research Ltd
HGMP: Hauraki Gulf Marine Park	NPOA: National Plans of Action
Ichthyotoxic: toxic to fish	NPSFM: National Policy Statement for Freshwater Management
ITQ: Individual transferable quota.	OsHV-1: Oyster herpes virus type 1
	PAUP: Proposed Auckland Unitary Plan
	Poito: Net floats
	Probable Effect Levels (PEL): Sediment contaminant guideline where adverse biological or environmental impacts are expected to occur frequently.
	PWRPS: Proposed Waikato Regional Policy Statement
	Quota Management Areas (QMA): QMAs are geographic areas within which fish stocks are managed in the NZ Exclusive Economic Zone.

Quota Management System (QMS): The QMS is the name given to the system by which the total commercial catch from all the main fish stocks found within New Zealand's 200 nautical mile Exclusive Economic Zone is regulated.

RMA: Resource Management Act

Rohe: Tribal boundary.

Sea Change: The Hauraki Gulf marine spatial planning process known as Sea Change – Tai Timu Tai Pari.

Soft Limit: A biomass limit below which the requirement for a formal, time-constrained rebuilding plan is triggered.

SSBo: Unfished spawning stock biomass – the total weight of sexually mature fish in the that would be present in an unfished stock.

Tangata whenua: People of the land.

Taonga: treasured or prized item; property, goods, possessions or effects.

Threshold Effect Levels (TEL): Sediment contaminant guideline associated with the onset of ecological effects.

Total allowable catch (TAC): Total Allowable Catch is the total quantity of each fishstock that can be taken by commercial, customary Māori interests, recreational fishery interests and other sources of fishing-related mortality, to ensure sustainability of that fishery in a given period, usually a year. A TAC must be set before a TACC can be set.

Total Allowable Commercial Catch (TACC):

Total Allowable Commercial Catch is the total regulated commercial catch from a stock in a given time period, usually a fishing year.

TSS: Total suspended solids

Usually resident population: The census usually resident population count is a count of all people who usually live in New Zealand (or in that area), and are present in New Zealand, on a given census night. This count excludes visitors from overseas and excludes residents who are temporarily overseas on census night. At a subnational area, this count also excludes visitors from elsewhere in New Zealand (people who do not usually live in that area), but includes residents of that area who are temporarily elsewhere in New Zealand on census night (people who usually live in that area but are absent).

WRC: Waikato Regional Council

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Under the Hauraki Gulf Marine Park Act 2000 the Hauraki Gulf Forum is required to prepare and publish, once every three years, a report on the state of the environment in the Hauraki Gulf, including information on progress towards integrated management and responses to prioritised strategic issues.

The Hauraki Gulf Forum is a statutory body charged with the promotion and facilitation of integrated management and the protection and enhancement of the Hauraki Gulf. The Forum has representation on behalf of the Ministers for Conservation, Primary Industries and Māori Affairs, elected representatives from Auckland Council (including the Great Barrier and Waiheke local boards), Waikato Regional Council, and the Waikato, Hauraki, Thames Coromandel and Matamata Piako district councils, plus six representatives of the tangata whenua of the Hauraki Gulf and its islands.

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