State of our Gulf 2017

Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi
State of the Environment Report 2017

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

Hauraki Gulf Forum
Tīkapa Moana
Te Moananui a Toi

State of our Gulf 2017

Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi
State of the Environment Report 2017

Cover: Two common dolphins by Darryl Torckler

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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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Hauraki Gulf Forum
Tīkapa Moana
Te Moananui a Toi

1. HE MIHI

I te tīmatatanga ko te kore, ko te pō, ko te ao tūroa, ka puta, ka ora ko te whai ao, ko te ao mārama.

Tīhei mauriora.

Mā wai e tō mā te whakatau mā wai e tō, tō tō i te waka i ngā hau apu tai tukituki o Tīkapakapa o Te Moana-nui-a-Toi.

Ka takoto te ara moana o Tangaroa o Hinemoana whakamautai ki te waha o Ikatere.

Whakamaua te titiro ki te aitanga a Tangaroa me te rearea!

Ka titiro whakawaho atu ki ngā ika pipiha nui o te moana, ā, ka arahina tonutia e ngā māhina ngā tātai whetū me ngā manu karoro inutai.

Ko te iho o ēnei wai e tuku atu ana i tōna ia ki ngā puna wai tapu ki ngā kōngutuawa.

Ahakoa tai timu, tai pari ko tēnei te rangi ka ū kia mau - hui tāiki e!

Tēnā koutou katoa.

Ko te katoa o ngā kupu i tuhia nei he kupu karakia, he kupu whakarite, he kupu whakanui i ngā wai tapu o mua.

Nā reira, me toka tū moana tātou katoa ki ngā wai o Tīkapakapa, tae noa ki Te Moana-nui-a-Toi.

Ki te kore tātou e mahi ngātahi, e noho hei kaitiaki mō ēnei wai, kāore e kore ka matemate haere ngā āhuatanga katoa o ēnei wāhi ātaahua.

Hei kōrero whakamutunga māku, ko ngā wāhi o Te Moana-nui-a-Toi, he taonga tuku iho.

Mei kore ēnei wāhi, kua kore rawa atu nei he ika, he manu, he kai mātaitai.

Nā reira, mā te ū ngātahi ki tēnei kaupapa, ki ēnei taonga, he oranga kei tua mō ngā reanga e haere atu ana.

Nā reira tēnā koutou katoa.

In the beginning there was only potential, then came the natural world, and then, the world of light.

Behold, the breath of life.

Who will recite the sacred chants to move the canoe forward in winds that dash the waters of Tīkapa Moana.

The widespread waters of Tangaroa and Hinemoana remain paramount.

Gazing to the descendants of Tangaroa and its beauty!

Awe-inspired, I look upon the wonders of the waters guided by the moon, the stars and the birds of the sea.

The heart of these waters run to the sacred springs.

Low tides, high tides to this day we shall protect and guard.

Greetings to you all.

The opening statements are sentiments, and thoughts that acknowledge our sacred waters.

Henceforth, it is vital for all to remain resolute regarding the waters of Te Moana-nui-a-Toi.

If we do not all work together and act as guardians for these waters, without a doubt the overall health of these stunning places will perish.

In conclusion, Tīkapa Moana and all its treasures are gifts left to us.

Without these places, there are no fish stocks, seabird life, or seafood.

By having a unified plan towards this forum we strive for sustainability for future generations.

Photo: Jack mackerel at Arid Island by Darryl Torckler

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Photo: Mangroves (mānawa) by Darryl Torckler

The Hauraki Gulf Forum has now prepared its fifth triennial Report on the State of the Environment of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, including information on the progress being made towards integrated management.

The 2017 Report shows that sufficient knowledge has now been assembled and verified to draw robust conclusions about some significant issues, sufficient to warrant prescriptive programmes of action, including statutory and regulatory initiatives, to restore the outstanding life-supporting capacity of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. It is not surprising that the report confirms some simple truths about the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, its waters, islands, catchments and life:

- Everything is connected. What happens in one place or realm affects all others. An action in one place may have distant or unforeseen effects.
- The Gulf, islands and catchments are diverse, bountiful and rich ecosystems and habitats that are naturally robust and productive.
- Almost all areas are naturally degraded and damaged by human activity, yet they retain resilience, and are demonstrably restorable.

This foreword focusses on 10 strategic issues needing political attention. They are not the only matters requiring action, but left unresolved these matters present barriers to the Hauraki Gulf Forum achieving its statutory goals.

The first points, review the 2017 state of the environment – physical and cultural. These are the fundamental building blocks of the life-supporting capacity and environmental resilience of Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi and the interrelationship between the Gulf, its islands, and catchments. The final points deal with governance machinery. They address the progress being made towards integrated management among the governing decision-makers in Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. The Forum wishes in particular to bring these matters to your attention as the Minister of Conservation and to other affected Ministers (including Fisheries, Agriculture, Crown/Māori Relations, and Environment) with a view to establishing an integrated programme of action across government and across the Crown, local government and iwi partners.

Selected key issues affecting the life-supporting capacity of Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, its islands and catchments:

1. Water quality: stormwater, sediments, nutrients, heavy metals, microbiological pathogens, micro-plastics and rubbish
2. Fish stocks, fishing activity and quaculture
3. Marine protected areas in the Gulf
4. Ocean sprawl
5. Biodiversity, habitat restoration, and species recovery
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Sewage overflow in Glendowie. Photo by Shaun Lee

1. Water quality: stormwater, sediments, nutrients, heavy metals, microbiological pathogens, micro-plastics and rubbish.

Water quality degradation is one of the most universally unmet costs of development of rural, urban and mining activity in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchments. Sediments, nutrients, heavy metals, pathogens, micro-plastics and rubbish accumulate in stormwater discharges, streams and rivers, estuaries and Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. They flow and move across time and space. Some environmental damage is permanent, or persists for generations. The Report updates measures of damage, confirms the longer term trends: points of improvement within a landscape of continuing degradation. There is a need for a more integrated, comprehensive and less piecemeal approach to regulation and performance. Refer to sections 6.2-6.9.

Water quality issues have emerged as a critical public concern during the recent election. Evidence in this report provides an up to date picture and possible solutions in Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi and its catchments.

These are long-term, cross-cutting, complex and complicated issues rather than simple or business as usual issues of great magnitude that are intergenerational in the making, but fall equally on urban and rural communities. We would appreciate some Ministerial advice on innovative options for a long-term approach to their resolution.

Tāmure (snapper) in a marine reserve. Photo by Darryl Torckler.

2. Fish stocks, fishing activity and aquaculture

Estimates suggest that Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi today supports less than 45% of the biomass present in 1925. Overharvesting of fish has had a significant adverse impact on the mauri and ecological health of Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Snapper and rock lobster populations are well below target stock levels, while kuparu (john dory), pōrae, kumukumu / pūwhaiau (gurnard) and araara (trevally) population levels are of concern.

Fishing has reduced the tāmure (snapper) population by about 80% with greatest impact on old, large fish. Snapper growth rates have also slowed. The adverse effects of removing tāmure (snapper) from the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi ecosystem are likely to be compounded by fishing methods such as bottom trawling that physically disturb the sea floor and kill or injure benthic species. Seabird mortality from tāmure (snapper) longlining is also a serious concern. These impacts alter the functioning mauri and intrinsic values of reef ecosystems within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Similarly, crayfish numbers have been reduced to about 20% of their 1945 levels. This is considered by managers to be well above the biomass necessary to sustain the maximum sustainable yield, but in fact yields are falling, and are currently at their lowest rate since 1979/1980, and are regionally the lowest in New Zealand. Refer to sections 6.1 - 6.1.9, 5.1,4 and ***figures 5.10 and 11***.

Over the last three years, fisheries managers and the Minister have responded with a number of plans to rebuild fish stocks. However, these plans have a framework and ethos of stock utilisation objectives, which increasingly appear to be at odds with wider Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi objectives and with the intention of the Hauraki Gulf Marine Park Act, especially the provisions of section 7 that recognises the national significance of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, and section 8 that sets out management imperatives for the Gulf. (See also Fisheries Act 1996 s II (2) (c)).

The new Government has made it clear that it intends to re-establish a stand-alone Ministry of Fisheries, and to change some of its statutory objectives and mechanisms. The evidence contained in this State of the Environment Report elucidates some of the issues requiring reform and the need for change. The Forum is happy to assist in any way that it can.

Minister, we support a fundamental review of Fisheries legislation to focus on transparency of decision-making and the abundance and well-being of fish and their habitats, so that the Fisheries legislation gives better effect to the objectives of the HGMPA, as was originally envisaged.

Giant boarfish come into the reefs for spawning at the Leigh Marine Reserve. Photo by Darryl Torckler.

3. Marine protected areas in the Gulf

Only 0.3 per cent of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is protected by statute (other than the Hauraki Gulf Marine Park Act). There are six marine reserves constituted under the Marine Reserves Act 1971, but only one has been created in this century, since the passage of the HGMP Act. For most of this period the 1971 Act has been under review, promising a more appropriate legal framework, but that has not yet been delivered.

This State of the Environment Report makes frequent references to the performance and condition of existing reserves, and their useful function as a benchmark against which to compare and measure conditions elsewhere in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, and to build expectations about potential recovery.

A recent survey of Aucklanders indicated that more people had visited a marine reserve in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi than had fished in its waters. Certainly there is strong public support for a more active programme of marine protected areas to be planned and implemented.

The legislative delay has become a barrier to integrated management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Can the Forum help?

Minister, we urge that you give priority to progressing new Marine protected areas legislation, and its implementation. The Forum stands ready to assist in any way it can.

Reclamation of the Waitematā Harbour. Photo by Shaun Lee.

4. Ocean sprawl

Sprawl is a somewhat pejorative word meaning 'to cause to spread out carelessly or awkwardly'. It often relates to landscape change which is sudden, unexpected and apparently unplanned or careless use of new land. It has been observed that built spaces expresses society's material and political priorities. In this context the authors of the report have appropriated the term to capture the burgeoning occupation of sea-space by built structures, especially for aquaculture.

Historically, we have observed the capacity of the Auckland Port to occupy increasingly extensive areas of seafront land and adjacent sea bed. Today the new structures sprawling out to sea are more related to shellfish and fish farming, but are no less permanent. In 2014, 2900ha of marine space had been zoned or consented for mussel and oyster farms, with 390ha for fish farms. Since then an additional 505ha has been consented or applied for, and time extensions have been granted for spat catching covering 4800ha.

There is no doubt that there is government, regional and local support and facilitation of this development, which is seen as creating revenue and jobs at every level. However there are increasing concerns that the benefits will accrue narrowly, that the loss of public sea space will have a negative effect on the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi environment, and that the development has been of a single economic objective, which is not well-meshed with other environmental and social objectives.

In addition three new marinas or marina extensions have been consented in the period 2014-17, and a dozen jetties and boat ramps approved. Clearly the building of facilities and infrastructure in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi needs careful planning to set long term standards and limits.

Infrastructure projects are a constant feature of development. Port location/expansion is a long-term issue as are marinas and marina extensions, wastewater outfalls and seafloor dredging associated with all classes of infrastructure. Some thoughts and proposals have been advanced on better managing these proposals (e.g. "Sea Change – Tai Timu, Tai Pari", refer 7 below). These issues remain as active components of the Forum's work. Refer to section 5.1.2 and 6.11.

Minister, we urge action on these matters relating to encroachments into the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi before they become the subject of conflict.

A pair of 'Nationally Critical' New Zealand fairy tern feed their chick. Photo by Susan Steedman.

5. Biodiversity, habitat restoration, and species recovery

The report highlights the national and global significance of three aspects of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi natural environment - the islands of the Gulf, the seabirds of the Gulf and the resident population of Bryde's whale. When counted together with the fish and other marine life these three aspects sheet home the unmistakable ecological strength and biodiversity values of the Gulf.

The islands are critical sanctuaries for many species. Significant progress is being made in the revegetation of the larger islands, and the restoration of functioning indigenous ecosystems, often in community-led programmes.

The islands have been a global proving ground for pest eradication techniques and endangered species recovery and translocation. Forty seven islands are now free of all mammalian pests, the latest Ahuahu / Great Mercury Island was declared pest-free in 2016. Weed control and plant diseases are an on-going task. Kauri die back disease is present on Aotea / Great Barrier Island and in pockets on the mainland. Myrtle rust is an emerging threat to all forests around the Gulf.

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi contains one of the few known resident populations of Bryde's whale in the world. The national population is estimated to be less than 250 mature individuals, with about 46 of these residing in the Gulf. Here their survival has been threatened by fatal ship strikes, but the introduction of a Hauraki Gulf Forum-inspired voluntary shipping protocol in 2013, has virtually eliminated this threat.

The striking seabird diversity of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, together with the combination of multiple predator free breeding sites on islands and on the mainland, with productive waters close to colonies, makes the Gulf a globally significant seabird diversity hotspot. This is a remarkable given the proximity to the country's largest metropolitan city. Overall, seabird populations are rebounding in the wake of considerable investment in eradications of mammalian predators from islands and coasts. However the New Zealand fairy tern, New Zealand storm petrel, black petrel and flesh-footed shearwater remain under threat, the last two mainly because of bycatch from the snapper (tāmure) longline fishery. Refer sections 6.10.1 - 6.10.3.

The Forum and the people of the Gulf are proud of the achievements of the Crown, iwi, local authorities, communities and individuals in protecting and promoting the interests of wildlife and wild indigenous habitats in the Gulf. Your support is appreciated.

Waka ama at Ōkahu Bay. Photo by Shaun Lee.

6. Tāngata whenua and treaty settlements in Tīkapa Moana/ Te Moana-nui-a-Toi /the Hauraki Gulf

Tīkapa Moana and Te Moana-nui-a-Toi are traditional names for the Hauraki Gulf. Many iwi and hapū have made this place their home, intensively occupying its shores and islands, generation after generation for many centuries. Iwi and hapū are related by whakapapa to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. It is a living, inter-connected and holistic relationship that sustains iwi and hapū and protects the essence or mauri of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. The ever-present spiritual and cultural markers left by tūpuna (ancestors), atua (gods), and taniwha (guardians) imprints this special relationship of iwi and hapū into the landscape and seascape of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Since 2010 there have been active Treaty Settlement negotiations taking place with over 25 iwi and hapū in the catchments and islands of the Hauraki Gulf. This growing engagement and negotiation, has reached a crescendo in the last three years, barely noticed by general society, but laying the ground work for dramatic shifts in the governance, participation and exercise of control and management over resources in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. These new instruments with partnerships, co-governance, co-management between the Crown, local government and iwi, at their heart, are paving the way for enhanced protection and conservation and integrated management. These settlements and the co-governance and relationship frameworks they contain, significantly change the cultural, economic and political landscape in Hauraki and Tāmaki Makaurau providing enhanced strategic focus on areas of common ground for the Crown, iwi and hapū, local government and communities while recognising the mana of iwi and hapū and the special relationship they share with their taonga.

Mention is made of the Sea Change – Tai Timu, Tai Pari initiative that culminated in the Hauraki Gulf Marine Spatial Plan. This process piloted a co-governance approach against a backdrop of live Treaty claims negotiations for at least 20 iwi and hapū of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. It enabled brave conversations around areas of tension to take place, particularly fishing and marine protected areas. Ahu Moana areas, for example, was an innovation that emerged to reflect the tikanga of iwi and hapū and local community aspirations, crosscut all the complex statutory processes and provisions for legal customary rights and practices, marine protected areas, environmental management, to integrate local near shore management. More brave conversations and innovations are needed to tackle the complex issues connected to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

There is, in 2017 an emerging sense of hope, and a restoration of mana (authority) over Tīkapa Moana/ Te Moana-nui-a-Toi. That sense is still consolidating, but it will change the cultural landscape. It has very real social, economic and political dimensions and a growing consciousness across communities that treaty settlements bring a new approach to the public management and governance of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi; a deeper identity, the reality of mauri (life force) a different intergenerational future. Long-standing grievances are being addressed and recognised providing spiritual and material uplift and an acknowledgment of the mana and kaitiaki role of iwi and hapū. That reality penetrates every detail of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, and of the Hauraki Gulf Forum's work, and so it should.

Huge changes have been made in the management and allocation of fisheries and aquaculture space to Māori in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, as detailed in the State of the Environment Report. Earlier Treaty settlements had secured Treaty-protected rights to fisheries and aquaculture at the time the quota management system was established. The Waitangi Tribunal acknowledged that Māori have commercial, recreational and customary fisheries interests and iwi and hapū in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi have reached Settlements with the Crown over their fisheries and aquaculture claims. Iwi and hapū are now major players in aquaculture and commercial fisheries. Protecting the fisheries and aquaculture Settlements that have been reached between iwi and hapū of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi and the Crown while addressing the government made changes that have remained seemingly piecemeal, ad hoc and incremental, without reference to the holistic relationship that Māori have with the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, integrated management of the Gulf, or the need to apply more than a resource utilisation ethos to the changes is a key challenge. The opportunity to address the fundamental management goals of the HGMPA, has been lost. The already complicated arrangements are made more complex and difficult. Refer to section 5.2.

The Hauraki Gulf Forum is still a long way short of achieving co-governance, something advocated by iwi and hapū consistently. But it is exploring, listening, learning, inventing and adapting to new processes, and relationships that work. This is a maturing governance sea-change. Nonetheless, issues remain where little, or no progress has been made. Those issues are primarily in the hands of Government.

Key among these issues are:

- Progressing the outstanding Harbour Treaty Settlement negotiations, which cover an, as yet, undefined area of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, but may directly affect the Forum, and wider Gulf administration
- Ensuring iwi and hapū treaty rights and interests are not adversely affected by emerging management approaches to resource use, coastal development and marine protected areas in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi
- The uncertainty around the status of the Recreational Fishing Park proposal introduced by the previous government which potentially adds another layer of complexity over the management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi
- Progressing Customary Seabed Rights applications under the Marine and Coastal Areas Act 2004. Addressing the backlog of of Taiāpure and Mahinga Mātaitai applications under the Fisheries Act 1996, as they affect the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. This should include reviewing the responsiveness of the interim closure provisions in s 186A of the Fisheries Act 1996 as a tool to better align and complement traditional rāhui (temporary closures).
- Noting the success of the Sea Change – Tai Timu, Tai Pari process and the Hauraki Gulf Marine Spatial Plan product in having the brave conversations around key tensions and finding innovative pathways forward to address the challenges facing the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

- Investment in developing a set of Māori cultural indicators aligned to the Forum's role and for the purposes of embedding meaningful input of iwi and hapū into the delivery and monitoring of the integrated management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

We would welcome the opportunity to discuss the potential for all three Ministers with Māori portfolios to play a leadership role in the Forum, and assist in addressing some issues, particularly those related to fishing, marine protected areas, and any proposals for a Recreational Park in Tīkapa Moana/ Te Moana-nui-a-Toi.

Information on progress being made towards integrated management and responses to strategic issues.

Sailing in the Gulf. Photo by Darryl Torckler.

7. Progress in achieving Integrated Management in the Gulf: "Sea Change – Tai Timu, Tai Pari : The Hauraki Gulf Marine Spatial Plan"

The Forum is very aware of the requirement in the Act to report on progress made towards integrated management of the Gulf (HGMP Act s 17 (1) (g)).

In the debates about the bill which preceded its passage through Parliament, "Integrated management" was explained as:

- Integrated across land and water (and so the scope of the Forum powers and functions include the Gulf and its catchments)
- Integrated across agencies (so it was to be a co-operative venture by all parties to the Forum)
- Integrated across statute (so there was to be common goals under all laws – RMA, land use and water, Fisheries, Conservation, Māori development, Marine Protection etc.)
- Integrated over time
- Integrated spatially (holistic and concerned with causal connections)
- Integrated to achieve equally weighted consideration of all matters set out in sections 7 and 8 of the Act

"Integrated management" was seen as an essential fix to ad hoc and ineffective decision-making. Easy gains were possible. Early gains were possible. Integrated management is a goal, the Forum was charged in section 13 on measuring progress towards achieving that goal. That task has proved difficult.

The Forum constituent parties report at each Forum meeting on their relevant achievements in relation to the objectives of the HGMPA. They have shared interests in common, but differentiated responsibilities. Those reports have covered an extensive and eclectic list of good projects. In mostly small ways they are helping to slow the degradation of the Gulf, but they are not sufficiently broad in scope or investment to arrest environmental decline "The key issue for the Gulf", the Report authors conclude, "appears to be the pace of change outstripping the ability of current management frameworks to respond effectively". They list six reasons for this: technical constraints, the commercialization of natural resources, financial implications, legislative and regulatory frameworks, institutional delays and the lack of an accepted, holistic and integrated plan for the Gulf (section 6).

About 2010, the Forum decided that an integrated plan was needed. In 2011 it published a guide to how a spatial plan could fill this role (HGF 2011: "Spatial Planning for the Gulf"). Consequently the project called Sea Change –Tai Timu, Tai Pari was established in 2013, sponsored by the Forum, Auckland Council, Waikato Regional Council, Department of Conservation and the Ministry of Primary Industries. The project was led by a governance group representing a partnership between mana whenua and local and central government agencies, having equal membership.
The writing of the Marine Spatial Plan was undertaken by a Stakeholder Working Group comprising 14 members reflecting a diverse range of interests. This Plan was published in 2016. Feedback from the public and public agencies is still coming in.

"Sea Change – Tai Timu, Tai Pari " is a major step towards demonstrating that an integrated and holistic plan is possible and capable of implementation, but it will probably fail because it has no legal status, is therefore unenforceable and given the scale of the implementation task, is probably unfundable at least under present arrangements. Formal responses from Government Departments have been slow, partly at least because of the disruption occasioned by the 2017 New Zealand elections. If the new Government sought to remedy these problems the Forum could actively contribute its learnings to a workable solution within or outside the Hauraki Gulf Marine Park Act. (section 7).

Minister, we would welcome a discussion on how the government might collaborate with the Forum in implementing the recommendations of Sea Change - Tai Timu, Tai Pari: The Hauraki Gulf Marine Spatial Plan.

Pulling up the dinghy up the beach at Aotea / Great Barrier Island. Photo by Darryl Torckler.

8. The Crown and the Forum

The Hauraki Gulf Forum was envisaged as an assembly of decision-makers, whose decisions collectively affected the Gulf. It was intended as a political/governance body, not a management one. The Crown is represented on the Forum by 'representatives' appointed by the Ministers of Conservation, Fisheries and Māori Affairs. The Forum could not be described as a meeting place where representatives worked together to solve shared problems. Rather, the officials attending appear as passive reporters of ministry actions or advocates for single issue policies.

The Crown representatives do not appear to have worked together in any integrated way. This siloed, single issue approach has militated against the achievement of integrated management. As Chair and Deputy Chair of the Forum we would like to discuss this matter, because it may be that more direct intervention at the ministerial level could lead to more constructive input from the Crown.

The situation is exacerbated by a Court ruling that the HGMP Act has conflicting objectives, and the Crown is obliged to take only very limited account of the Act. Such a finding may significantly weaken the intended effect of the Act. In fact, the Fisheries Act resource utilization objectives are directly in conflict with the objectives of the HGMPA in the Gulf. It appears to the Forum that the Crown risk management approaches for oil pipeline security, and potential oil leaks from a sunken ship may place the environment of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi in jeopardy.

We would welcome your intervention to resolve these issues. We would welcome the direct involvement of Ministers at the Forum meetings.

Arch Rock in the Mokohinau Islands. Photo by Darryl Torckler.

9. Integrated funding

The Forum is enabled to facilitate and encourage coordinated financial planning by constituent parties section 17 (1) (b). This provision has never been seen as palatable by members. We would be interested to discuss whether Government has any appetite for a joint cross-VOTE: Hauraki Gulf Marine Park fund to advance work on Gulf strategic issues. It may be possible that such a fund could stimulate local government financial allocations.

Minister, could we, through you, discuss possible new financial mechanisms for Crown work related to the Hauraki Gulf with other Ministers including the Minister of Finance?

A regatta with many boats anchored in Mahurangi Harbour. Photo by Darryl Torckler.

10. The America's Cup opportunities

The 36th Americas Cup Regatta will be held in the Gulf in 2021. The Gulf, its natural and cultural resources and their management will be showcased to the world. The Forum and the Park will be in their 21st year, ideally poised to portray the successes that have been achieved in those years, and to look forward to a restored and resilient place within the next two decades at the New Zealand bi-centennial in 2040.

The Gulf is a work in progress, but together we are working on it. Government might consider matching its investment in infrastructure and event management, with its investment in improving the state of the environment of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Minister, we are keen to explore with you and your colleagues how an 'ethical' government investment strategy in the well-being of the Gulf, in this term, might support the investment in the regatta event.

Mayor John Tregidga
Chairman, Hauraki Gulf Forum

Liane Ngamane
Deputy Chair, Hauraki Gulf Forum

WHAKARĀPOPOTOTANGA MATUA

3. EXECUTIVE SUMMARY

Photo: Trevally and kawahai feeding in the Mokohinau islands by Darryl Torckler

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi[1] has been transformed over the last two human lifespans. Native terrestrial species have been driven to extinction, native forests and vast wetlands have been cleared and replaced with pastoral land or urban development, water quality has been greatly reduced by contaminants and sediment, ecologically important marine habitats have been destroyed, fish populations have been greatly depleted, and te ao Māori (the world of Māori) has been ruptured. Damage caused by boom and bust industries, such as mining, native forest logging, and mussel dredging has left a lasting environmental legacy. These historical effects have been compounded by ongoing development, commercial activity and a growing demand for the Gulf's treasures.

Previous State of the Gulf reports (2011, 2014) found that most indicators pointed towards ongoing environmental degradation, with resources continuing to be gradually lost or suppressed. The reports called for bold, sustained, and innovative steps to be taken to improve the management of the Gulf's resources and halt progressive environmental degradation.

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

Much has happened since 2014. This report catalogues those changes, and considers progress made on integrating management and achieving the strategic outcomes sought by the Forum.

[1] Also referred to as the 'Hauraki Gulf' or 'Gulf' in this report.

TAKINGA KŌRERO HŌU
3.1 SITUATION UPDATE

NGĀ PĒHITANGA
3.1.1 PRESSURES

Cumulative pressures on the sea are mounting as the human population and commercial pressures escalate. Auckland's population has boomed over the last decade, increasing by almost a quarter of a million people between 2006 and 2016. Around 34% of New Zealanders now live in Auckland, and Auckland's population is expected to exceed two million people by 2033. Tourism has also increased with around 2.6 million people visiting Auckland in the year ended August 2017. This rapid population growth has put pressure on land and coastal resources, and exisiting urban infrastructure.

The Auckland Unitary Plan provides for population growth through a combination of intensification and urban sprawl, with 15,000 hectares of rural land being earmarked for future development. Auckland's rapid growth is putting pressure on urban infrastructure, which is struggling to meet current demand, let alone additional demand. Wastewater regularly overflows from Auckland's wastewater reticulation system into the Gulf's waterways. The proposed Central Interceptor sewer will alleviate overflows in one of the worst affected parts of Auckland, but less frequent wastewater overflows will continue for the foreseeable future. Stormwater management has improved since the 1990s, but challenges remain in older urban areas where past actions constrain management options.

Auckland's urban sprawl is not limited to the terrestrial environment, with increasing 'ocean sprawl' also occurring. This includes:

- increasing space allocated to marine farms (35ha consented since 2014 and a publicly notified application for a 470ha mussel farm);
- construction of more marinas, boat ramps and jetties (completion of the Sandspit Marina, consent for a new marina on Waiheke, and an extenstion to Westhaven Marina);
- development of port facilities, with the considerations underway to potentially relocate the Port of Auckland;
- dredging of navigation channels; and,
- the construction, maintenance and restoration of stormwater outfalls, water supply ponds and treatment ponds.

Auckland is also a key gateway for invasive pest species from other countries and parts of New Zealand. Invasive species pose a serious threat to the natural values of the Gulf and its economy. The combination of frequently moving vessels, people, and things, together with the sprawl of man-made structures into the ocean, means the probability of more pests arriving, establishing, and spreading is high.

Increasing numbers of residents and tourists are utilising the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi for recreation such as boating, fishing, wildlife watching and visiting nature reserves and island sanctuaries. These activities put pressure on fish stocks, can damage benthic habitats, disrupt the natural behavior of wildlife, and increase the risks of introducing and spreading pests and diseases to pest-free sanctuaries or new regions.

Utilisation of our marine and coastal resources puts large pressures on the Gulf. The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is intensively fished by commercial and recreational fishers. Snapper (tāmure) has historically been the main commercial finfish species landed, but in recent years landings of jack mackerel caught in the broader Gulf have exceeded snapper landings. Scallops (tipa), sea urchins (kina) and crayfish (kōura) are the main invertebrates targeted by commercial fishers in the Gulf. Rules govern how, where and when fishing can occur. Bottom trawling and Danish seining are prohibited from the inner Hauraki Gulf, but longlining can, and does, occur in most of the Gulf.

Agriculture is the dominant landuse in the Gulf's catchment. Stock densities and numbers tend to be relatively low in many areas, but the Hauraki Plains are among New Zealand's most intensively stocked agricultural areas. Dairy cow numbers on the Hauraki Plains have been stable since the early 2000s, averaging around 410,000 cows in the Hauraki and Matamata-Piako Districts. Forestry is also a significant landuse, with around 7% of the Gulf's catchment covered by exotic forest in 2012. Forestry reduces sediment runoff while the trees are standing, but exacerbates erosion potential when they are harvested. Mature or regenerating native forest covered around 27% of the catchment in 2012.

Climate change throughout the 21st century is likely to compound the effects of existing stressors. The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is expected to become warmer, more acidic and more susceptible to invasive species from warmer regions. Rising sea levels and an increased frequency of ex-tropical storms is predicted to increase coastal inundation, flooding, erosion and catchment sediment loads.

3.1.2 TĀNGATA WHENUA

There have been significant developments for mana whenua since 2014. Mana whenua played a significant role in the development of Sea Change – Tai Timu, Tai Pari, the Hauraki Gulf Marine Spatial Plan, and greater recognition has been provided through the provisions of the Auckland Unitary Plan and Waikato Regional Policy Statement. Seventeen applications have been lodged for protected customary rights and customary title within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, which if successful, would provide mana whenua groups with a much greater say on the management of the areas covered. In addition, progress has been made on over 13 treaty settlements with the Crown's commitment to future harbour negotiations, and New Space Regional Aquaculture Agreements have been entered between the Crown and iwi.

The Māori economy continued to be built around the Gulf's natural resources. Asset transfers have added value to the existing commercial power that mana whenua have within the fisheries and aquaculture industry. Māori involvement in tourism is also increasing. Recent examples include the establishment of a mana whenua led annual Tāmaki Herenga Waka Festival in 2015 and the establishment of Te Herenga Guided Walks on Motutapu and Rangitoto Islands.

There are still no established mātaitai reserves or taiāpure established, and only one rāhui aligned to section 186 currently in place within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Given the first applications for mātaitai reserves or taiāpure were lodged in the late 1990's, it is not clear what the barriers are for customary management, provided for by legislation, being realised.

The lack of Māori cultural indicators is still a significant gap in the ability for mana whenua to provide meaningful input on the delivery of integrated management for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

MAHI WHAKAHAERE
3.1.3 MANAGEMENT

National and regional management frameworks have been evolving. Significant developments over the past three years, have included:

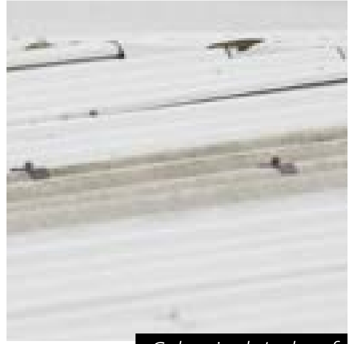
- the release of New Zealand's first marine spatial plan (Sea Change – Tai Timu, Tai Pari, the Hauraki Gulf Marine Spatial Plan);
- the adoption (of most) of the Auckland Unitary Plan;
- progress on the New Zealand Policy Statement for Freshwater Management;
- the adoption of the Snapper (SNA1) Management Plan, and changes to management frameworks for the Coromandel scallop fishery;
- release of the National Policy Statement Urban Development Capacity, and a National Environmental Standard on the harvesting of production forests (effective in 2018);
- a review of New Zealand's fisheries management by the Ministry for Primary Industries (MPI).

TAKINGA KŌRERO Ā-TAIAO HŌU
3.2 ENVIRONMENTAL UPDATE

Eleven key environmental indicators have been used to assess the state of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. These are: fishing; toxic chemicals; sediment and benthic health; mangroves; nutrients; microbiological contamination; non-indigenous marine species; harmful algae, pathogens and mass mortalties; maintenance and recovery of biodiversity; litter; and, coastal development.

Commercial fishing boat. Photo by Shaun Lee.

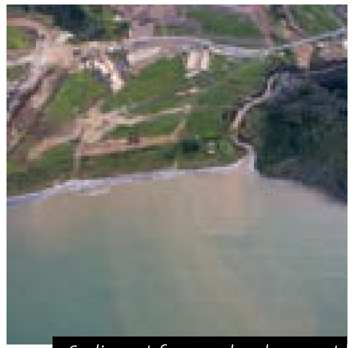
Fishing occurs in most parts of the Gulf and has one of the greatest influences on the marine ecosystem. Of the top 15 finfish stocks caught in the Gulf, only four are at or above their target levels (kahawai, albacore tuna, baracoutta and gurnard). Snapper are overfished, john dory is 'about as likely as not' below its soft limit, and the status of the nine remaining species (relative to their target levels) is unknown. Commercial crayfish catch rates in the CRA2 stock (which includes the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi) have been declining since 2007, and catch rates are now at their lowest levels since the 1979-1980 fishing year. A recently discovered, large scallop bed has collapsed after 3-4 years of fishing pressure. Bottom trawling, scallop dredging and other methods that disturb the seabed have continued, but around 23% fewer bottom trawls and 40% fewer scallop dredge tows were carried out in the latest 3-year period. High resolution data on where Danish seining occurs has only recently been collected. It shows that MPI have been allowing Danish seining to occur in areas where regulations specify it is not permitted[2]. MPI are getting a legal opinion to determine whether the area in question was correctly specified in the regulations. Threatened seabirds also continue to be caught by the fishing industry, with little change in the total number captured in the most recent three years of data (2011-2013).



Galvanised steel roof. Photo by Shaun Lee.

Toxic chemicals, such as heavy metals, affect urban estuaries in Auckland and the coast in 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 Tāmaki Inlet and Waitematā Harbour. Long-term trend analyses of 51 Auckland sites showed that significant reductions in lead, copper and zinc occurred at 25%, 31% and 8% of sites, respectively, while significant increases in lead, copper and zinc occurred at 6%, 14% and 14% of sites, respectively. Insufficient data is available to assess trends at Waikato sites.

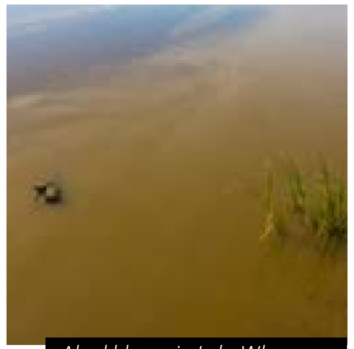
[2] Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986.


Sediment from a development near Ōkura Estuary. Photo by Geoff Reid

Sediment is a serious environmental contaminant, particularly in estuaries and nearshore areas of the inner Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Modern sediment accumulation rates in the Gulf are typically greater than natural sedimentation rates. The Firth of Thames has been particularly impacted. Dredging and sedimentation led to a 'step-change' in the ecological functions and values of the Firth, with extensive shellfish beds (mussels and oysters) being replaced by muddy sediments containing a persistent mud-tolerant community of species. Regular monitoring of benthic communities shows that sediment-related ecological effects are also occurring at other sites scattered around the Gulf (although not all ecological changes are related to sediment). Total suspended sediment concentrations have not changed at the majority of the 21 monitored Auckland sites over the past 10 years. Three sites showed worsening trends and four sites had improving trends (comparable data is not available for sites in the Waikato region).


Mangroves. Photo by Darryl Torckler.

Mangrove expansion is a natural response to sedimentation. Long-term increases in mangrove cover have been observed in the Gulf's estuaries, but clearances are now reversing those trends in some areas. Since the 2014 report, nearly 11 hectares of mangroves have been removed from Whangamatā, and nearly 18 hectares were removed from Tairua. Minor clearances have also occurred in several other areas. However, there is little evidence that mangrove removal facilitates the return of sandy sediments and associated communities.


Algal bloom in Lake Whangape Photo by Shaun Lee.

Nutrients can compound the effects of sedimentation. Greatest nutrient inputs to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi come from land uses associated with dairy farming on the Hauraki Plains. Estimated leaching rates of agricultural nitrate from the Hauraki Plains, and modelled concentrations of total nitrogen and total phosphorus in Hauraki rivers are estimated to be amongst the highest in the country. However, improvements in the treatment of sewage, industrial wastewater, and dairy shed effluent have resulted in decreases in the combined nitrogen and phosphorus loads from rivers on the Hauraki Plains over the past 24 years. Despite the decreasing loads, nitrogen concentrations in the Firth of Thames increased substantially between 1998 and 2013. The causes of increasing nitrogen concentrations in the Firth are currently being studied. It is possible that the increasing trend may be due to a decreased capacity of the Firth to process (denitrify) the nitrogen.

Coastal nutrient concentrations have generally been stable or declining in the Auckland region, but trends in ammonium-N have recently changed from declining to increasing in western sites of the Waitematā Harbour.


Sewage overflow in Glendowie. Photo by Shaun Lee.

Human health can be compromised by **microbial contamination** from wastewater discharges and animal faeces. Beach water quality monitoring showed that around half of the monitored sites exceeded the microbial action guideline for contact recreation at least once every three years in the Auckland region, while in the Waikato region, 13-29% of sites exceeded the action guideline at least once. Beaches from the North Shore, Central Waitematā, Howick and Tairua Harbour had the most frequent exceedances. Since the 2007-2010 period, the water quality has improved at 14/34 sites and worsened at 9/34 sites.


Droplet tunicate. Photo by Shaun Lee.

Non-indigenous marine pest species pose a serious threat to the entire Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. The Port of Auckland is a high-risk area in terms of its capacity to facilitate the introduction, establishment and spread of non-indigenous species. Between 2000 and 2014, at least five non-indigenous species that exhibit pest characteristics arrived in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Since 2014, two more species have arrived in the Gulf, one of which is a potential pest species (*Botrylloides giganteum*).

Consumption of shellfish contaminated with **harmful algae** can cause human illness, and the presence of harmful algae is regularly monitored by MPI and the aquaculture industry. Since 2000, there have been nine reported harmful algal blooms in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, but the only cases of illness have occurred when people ignored the warning signs. Three **mass mortality** events have been reported over the past three years, two for shellfish and one for fish. The shellfish mortalities were thought to be the result of stress, possibly caused by spawning or environmental conditions, which made the shellfish susceptible to opportunistic pathogens. The cause of the fish kill is unknown.


Dead cockle. Photo by Shaun Lee.

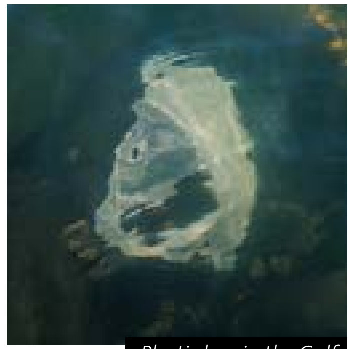
Terrestrial **biodiversity values** in the Hauraki Gulf Marine Park have rebounded as a results of pest eradication, revegetation and translocation efforts on the Gulf's islands. Significant progress is being made in re-vegetating Motuora, Motutapu, Te Motu-o-Ihenga / Motuihe), and Rotoroa Islands, with much of this work community-led. Mammalian pests are now absent from 47 islands in the Gulf, with Ahuahu / Great Mercury Island declared pest-free in 2016. Argentine ants have been successfully eradicated from Tiritiri Matangi Island after a 15-year effort. Progress is being made towards removing them from Kawau and Aotea / Great Barrier islands, and towards the eradication of Darwin's ants from Rangitito Island. Species translocations to pest-free islands have contributed to the improvement in the conservation status of five species (takahē, weka, brown kiwi, kōkako and hihi) since 2008. Challenges remain, including kauri dieback and myrtle rust, which are serious threats to native vegetation. The eradication of plague skinks from a number of islands is also deemed unfeasible at the present time.


Plague skink. Photo by Shaun Lee.

Bryde's whales are a 'Nationally Critical' species with less than 250 individuals in New Zealand. Ship strike in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is the major cause of death for New Zealand Bryde's whales, with an average of 0.9 whales killed per year between 1996 and 2013. However, the future for Bryde's whales is looking brighter following the implementation of a voluntary speed reduction to 10 knots for large ships in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Since its implementation in 2013 there has only been one recorded ship strike.

The conservation status of four seabirds (New Zealand storm petrel, New Zealand dotterel, pied shag and red-billed gulls) that reside in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi has improved since 2014. However, serious concerns remain about the long-term survival of four species that breed in the Gulf:

- the New Zealand fairy tern, which only has around 40 individuals and nine breeding pairs remaining;
- the New Zealand storm petrel, which was thought to be extinct until 2003;
- the black petrel, which has been heavily impacted by commercial fishing activity, with an estimated 392 birds captured in 2013-2014, of which, over 100 were captured by the north-eastern snapper longline fishery;
- the flesh-footed shearwater, the most common species incidentally captured by north-eastern snapper longline fishery.


Plastic bag in the Gulf. Photo by Shaun Lee.

Trends in wader species counted in the Firth of Thames between 1960 and 2016 have varied. Four species (variable oystercatcher, New Zealand dotterel, banded dotterel and spur-winged plover) have increased in number. One endemic species (South Island pied oystercatcher) and two migratory species (ruddy turnstone and red knot) display cyclic patterns, and the migratory eastern curlew shows a decreasing trend.

Man-made litter is a ubiquitous and on-going issue for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Watercare Harbour Clean-Up Trust and its precursor, the Waitematā Clean-up Trust, have been removing litter from the Waitematā Harbour and surrounding areas since 2002. Between 2014 and 2016, the Trust's staff spent around 6000 hours on clean-up activities, and together with a host of volunteers removed around 882,000m3 of rubbish. The bulk of marine litter near Auckland mainly comes from land-based sources, while fishing-related material dominates further afield.


Golf course in sand dunes. Photo by Shaun Lee.

Coastal development causes a variety of environmental impacts that tend to be cumulative and unidirectional. Increasing population and affluence is driving demand for holiday homes, recreational facilities and economic opportunity. The number of dwellings in popular holiday areas is increasing faster than the resident population.

TE ANGA WHAKAMUA KI TE WHIRIWHIRI I NGĀ MAHI WHAKAHAERE ME TE TUKU WHAKAARO KI NGĀ RAUTAKI MATUA A TE PAEPAE

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

Tangible progress has been made over the past three years on addressing the issues identified by the Forum. The settlement of treaty claims has led to a step-change for Māori. Nutrient loads from the Hauraki Plains and heavy metal concentrations in Auckland's urban estuaries remain elevated, but there are signs of improvement. The implementation of voluntary speed restrictions has brightened the outlook for Bryde's whales, and biodiversity gains are progressively being made on the islands of the Gulf.

However, pressures are rapidly mounting as the population increases – demand for facilities, infrastructure and resources is pushing development towards the sea, and fisheries indicators point to significant stress. Gains could easily be undone by new activities, or by the emerging effects of climate change.

A key issue for the Gulf is that the pace of change is outstripping the ability of current management frameworks to respond effectively. There appear to be several reasons for this:

- **Technical constraints.** Some of the issues facing the Gulf are incredibly difficult to resolve because scientific or engineering solutions are not available right now, and/or legacy actions and emerging global issues are likely to constrain what can practicably be achieved.
- **The commercialisation of natural resources.** The coast is the new frontier for development. If commercial opportunities exist, they are likely to be explored.
- **Financial implications.** The costs of resolving environmental issues can be high, both for management agencies (and by implication, the community), and the private sector.
- **Legislative and regulatory frameworks.** The issues facing the Gulf are difficult to manage. Management agencies have struggled to develop effective controls for some issues, and there are tensions between regulations such as the Resource Management Act and Fisheries Act.
- **Institutional delays.** The development and implementation of regulation can be exceedingly slow.
- **The lack of an accepted, holistic, and integrated plan for the Gulf**. The delivery of Sea Change – Tai Timu, Tai Pari Plan was a significant step towards integration. The plan was developed through the collaboration of mana whenua, a range of stakeholders and key management agencies. The outcome is a plan for managing the Gulf that provides options for moving beyond business as usual.

RAUHANGA
4. BACKGROUND

Photo: Summer dinghy trip at Aotea / Great Barrier Island by Darryl Torckler

The Hauraki Gulf Marine Park (HGMP) was established under the Hauraki Gulf Marine Park Act (2000). It includes the foreshore, seabed (excluding defence areas) and seawater on the east coast of the Auckland and Waikato regions (i.e. the Gulf), as well as Te-Hauturu-o-Toi / Little Barrier Island, the Mokohīnau 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, Waitākere City Council and Rob Fenwick. Although the HGMP does not include the entire catchment of the Gulf (*Figure 4.1*), the Act does recognise the inter-relationship between the Gulf, its islands and catchments, and therefore contains objectives related to catchment management.

The marine environment in the HGMP encompasses deep oceanic waters, shallow coastal seas, bays, inlets, harbours and 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 HGMP 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 HGMP 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 mana whenua for many generations. The Māori history of the HGMP can be traced through places like the pā (fort), kāinga (village) and garden sites of antiquity. 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 Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi includes the earliest places occupied by Māori, some more than a thousand years ago according to tribal histories. It has been intensively occupied since these earliest arrivals having sustained iwi and hapū for centuries with a complex, layered and at times, turbulent history amongst iwi and hapū for its many resources and in response to its exploitation post colonisation. The mana whenua of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, include (Sea Change Stakeholder Working Group 2017):

Ngāti Whātua;	Ngāti Tamaoho;	Ngāti Maru;
Te Uri o Hau;	Ngāi Tai ki Tāmaki;	Ngāti Tama-te-rā;
Ngāti Whātua o Ōrākei;	Te Akitai-Waiohua;	Ngāti Paoa;
Ngāti Whātua o Kaipara;	Ngāti Wai;	Ngaati Whanaunga;
Te Kawerau-a-Maki;	Ngāti Manuhiri;	Te Patukirikiri;
Ngāti Te Ata;	Ngāti Rehua-Ngāti Wai ki Aotea;	Waikato-Tainui;

Ngāti Hako;	Ngāti Pūkenga-ki-Manaia;
Ngāti Hei;	Ngāti Rāhiri Tumutumu;
Ngāti Porou ki Harataunga ki Mataora;	Ngāti Tara Tokanui.

It is acknowledged that this may not be a full representation of all mana whenua, and that many iwi have multiple hapū (sub-tribes) with ancestral areas and interests inside and outside of the Hauraki Gulf Marine Park.

The HGMP 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 HGMP for recreation and the sustenance of human health, wellbeing and spirit. The Gulf, its islands and catchments have complex inter-relationships that need to be understood and managed, to ensure that their values are maintained, protected or enhanced in perpetuity. The HGMP 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 / Tīkapa Moana / Te Moana-nui-a-Toi and its catchment.*

TE PAEPAE O TĪKAPA MOANA
4.1 THE HAURAKI GULF FORUM

In addition to establishing the park, the HGMP 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 mana whenua representatives, and representatives from the Ministry of Māori Development, MPI and DOC. Among other things the Forum is required to:

- promote and advocate integrated management and, where appropriate, the sustainable management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, its islands, and catchments;
- identify strategic issues;
- prepare and publish a report on the state of the environment in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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 Marine Park is:

Tīkapa Moana / Te Moana-nui-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 Moana-nui ā Toi, he wāhi 'e whakanuitia ana, e tiakina ana', he 'tini hoki te ika, te mātaitai me te kaimoana', he 'maha ngā tūmomo uri o Tangaroa', ā, he wāhi hāpai 'honohonotanga ā-wahi, ā tatai', hāpai 'oranga ōhanga' hoki.

The 2011 State of our Gulf report highlighted the incredible transformation the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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

The 2014 State of our Gulf report subsequently found that pressures on the Gulf remained high and were continuing to increase. Auckland's population was growing faster than any other region in the country. This was driving demand for further land development and putting pressure on ageing water and transport infrastructure, which wasn't designed to meet current requirements. Demand for holiday homes appeared to be behind a progressive coastal development on the Coromandel Peninsula, while already high levels of boat ownership were expected to increase, creating extra demand for boat ramps, marinas and moorings. Thousands of tonnes of fish were being extracted every year from the Gulf by both commercial and recreational fishers, with much of the catch caught using fishing techniques that disturb the seabed. Available information suggested that the Hauraki Plains are one of the most intensively farmed areas in the country. Nitrogen loads from the rivers draining the plains were already predicted to be high and were expected to increase out to 2020. Recent aquaculture reforms designed to enable fish farming in the Firth of Thames allowed for an additional nitrogen load that was equivalent to around a third of the load already coming from the Hauraki Plains. Applications for a further 4827ha of spat catching aquaculture space were also due to come off hold.

The report also recorded the changes being made to management frameworks. Between 2011 and 2014 changes had occurred in legislation governing resource management, aquaculture, biosecurity, and ballast water discharges, and further changes to the Resource Management Act 1991 (RMA) had been signalled. A National Policy Statement for Freshwater was implemented, and revised. National plans of action for sharks and seabirds were updated, while draft national inshore finfish and shellfish plans had been released. Total allowable catches for snapper(tāmure), crayfish(kōura) and scallops (tipa) were altered, and a Snapper 1 (SNA1) Strategy Group was established to develop a long-term plan for the management of the stock. The Auckland Plan was produced and the Proposed Auckland Unitary Plan notified. Waikato Regional Council had adopted its Regional Policy Statement, and the proposed Thames-Coromandel District Plan was notified.

Mana whenua outcomes were advancing 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. However, the 2014 State of the Gulf Report concluded that progress on management integration, and consistency with the Forum's strategic framework was mixed.

TĒNEI PŪRONGO
4.2 THIS REPORT

Change has continued apace over the past three years, and this update continues to track that story. The 2017 report re-examines the pressures the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi faces, updates information on the current management, knowledge and state of the Gulf, and considers progress towards improving integrated management and achieving the strategic outcomes sought by the Forum. The key environmental indicators used to assess its state, have been reported on since 2011[3] and include:

1. Fishing
2. Toxic chemicals
3. Sediment and benthic health.
4. Mangroves[4]
5. Nutrients
6. Microbiological contamination (pathogens)
7. Non-indigenous marine species
8. Harmful algae, pathogens and mass mortalities
9. Marine litter
10. Maintenance and recovery of biodiversity
11. 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 regulatory frameworks and management agencies.

[3] Note that further details on the selection of these indicators are provided in the 2011 State of Our Gulf report (Hauraki Gulf Forum 2011).

[4] Mangroves used to be reported under the sediment indicator.

HE TĀTARITANGA
5. SITUATION ANALYSIS

Combined influences and actions

Nāku te rourou, nāu te rourou, ka ora ai te iwi

With your basket and my basket the people will be sustained

Photo: White-faced storm petrel foraging off Aotea / Great Barrier Island by Darryl Torckler

NGĀ PĒHITANGA INĀIANEI ME ŌNA TAHURI KĒTANGA
5.1 CURRENT AND CHANGING PRESSURES

The Hauraki Gulf's population is large and rapidly growing. In 2013, around 34% of New Zealand's population (1.6 million people) lived in Auckland. Between 2006 and 2016 the region's population increased by 18%, adding almost a quarter of a million people. Auckland's population is expected to reach 2.1 million by 2033.

Population growth is driving demand for urban development, leading to urban sprawl and intensification. An additional 813ha of greenfield land was converted for urban use, and 123ha of new roads built between 2013 and 2016. The Auckland Unitary Plan provides for 15,000ha of rural land for future urbanisation, with the potential to accommodate approximately 137,000 dwellings.

More modest levels of development have occurred on the Coromandel Peninsula over the past three years. Demand for holiday homes is a key driver for development of that area. Similar numbers of occupied and unoccupied dwellings occur on the peninsula, which is well above the national average of 10% of dwellings being unoccupied.

Population growth and development are putting pressure on urban infrastructure. Watercare Services already manage around 8,000km of wastewater pipes, 18 wastewater treatment plants and about 420,000 wastewater connections. Auckland Council manages around 6,000km of stormwater pipes, 20,000km of streams, 150,000 manholes and 370 ponds and wetlands. Key infrastructure needs to be upgraded to meet current demand, let alone the additional demand created by population growth. The cost of providing new infrastructure to service Auckland's greenfield areas alone is estimated to be $20 billion over the next 30 years.

Wastewater regularly overflows from Auckland's wastewater reticulation system into the Gulf's waterways. 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 for the foreseeable future. Data on overflows from wastewater networks to waterways on the Coromandel Peninsula are not available.

Stormwater management has improved since the 1990s, but challenges remain in older urban areas where past actions constrain management options. The key stormwater contaminants are copper, lead and zinc. Copper loads are predicted to remain fairly stable or slowly increase in the foreseeable future. Lead loads declined markedly after lead was banned as a fuel additive. Zinc loads are predicted to initially decline rapidly as galvanised steel roofs reach the end of their lives and are replaced, and then slowly increase.

Aggregates are required to support urban development. Sand is mined from northern parts of the Gulf and rock is quarried for local construction on populated islands. Quarrying of red chert for over a century has ravaged Karamurau Island, mirroring impacts on Auckland's volcanic cones.

Development is increasingly sprawling out into the coast. In 2014, 2900ha of marine space had been zoned or consented for mussel and oyster farms, with a further 390ha zoned for fish farms. Since 2014, an additional 35ha of space has been consented for mussel and oyster farming, and a resource consent application for a 470ha mussel farm has been publicly notified. Time extensions have been provided for processing applications for 4800ha of spat catching space.

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi contains one of New Zealand's busiest ports. It has been progressively developed on reclaimed land since the 1800s. Dredging is also required to maintain navigation channels and berthing depths. Port development is reaching the limits of environmental capacity and public acceptability. A 'Consensus Working Group' that was established to consider the future of the port recommended that the port's freight operations are relocated, with one alternative being the Firth of Thames.

Demand for amenities that support activities carried out in the Gulf is already high and increasing. Past estimates indicate that: at least 11,000 yachts and launches; between 2,500 and 2,800 personal water craft; and, 75,000 small craft use the Gulf. In 2014, the Gulf contained 19 marinas, with around 49% of New Zealand's 12,918 marina berths located in the Auckland region. Since 2014, consent has been granted for a new marina at Kennedy Point, Waiheke; 66 new marina berths and an extension to a floating berth at Westhaven; at least twelve new private jetties or boat ramps; and, a new ramp at Kawakawa Bay. Sandspit Marina has also been completed. An application for a new marina in Mātiatia Bay, Waiheke was declined.

Between 1994 and 2012, 34 consents were issued for maintenance dredging and eight consents were issued for capital dredging in the Auckland region. Dredging was carried out to provide access and safe navigation for the shipping, defence, fishing, aquaculture and recreational sectors to their respective facilities. Other drivers for dredging included the construction, maintenance and restoration of stormwater outfalls, water supply ponds and treatment ponds; to alleviate flooding or divert stormwater flows; and, to allow communities to gain or maintain access to the ocean for recreational benefits. Dredging also occurs in Tairua, Whitianga, Whangamatā and elsewhere on Coromandel Peninsula, but a published breakdown is not available for those areas.

Farming is the leading landuse in the Hauraki Gulf catchment, with stock numbers dominated by dairy cattle. The Hauraki Plains are among New Zealand's most intensively stocked areas, but stock densities and numbers tend to be relatively low in other parts of the Hauraki Gulf catchment. The number of dairy cows on the Hauraki Plains grew over the last century, peaking at an annual average of around 410,000 cows in the Hauraki and Matamata-Piako Districts between 2001-02 and 2015-16.

Exotic forests are scattered throughout the catchment, with larger plantations mostly occurring on steeper land. Sediment runoff is expected to be low in standing forests, but erosion potential increases when forests are harvested. Data from 2012 shows that around 10% of the exotic forest in the Gulf's had been recently harvested.

Fishing affects the entire Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. It is New Zealand's most intensively recreationally-fished area. Around 75 finfish species are caught commercially in the Gulf. Snapper (tāmure) has historically been the main commercial finfish species landed, but in recent years, landings of Jack mackerel caught in the broader Gulf have exceeded snapper landings. Scallops, sea urchins and crayfish are the main invertebrates targeted by commercial fishers. Recreational catches are significant with estimated landings close to commercial landings for species such as snapper.

Rules govern how, where and when fishing can occur. Bottom trawling and Danish seining are prohibited from the inner Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, but longlining can, and does, occur in most of the Gulf. Recreational effort is mostly confined to nearshore areas. An error in the Ministry of Primary Industries application of the Danish seining regulations has allowed this method to be used in some areas where it is prohibited.

The Gulf's six marine reserves only protect around 0.3% of the Gulf, and only one new reserve has been created since the HGMP Act was enacted. Cable protection zones prevent fishing in around 4.9% of the Gulf, but there is little evidence of ecological recovery in the largest of those zones.

The increasing popularity of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi as a destination brings added pressure and risks. Around 2.6 million visitors arrived into Auckland for the year ended August 2017. High numbers of tourists are visiting the Gulf's islands and marine reserves, and seeking out experiences such as dolphin, whale and bird watching.

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is a gateway for invasive species, with new exotic species regularly arriving. There is a high likelihood that more exotic species will arrive in the Gulf, establish viable populations, and spread within, and beyond, the Gulf. Transmission risks are increased by: large numbers of international, national and local vessel movements; large volumes of freight; the sprawl of artificial structures into the coast; and, high numbers of people visiting the Gulf's Islands.

The effects of climate change are expected to become more pronounced throughout the 21st century, and will compound the effects of other stressors. Climate change is predicted to cause the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi to become warmer and more acidic; increase risks associated with invasive species; raise sea-levels that will exacerbate coastal inundation, flooding, and erosion; and, generate more severe ex-tropical storms that will increase potential for flooding, erosion and land-slips.

The two previous State of our Gulf reports described the special, but finite, natural values of the HGMP. They 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 population. In this section, current and changing pressures on the Gulf are considered in more detail. Ongoing pressures continue from: population growth and associated demand for housing, infrastructure and facilities; tourism, shipping, fishing and aquaculture; farming and forestry; and, a myriad of other actions and activities that are carried out in the Gulf and its catchment. These pressures are discussed below. It is also important to appreciate that the Gulf is affected by the combined and cumulative influences of all of these activities, and together with past actions, these pressures can have had a lasting impact.

TE TUPU O TE TATAURANGA Ā-IWI ME NGĀ WHAKAWHANAKE O TE NOHO Ā-TĀONE
5.1.1 POPULATION GROWTH AND URBAN DEVELOPMENT


Coastal construction at Te Arai. Photo by Shaun Lee.

There were estimated to be half a million households living on the land and islands adjacent to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi in 2013, with Auckland in particular experiencing sustained and rapid population growth. In 2016, 34.4% of New Zealand's population (1.6 million people) lived in Auckland. Between 2006 and 2016, Auckland's population increased by 241,400 or 18%. Since the last State of Environment report in 2014, the population has increased by 87,500 people.

Auckland's population is expected to reach between 2.11-2.28 million by 2033 (medium–high projections respectively) (Statistics NZ 2017b). During the year ended March 2017 there was a net gain to New Zealand's population from permanent and long-term migration that exceeded 70,000 for the first time since the early 1870s[5]. Over half of new migrants choose to initially locate in Auckland.

[5] The net migration gain is the balance of arrivals and departures.

Population growth has put significant pressure on the housing stock and driven demand for new development. The issue of urban growth was central to the Auckland Unitary Plan, which became operative (in part) in 2016. Currently, it is anticipated that approximately 400,000 new dwellings will be needed in the Auckland region over the next 30 years. The Auckland Plan sets Auckland Council's strategic direction on how this growth will be accommodated. As part of a quality compact approach to growth, the Auckland Plan anticipates that up to 70% of new dwellings will be built within the existing urban area. The Auckland Unitary Plan identifies approximately 15,000ha of rural land for future urbanisation, with the potential to accommodate approximately 137,000 dwellings (Auckland Council 2017a). It seeks to concentrate greenfield development/growth around existing centres, with the aim *"to avoid new towns and villages outside the Rural Urban Boundary to support the efficient provision of infrastructure and protection of rural and coastal environments"*[6].

Some future urban areas (within rural settlements) directly adjoin the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi coast, including developments in Maraetai, Warkworth North and Clevedon. Other large future urban areas near or at the coastline include Whenuapai, Scott Point, Riverhead, Algies Bay and Special Housing Areas at Silverdale and Red Beach. Of these, the Clevedon Waterways Precinct is particularly notable. This development was successfully re-zoned and inserted into the Unitary Plan in 2016, following a similar proposal being declined by the Environment Court in 2010. The new zone covers around 847ha of current farmland, which will be converted to commercial and residential use. The zone is immediately adjacent to the Wairoa River, and allows for a canal-based marine village of up to 350 dwellings. The development will involve declamation of land to construct a series of canals, with berths and boat moorings. If the development is unable to be connected to the Clevedon wastewater system it will provide its own wastewater system using part of the precinct as a wastewater disposal field.

New building on the Coromandel Peninsula during the last three years is modest compared with Auckland. However, the trend of building holiday homes on the Coromandel continues. The Coromandel Peninsula has a transient, seasonal population, with a large number of holiday homes. For instance, in the 2013 census, the latest for which comprehensive information is available, the resident population of the district was 26,178 whom largely lived in 12,000 occupied private dwellings. A further 11,946 (49.5%) were unoccupied at the time of the census, with most of these likely to be holiday homes. In the last three years, building consents have been issued for an additional 960 new dwellings, with just under half (460) in the Mercury Bay area. Many of these were associated with the Whitianga Waterways development, which when complete, will provide for over 1,500 dwellings (Hopper Developments 2016).

Urban infrastructure

New urban development and intensification is also adding pressure on Auckland's infrastructure. Auckland Council puts the indicative cost of new bulk infrastructure to service greenfield areas alone at $20 billion over the next 30 years (Auckland Council 2017b). Additional costs are associated with maintaining and upgrading infrastructure in existing urban areas.

Auckland's public wastewater reticulation and treatment is managed by a council controlled organisation, Watercare Services Ltd (Watercare). Watercare's regional wastewater network consists of around 8,000km of pipe, 18 wastewater treatment plants and about 420,000 wastewater connections. Like all wastewater systems, Auckland's sewer network has been deliberately designed so that in the event of heavy rain, pipe blockages or breakages, pressure is relieved by allowing wastewater to overflow to the environment through gully traps, manholes and engineered overflow points rather than backing up into homes. This reduces the potential for wastewater to create a serious public health hazard, but it also means wastewater overflows to land, streams and the coast can occur. These discharges were provided for in a 35 year, Auckland-wide, discharge consent granted to Watercare in June 2014. The consent authorises the discharge of wastewater from existing and specified future public wastewater networks. Among other things the consent requires Watercare to achieve discharge targets that include:

[6] Policy 1A.

- limiting the number of wet weather overflows from each engineered overflow point to either:
  - an average of no more than two per year; or,
  - an alternative discharge frequency as justified by a best practicable option assessment;
- limiting dry weather overflows to events caused by network failures, such as breakages, blockages, third part damage and mechanical or power failure; and,
- achieving an 80% reduction in the average annual wastewater overflow volume in the Western Isthmus (Central Interceptor) catchment by 2030.

The central Auckland isthmus remains a particularly problematic area, which includes the Western Isthmus (Central Interceptor) catchment. Around 20% of the connections within the Western Isthmus (Central Interceptor) catchment area go to the old combined stormwater and wastewater

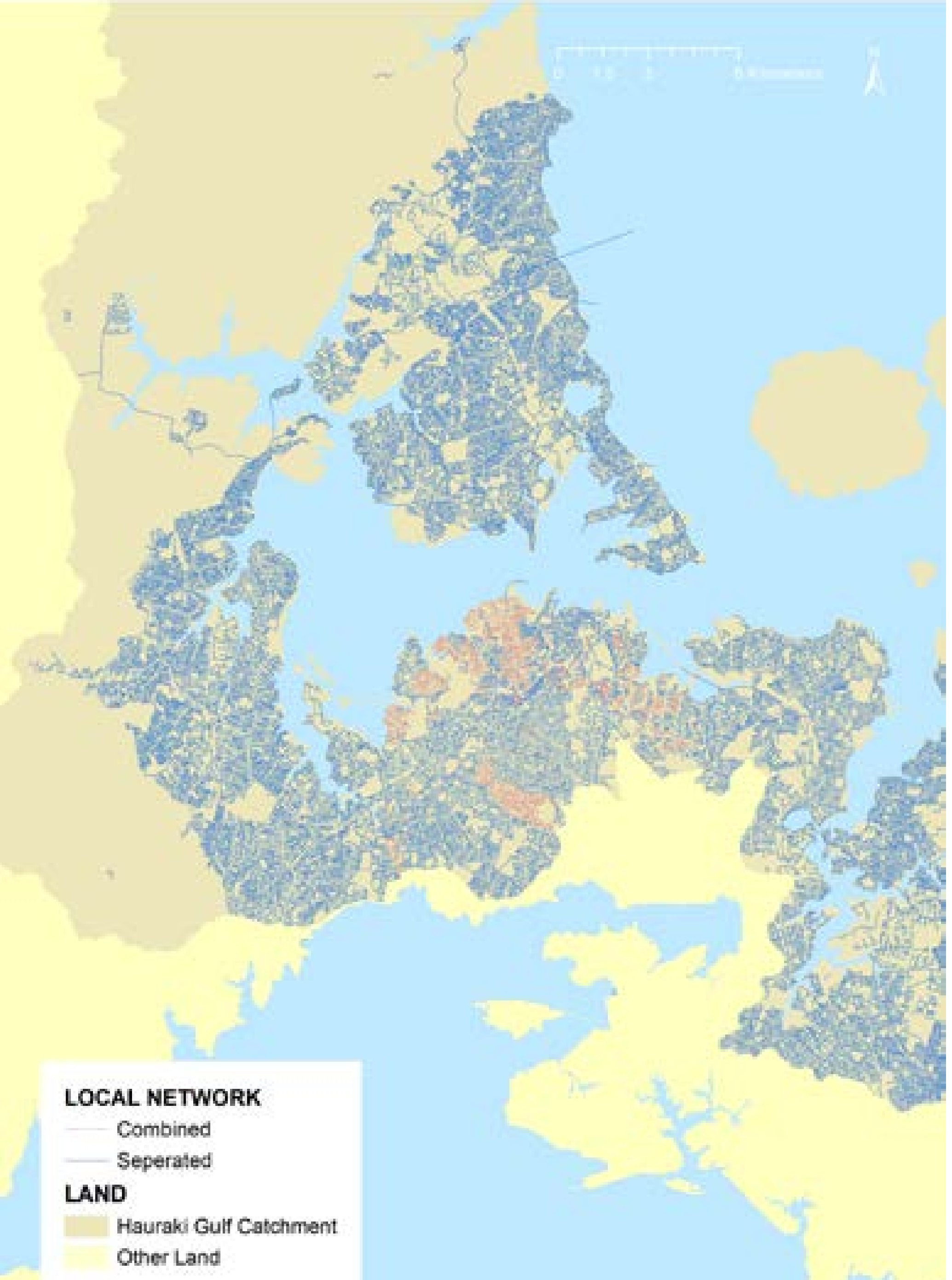


***Figure 5.1**: Central Auckland areas serviced by a combined wastewater and stormwater pipe network (i.e. both services are included in the same pipe (red)), and areas with separate wastewater pipes (blue).*

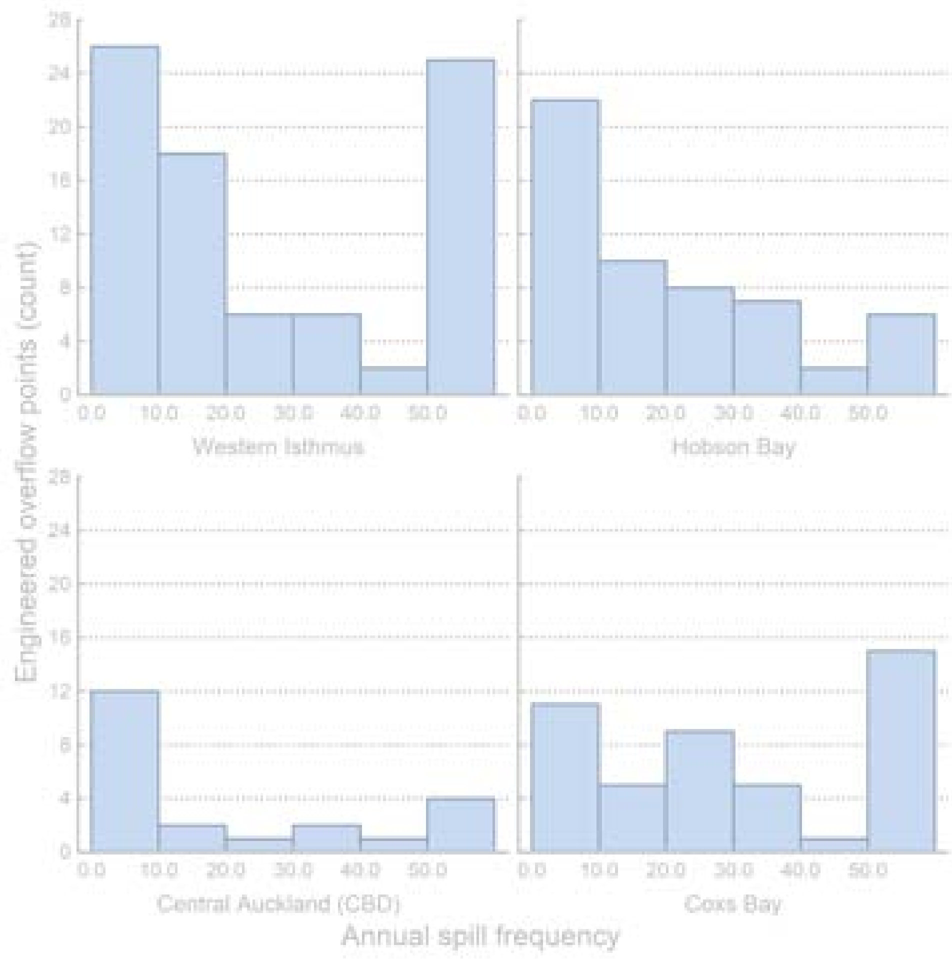


***Figure 5.2**: Modelled annual frequencies of wastewater overflows (from engineered overflow points) in Auckland's worst catchments (data provided by Watercare Services Ltd).*

pipe system, which was originally constructed for the Ōrākei outfall in the earlier part of the 20th century (see ***Figure 5.1***). The combined pipe system in this area conveys wastewater to Māngere Wastewater Treatment Plant in dry weather. 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 / Tīkapa Moana / Te Moana-nui-a-Toi. While only 20% of Watercare's engineered overflows are within this combined system area, it contains 68% of the ones that overflow more than 12 times per year, approximately 50 of which spill every time it rains (see ***Figure 5.2*** for modelled discharge frequencies from Auckland's four worst catchments).

Outfalls in the western isthmus (Central Interceptor) catchment are estimated to discharge around 2,200,000 m^3 of diluted wastewater on an average annual basis. This catchment is therefore the focus of a $1 billion initiative: the 'central interceptor' project. The initiative involves constructing a 13km tunnel between Western Springs and the Māngere Wastewater Treatment Plant, which has been designed to comply with consent requirements to reduce average annual overflow volumes in the catchment by 80%. Construction is scheduled to begin in 2019 and be completed by 2025. Other drivers for the project are to cater for Auckland's ongoing population growth and to provide resilience to at-risk sections of the sewer system. 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. This would include most of the industrial trade waste treated at the Māngere treatment plant (Watercare Services Limited 2012).

A significant number of overflows also occur in areas serviced by separate stormwater and wastewater systems. These include overflows from engineered overflow points and uncontrolled discharges to waterways (see ***Figure 5.3*** for the number, duration and location of discharges a.

b.

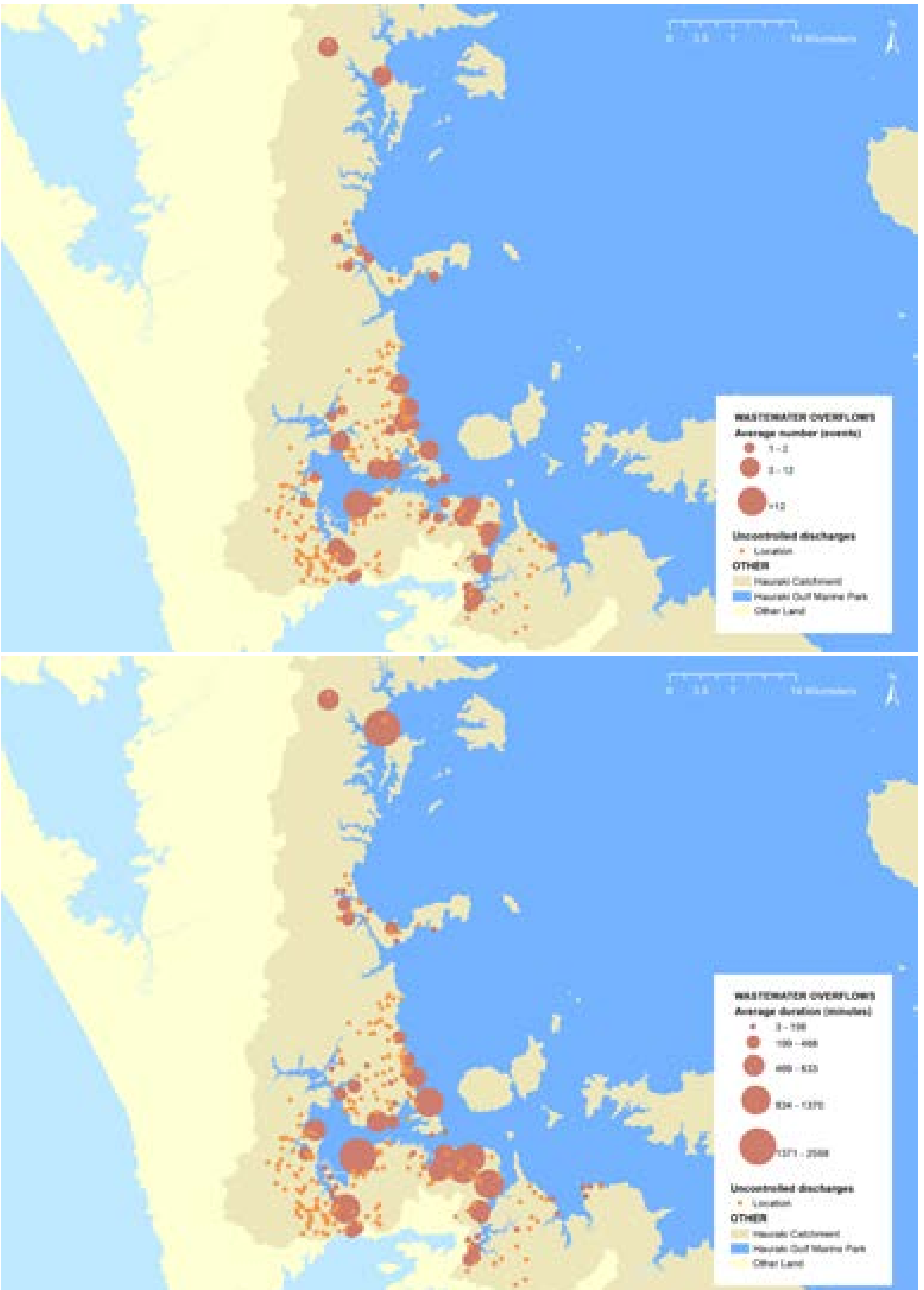


***Figure 5.3**: Bubble plots showing the a) average number, and b) average duration (minutes) of all wastewater overflows from remotely monitored, engineered overflow points that directly, or indirectly discharge to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, during a two year period from June 2014 to June 2016. The locations where uncontrolled discharges that potentially entered watercourses over the same period are also shown (orange dots). Data provided by Watercare Services Ltd.*

from remotely monitored engineered overflow points between June 2014 and June 2016, and the locations of uncontrolled discharges over the same period). Three hundred and twenty-six uncontrolled overflows that potentially entered watercourses were recorded in catchments draining to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi between June 2014 and June 2016. These were caused by: heavy rain (33% of events); pipe blockages due to fat (19%), roots (17%), rubbish (7%) or silt and foreign objects (5%); broken or damaged pipes (3%); or, other or unknown causes (14%).

Wastewater treatment plants are also having to be upgraded to cope with population growth and urban development. Since 2014, consents have been obtained for increasing the capacity and reconfiguring the Warkworth and Snells Beach plants. Similar upgrades to other plants are likely to be required in the near future.

New development has also strained local wastewater facilities in Coromandel townships, leading to planned or completed upgrades of treatment plants at Whitianga, Coromandel, Thames and Matarangi. Spikes in the populations of these (and some Auckland) areas over holiday periods can be a challenge, due to 'shock loads' on sewage treatment systems. The discharge of untreated

Sewage overflow in Glendowie. Photo by Shaun Lee

sewage into the coastal marine area (except from ships and offshore installations) is prohibited activity in the Waikato region. However, like all wastewater networks, pipe systems in townships throughout the Coromandel Peninsula contain relief points, which occasionally overflow. Between July 2016 and June 2017, 41 wet weather and 11 dry weather overflows occurred from wastewater networks on the Peninsula. These were generally reported as discharges or backflow issues to homes, properties or roads. It is not known how many (if any) of these overflows entered waterways.

Many rural settlements and coastal villages 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 tends to increase as the extent of development and housing density increases, with localised microbial contamination of some coastal areas.

Population growth and urban development is also adding pressure to Auckland's urban stormwater system. Auckland Council currently manages around $4 billion worth of stormwater assets including around 6,000km of stormwater pipes, 20,000km of streams, 150,000 manholes and 370 ponds and wetlands (Auckland Council 2015). More assets associated with new developments are also continually being vested to Council. Additional, publicly-owned stormwater assets are managed by the New Zealand Transport Authority, with many others in private ownership.

Urban stormwater run-off is a flood hazard, it erodes waterways and contains sediments, gross pollutants and chemical contaminants that commonly discharge directly or indirectly (via streams) to the coast[7]. The ingress of stormwater into the wastewater network is also a major contributor to wastewater overflows.

[7] Stormwater in parts of the central Auckland isthmus drains to ground.

Stormwater outlet at Archibald Park. Photo by Shaun Lee.

In the past 30 years, there has been increasing emphasis on understanding and mitigating the impacts of stormwater discharges. Seminal work initiated in the Auckland region in the 1990s and 2000s, raised the awareness of stormwater impacts and management throughout New Zealand (e.g. Williamson et al. 1998; Beca Carter Hollings & Ferner Ltd 1999; Auckland Regional Council 2003; Williamson & Kelly 2003; Green 2008). As a result, there has been a fundamental shift in the management of stormwater from new urban developments, which are now required to install sediment controls during earthworks phases, and stormwater devices and other measures for limiting flood flows and contaminant runoff, and maintaining stream values. Dealing with stormwater from older urban areas continues to be more challenging because legacy decisions and actions often limit contemporary management options.

The primary urban stormwater contaminants are considered to be copper, lead and zinc (although lead has become less of an issue since its removal from petrol in the 1990s). Copper loads from the urban catchments surrounding Waitematā Harbour were predicted to remain fairly stable or slowly increase out to the foreseeable future. Zinc loads were predicted to initially decline rapidly as galvanised steel roofs reach the end of their lives and are replaced, and then slowly increase (Green 2008). Patterns in other urban catchments were expected to follow similar trajectories, although actual loads would vary depending on the type and extent of development, traffic volumes and a range of other factors. Loads of urban stormwater contaminants from townships along Coromandel Peninsula are expected to be relatively low, because of the limited scale of development and low traffic volumes. However, localised contamination can still occur directly around outfalls that discharge stormwater from sources such as landfills, and commercial and industrial yards.

Under both the former Auckland Regional Council's (ARC) Air Land and Water Plan and the Auckland Unitary Plan, consents are required for discharges from urban stormwater networks. Stormwater consent applications were initially lodged by Auckland's legacy councils in 2001, but these were processed in a piecemeal fashion with a number remaining 'on hold' for around 16 years. It was not until October 2017 that Auckland Council finally lodged a region-wide stormwater network discharge consent application. The network discharge consent will supersede all other applications previously lodged, and was prepared in accordance with the relevant requirements in the Auckland Unitary Plan.

Mining and quarrying

Aggregates are required to support urban development. The construction industry prefers to source these resources locally, to reduce transport costs. Sand mining and quarrying are therefore carried out in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Both of these activities utilise non-renewable resources.

Seabed mining in the Gulf provides sand for use in the production of asphalt, concrete and other cement-based products. Sand is also used, in much lesser quantities, for landscaping, drainage systems and for beach replenishment.

In 2017, coastal permits providing for sand extraction from the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi included:

- one permit for 2,000,000m3 of sand, including shelly gravel lag, by suction dredging in the outer Pākiri area (near Te Hauturu-o-Toi / Little Barrier Island);
- three permits in the near-shore Pākiri, totalling up to 76,000m3 per year;
- one permit consenting sand extraction for beach replenishment at Waiheke Island.

These consents were granted in the early 2000s and expire between 2019 and 2023.

***Figure 5.4**: Quarrying impacts on Karamurau Island, Kawakawa Bay (red dot on the inset shows the location of the island).*

Quarrying is also carried out on the Gulf's islands to provide aggregates for local construction activities. However, one of the Gulf's small islands is unique for being almost entirely a quarry (Karamurau Island in Kawakawa Bay), and for providing a distinct aggregate product that is in limited supply (red chert or jasper, otherwise known as 'red rock'). The island has been quarried for red rock since 1908. Over that period the island's form has been significantly altered and now consists of an outer ring, with the quarry and associated infrastructure in the centre of the island (***Figure 5.4***). The quarrying of Karamurau Island mirrors Auckland's unenviable history of quarrying volcanic cones. Fifteen of the 38 volcanic cones present in 1840 had been completely removed by 2010, with a further nine being 'fiercely ravaged'. Only two of those original 38 cones remain untouched by quarrying (Hayward et al. 2011).

TE HORANGA MOANA
5.1.2 OCEAN SPRAWL

The concept of 'urban sprawl' is well-understood and relates to the global trend of towns and cities growing and sprawling out across the surrounding landscape. The term 'ocean sprawl' is a phrase used in the scientific literature (e.g. Bishop et al. 2017), to describe coastal engineering works and structures that are increasingly sprawling out into our estuaries, harbours and oceans. These include harbours, marinas, berths, coastal protection/walls and flood defence, roads and bridges, waste disposal, dredging and seabed extraction, pipelines and underwater cables, ship wrecks, aquaculture structures, shipping routes and coastal reclamations. The growing number and cumulative effects of artificial structures in the coastal environment affects marine ecosystems, landscapes, amenity values and options for future uses.

Previous State of Our Gulf reports have highlighted evidence of ocean sprawl, without framing it within that context. In this report, some of the key contributors to ocean sprawl in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi are identified and discussed.

Aquaculture

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is one of the first areas in New Zealand to develop commercial aquaculture. Development of mussel and oyster farms began in earnest in the 1970s, and the industry has grown to become one of the most significant commercial activities carried out in the Hauraki Gulf. Māori have a long history of involvement and remain major operators and investors (see section 5.2). The total production from the Hauraki Gulf marine farms was 1,198 metric tonnes of oysters in 2016, and 27,196 metric tonnes of mussels (Aquaculture NZ, pers. comm.). This equates to approximately 60% of New Zealand's oysters being farmed in the Hauraki Gulf, and 33% of the national production of mussels.

In 2014, Council data showed that 2900ha of marine space was zoned or consented for mussel and oyster farms, with a further 390ha zoned for fish farms in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi[8]. Since then, Auckland Council has consented and additional 35ha of extensions and new space for mussel and oyster farming, and spat growing operations in the Firth of Thames (Waimangō Point) and Mahurangi Harbour. A resource consent application for a 470ha mussel farm contained within a 664ha area in the western Firth of Thames was also publically notified in September 2017.

Waikato Regional Council indicate that no new space has been allocated to shellfish farming since 2014. However, applications for approximately 4,800ha of new spat catching space were due to come off hold at the end of December 2014 (see ***Figure 5.5***). Waikato Regional Council, Auckland Council and the applicants have agreed for the applications to remain on hold until future statutory planning provisions are in place.

Another relatively recent development was the allocation in 2011 of new space for the first finfish farms in the Gulf. Two finfish farming zones were established during aquaculture reforms that led to an amendment to the RMA in 1999 and the Waikato Regional Coastal Plan (***Figure 5.5***). In January 2017, WRC called for tenders seeking authorisations to apply for resource consents to undertake fish farming in 240ha of the Coromandel Marine Farming Zone. At the time of writing, tenders were being considered by the Council. If authorisations were granted, the successful applicants would have two years to apply to WRC for consent.

It is estimated that the Coromandel marine farming zone will allow for production of up to 8,000 tonnes per year (estimate based on kingfish farming). Production could realistically commence within five years of resource consent being granted (WRC, pers. comm.).

[8] Note that obtaining accurate estimates of the amount of space actually being farmed is more complicated than the data on zoned and consented space suggests, because: actual farm areas have frequently differed from consented areas; development within some consented areas and aquaculture zones is ongoing; and, spacing exists between farms within aquaculture zones. Various estimates have therefore been used for the amount of space actually being farmed, which vary in how each of these factors are accounted for. Efforts have been made over the past three years to align consented spaces with the areas that are actually farmed, but more work is required to obtain a consolidated and accurate dataset.

If the fish farming industry does become established in the Gulf, it will present a range of economic opportunities – both water and land-based. Fish farming would also create a new set of environmental issues. A key difference between oyster and mussel farming and finfish farming is that finfish require feeding. This greatly increases the nutrient loads discharged from the farms and intensifies local adverse effects on marine sea bed communities. These potential environmental effects have been provided for in the Waikato Regional Coastal Plan (see Section 5.5).

Aquaculture is earmarked as a high growth industry, with continued international demand for high quality seafood products. There is also a growth trend in high value nutraceuticals derived from mussels and other aquaculture products. Aquaculture is especially important for the Thames-Coromandel economy, with marine farming contributing up to 7.2% of the district's Gross Domestic Product (NZIER 2017). The vast majority (95%) of the Thames-Coromandel aquaculture industry is based on mussel farming, with a small quantity of oyster farming. Finfish farming will diversify the industry.

Work carried out by NZIER (2017) indicates that the expansion of both mussel and oyster production by 50% is a plausible scenario for the Thames-Coromandel District. However, this requires infrastructure to be upgraded to handle the increased volumes of produce and inputs used. This includes wharves and facilities to handle additional barge movements, and roads to handle additional truck movements. It is noatable that the industry operates across regional and district boundaries, with a significant proportion of shellfish grown in the Auckland region being processed in Thames-Coromandel. A Marine and Harbour Facilities Strategy is currently under development by Thames-Coromandel District Council (TCDC) that will prioritise and aid decision-making around such infrastructure.

***Figure 5.5**: Aquaculture in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, showing the extent of existing marine farms and zones in the eastern Tāmaki Strait, Coromandel and Firth of Thames, together with notified applications and spat catching consent applications that are currently on hold.*

Ports of Auckland

Auckland's Port occupies 77ha of reclaimed waterfront land in the Waitematā Harbour in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Its core business is the transfer of freight cargo, but the cruise industry is becoming an increasingly important component of its activities, and complimentary commercial activities are also catered for. For instance, Holcim moved its cement operations from the Port of Onehunga to the Ports of Auckland in 2015, to provide for larger ships. Holcim's silo is now located alongside the 2,700 m2 Golden Bay 'horizontal silo' that opened in 2010.

Other recent developments at the Ports of Auckland include the continuing expansion of Fergusson Terminal, which was consented in 2003. The consent granted the reclamation of approximately 9.4ha and the dredging of approximately 6 ha. Around 2.5ha of reclamation remains to complete that work, which has involved a 50 m extension northward of the main Fergusson Terminal Wharf (completed in October 2015). A new 296 m wharf extension across the north face of the Fergusson reclamation was also completed in 2017. This gives the container terminal a deep-water berth, capable of taking bigger ships, which are expected in New Zealand in future years.

Kayakers in the Waitematā Harbour. Photo by Shaun Lee.

Consent was issued in late 2014 to extend both the existing Bledisloe Wharf 'B3' and 'B2' berths. Consent for a tub berth facility, located between Bledisloe and Jellicoe wharves was also issued in late 2014. The effects of the port operations extend well beyond the docks and wharves. Ports of Auckland have deepened the access channels (including Rangitoto Channel) and berths, and has to maintain channel depths.

The growth of trade/cargo freight alongside growth of inner-city communities and increasing recreational use of the harbour has created tension between Ports of Auckland and neighbouring communities. That tension 'boiled over' with the 2015 Ports of Auckland proposal to extend Bledisloe Wharf 98 m out into the harbour. A decision by independent commissioners to process the application as 'non-notified' was appealed to the High Court by a community group 'Urban Auckland'. The court ruled that the application for expansion should have been notified, and overturned the consents.

The Consensus Working Group was subsequently established in July 2015 to develop a strategy and recommendation for the long-term future of the freight shipping and cruise industries. From the outset it was recognised that:

1. Capacity will constrain future freight and cruise demands, limiting economic growth.
2. Tension exists between development of Auckland's Central Business District and activities at the Ports of Auckland.
3. Port activities create environmental, economic, social and cultural impacts that need to be understood and addressed.

The Consensus Working Group's brief required consideration of five options, which potentially impact on activities in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi:

4. Constrain the Ports of Auckland to its current footprint.
5. Downsize Auckland's port by shifting some of the operations to another location.
6. Relocate some or all volume or activity of Auckland's port.
7. Enable growth of the Ports of Auckland in its current location.
8. Build a new port elsewhere.

The Consensus Working Group found that the existing port will not be able to accommodate anticipated long-term freight and cruise tasks within its current footprint, but noted that the timing of a move is dependent on several triggers. They are explained as follows:

- The port may move when the social, environmental, cultural, economic, urban development or other conditions indicate that moving the port is **beneficial** [sic] for the city centre, or Auckland or New Zealand;
- The port may move when expected demand growth, expected capacity growth and the time required to complete the move indicate that moving the port has become **necessary** [sic] (Consensus Working Group 2016).

The Consensus Working Group recommended a port relocation option should be established, with the current site continuing to be used for cruise ships. Two sites were identified for comprehensive investigations of their potential for future freight operations, within Manukau Harbour and the Firth of Thames. The third recommendation was to undertake regular monitoring of relocation triggers, to identify the time when a port relocation should take place. Finally, the Consensus Working Group recommended the existing port should not expand beyond its current footprint.

These recommendations, although at conceptual stage, are of relevance to the HGMP, given that one of the suggested indicative locations of a new port was in the western Firth of Thames, between Kawakawa Bay and Waimangō Point. The prospect of establishing and operating a major freight port in any new location would have significant environmental, social and cultural impacts for the new community and environment. Such a proposal would face substantial hurdles to get the necessary resource consents for the development.

Amenity and recreation facilities

The natural endowment of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is highly valued. The 2,500km long gulf coastline offers beaches, parks, open spaces and coastal access to cater for a wide range of recreational water sports and sailing, fishing, swimming, diving, festivals, picnicking, camping, island visiting and wildlife watching. The Hauraki Gulf is also an area where people retreat to for holidays, evidenced by the six times population increase in the Thames-Coromandel district over the Christmas holiday period.

A recent New Zealand-wide survey showed that 51% of New Zealanders are involved in recreational boating (Maritime New Zealand 2016). The most popular recreational vessels are power boats (47%) and kayaks (30%), with dinghies (7%), sailboats (6%) and jet skis (5%) being other significant preferences. In 2012, there were estimated to be at least 11,000 yachts and launches, between 2,500 and 2,800 personal water craft, and 75,000 small craft such as dinghies, canoes, lasers, optimists and windsurfers in the Hauraki Gulf (Leersynder 2012; Hauraki Gulf Forum 2014). Fifteen marinas were located in the Auckland region (including two dedicated dry stack facilities), providing a combined total of 6,377 berths. Four marinas are located in the Waikato Region. Around 49% of the 12,918 marina berths in New Zealand were in the Auckland region. There were also estimated to be around 5,190 swing and pile moorings in the Auckland and Waikato Regions. Between 2011 and 2041, the number of yachts and launches in the Auckland region is predicted to increase by 1600, and the number of trailer boats is predicted to increase by 52,000.

Boat ramp at Ōkahu Bay. Photo by Shaun Lee.

Increasing boat numbers are fuelling pressure for the development of boat ramps, moorings and marinas. New Zealand's hosting of the 36th America's Cup is also likely to be a driver for the development of additional facilities over the next few years. Sandspit Marina was completed in July 2016. It has 131 berths ranging in size from 12-18 m and caters for the members of the Sandspit Yacht Club and visitors. The Clevedon Waterways Precinct was also zoned for in the Auckland Unitary Plan. It will provide an additional 300 berths in a new waterways development.

Since 2014, consent has also been given for:

- a 186 berth floating marina at Kennedy Point, Waiheke after a hearing of an Auckland Council delegated independent panel of five commissioners
- 66 new marina berths at Westhaven by Panuku Development
- the extension of the existing floating pontoon in Westhaven Marina to cater for more vessels
- at least twelve new private jetties or boat ramps, one kayak landing facility, and a new ramp for a boat club in Kawakawa Bay.

The application for a 112 berth marina in Mātiatia Bay, next to the passenger ferry terminal on Waiheke Island was rejected by the Environment Court in 2015. The application proved divisive for the Waiheke community, and was a contentious issue for a number of years. An opposition group called 'Direction Mātiatia' raised funds from the community to challenge the application.

Dredging

Dredging is required by the shipping, defence, fishing, aquaculture and recreational sectors to provide access and safe navigation to their respective facilities. Other drivers for dredging in the Gulf include:

- the construction, maintenance and restoration of stormwater outfalls, water supply ponds (e.g. Ōtara Lake), and treatment ponds
- the alleviation of flooding or diversion of stormwater flows which cause erosion
- to allow communities to gain or maintain access the ocean for recreational benefits.

Sand sifting sea star. Photo by Shaun Lee.

A 2012 review of dredging activities in the Auckland region identified 42 coastal dredging consents issued between 1994 and 2012 (Kelly & Faire 2012). These included:

- 34 consents for maintenance dredging
- 8 consents for capital dredging.

These consents were mainly associated with the following activities:

- coastal management related to activities such as the clearance of stormwater pipes or the redistribution of sand within a beach (20% of consents)
- to provide for recreational boating by allowing safe access to marinas, boat ramps or yacht clubs (32% of consents)
- to provide for the operation of regionally important infrastructure such as ports, ferry terminals, Māngere Wastewater Treatment Plant (which is outside the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi), defence facilities and Ōtara power station (25% of consents)
- to provide access to structures and remove contaminated sediment (20% of consents).

Waikato Regional Council have issued 13 capital or maintenance dredging consents since 2006, that provide for marina construction and the maintainance of access to marinas, wharves and/or boat ramps in Whitianga, Whangamatā, Te Kōuma, Waikawau, Tairua and Matarangi.

5.1.3 TE MAHI Ā-TUAWHENUA RURAL LAND USE

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment is dominated by grassed land (predominantly high producing grasslands), particularly on the Hauraki Plains (Landcare Research 2015, ***Figure 4.6***). In 2012, high and low producing grassland covered 59% of the overall catchment (based on data from the land cover database LCDB 4.1; Landcare Research 2015). In comparison:

- built-up areas (i.e. settlements, towns, and cities) only covered 4% of the catchment, with an additional 1% covered by urban open space;
- short rotation and other perennial crops, orchards, and vineyards covered 1% of the catchment;
- standing and recently harvested exotic forest covered 7%;
- native forest and scrub covered 27%.

Dairying is the main farming activity, with overall stock numbers dominated by dairy cattle (Statistics NZ, unpub.data from 2012 census, ***Figure 5.7***)[9]. Dairy cows on the Hauraki Plains grew in number over the last century (Cameron & Bell 2008), to produce one of New Zealand's most intensively stocked areas (StatsNZ unpublished data, ***Figure 5.8***). Numbers peaked in the Hauraki and Matamata-Piako Districts in the 2000s. Since 2001-2002, an annual average of 410,000 cows[10] has been reported for the Hauraki and Matamata-Piako Districts (based on LIC and Dairy NZ annual dairy statistics reports). Directly comparable temporal data is not available for areas in the South Waikato District draining to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, but Statistics NZ data indicates that the Putaruru and Tirau wards (which substantially overlap the Gulf catchment) had around 60,600 dairy cows at the time of the 2012 census. Overall stock densities and numbers tend to be relatively low in other parts of the Hauraki Gulf catchment, where other landuses are more prominent and land tends to be steeper.

Exotic forests are scattered throughout the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment, with larger plantations mostly occurring in steeper areas along the Coromandel, Kaimai, Hunua, and Whitford Ranges, and in hill country from Riverhead north. Exceptions include Pākiri Forest, which is located in dune land directly adjoining the coast, and a sizable plantation on the southern end of Great Mercury Island. Sediment runoff is expected to be low in standing forests, but erosion and sediment runoff rates can be high during and after harvesting. In 2012, around 89% of the exotic forest in the catchment was standing, while 11% had recently been harvested (Landcare Research 2015).

The larger islands of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi including Aotea / Great Barrier Island, Te Hauturu-o-Toi / Little Barrier Island, Rangitoto, Kawau and Waiheke have moderate to high levels of mature or regenerating native forest cover (***Figure 5.6***). Coromandel Peninsula and the Kaimai Ranges are also extensively vegetated, with much of the area recovering from the intensive logging and mining activity, which dominated the Coromandel economy in the 19th and early 20th centuries. About 400ha of mature kauri trees still exist on the peninsula, located in areas too difficult to log during the timber boom. The Coromandel Forest Park (73,000 ha) was created in 1971 to promote public recreation and conserve surviving native forest. Significant tracts of native forest also occur in the Hunua Ranges, the northern and eastern margins of which are within the Gulf's catchment.

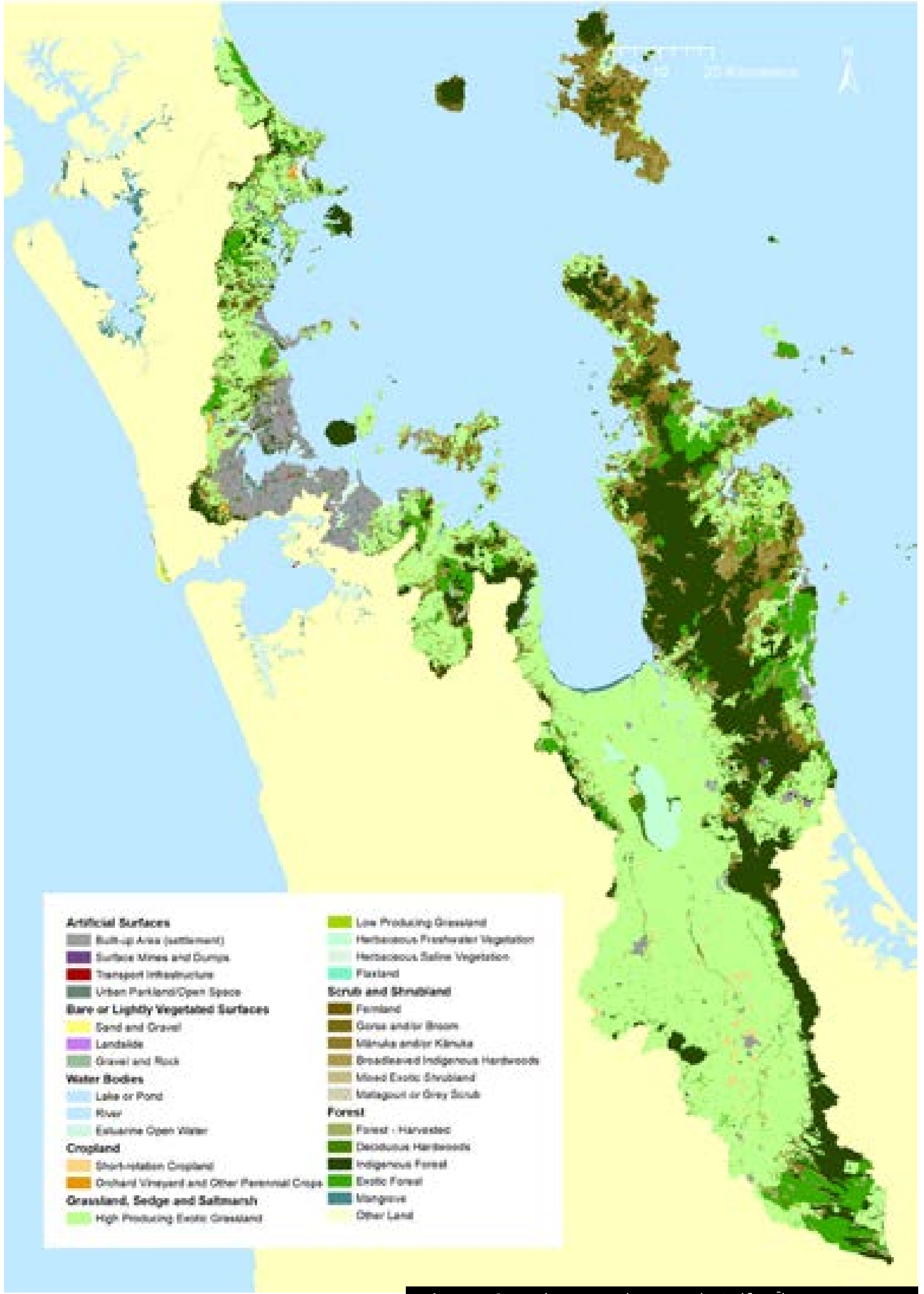
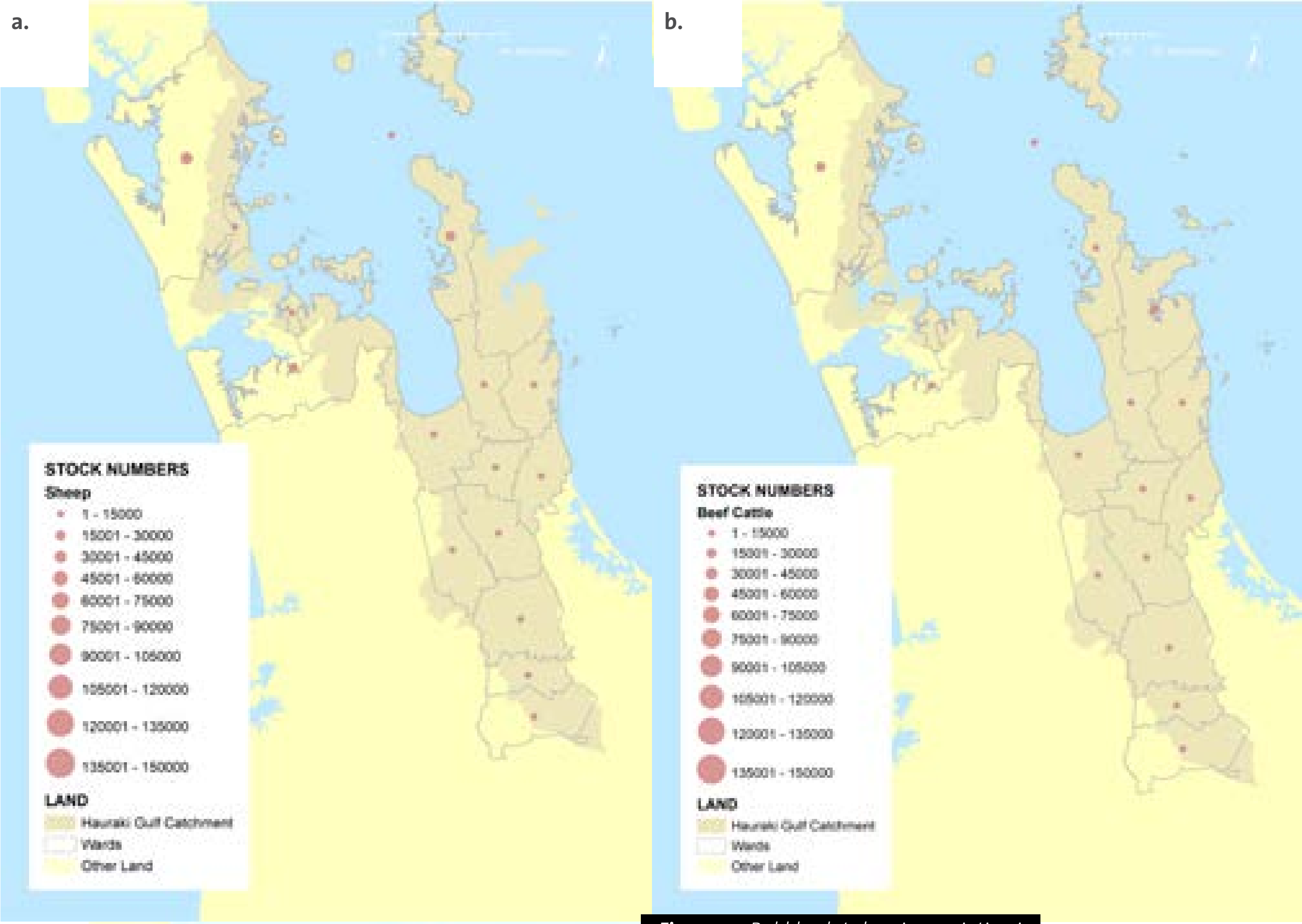


Figure 5.6*: Land cover in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment (LCDB 4, Landcare Research 2015).*

[9] Note that StatsNZ figures from the 2012 census are higher than those produced by LIC and Dairy NZ (2012).

[10] Varying from around 404,000 to 414,000 cows.



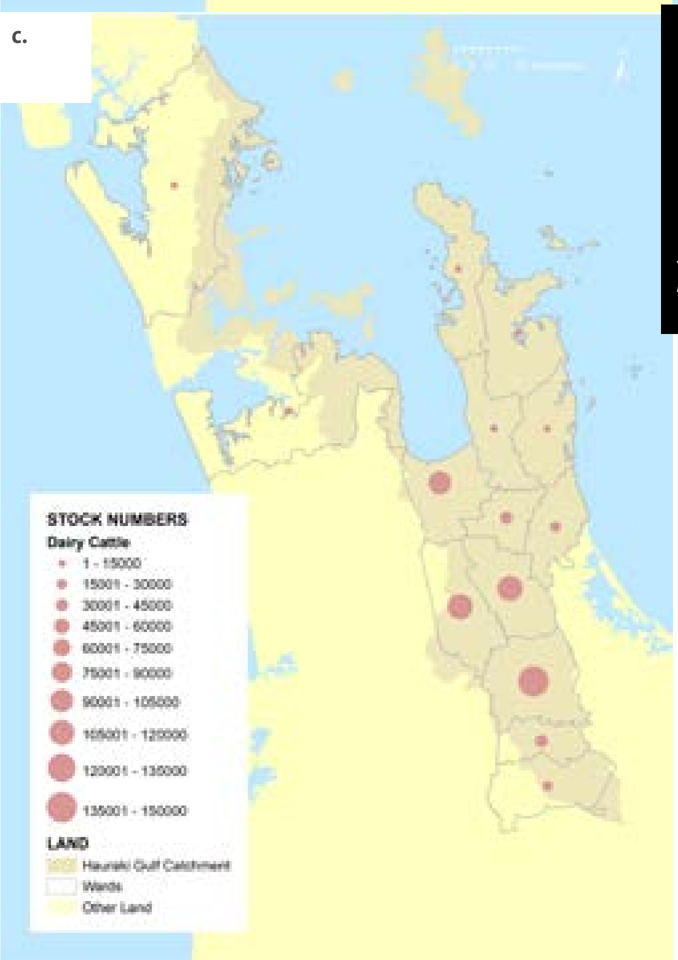


***Figure 5.7**: Bubble plot showing variation in reported numbers of a) sheep, b) beef cattle c) dairy cattle for wards of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment in 2012 (data provided by Statistics NZ). Note that scaling is the same for each group, but zero counts, and confidential or suppressed data (by Statistics NZ) have been excluded. The point in the centre of the Gulf represents stock on the Gulf's islands.*

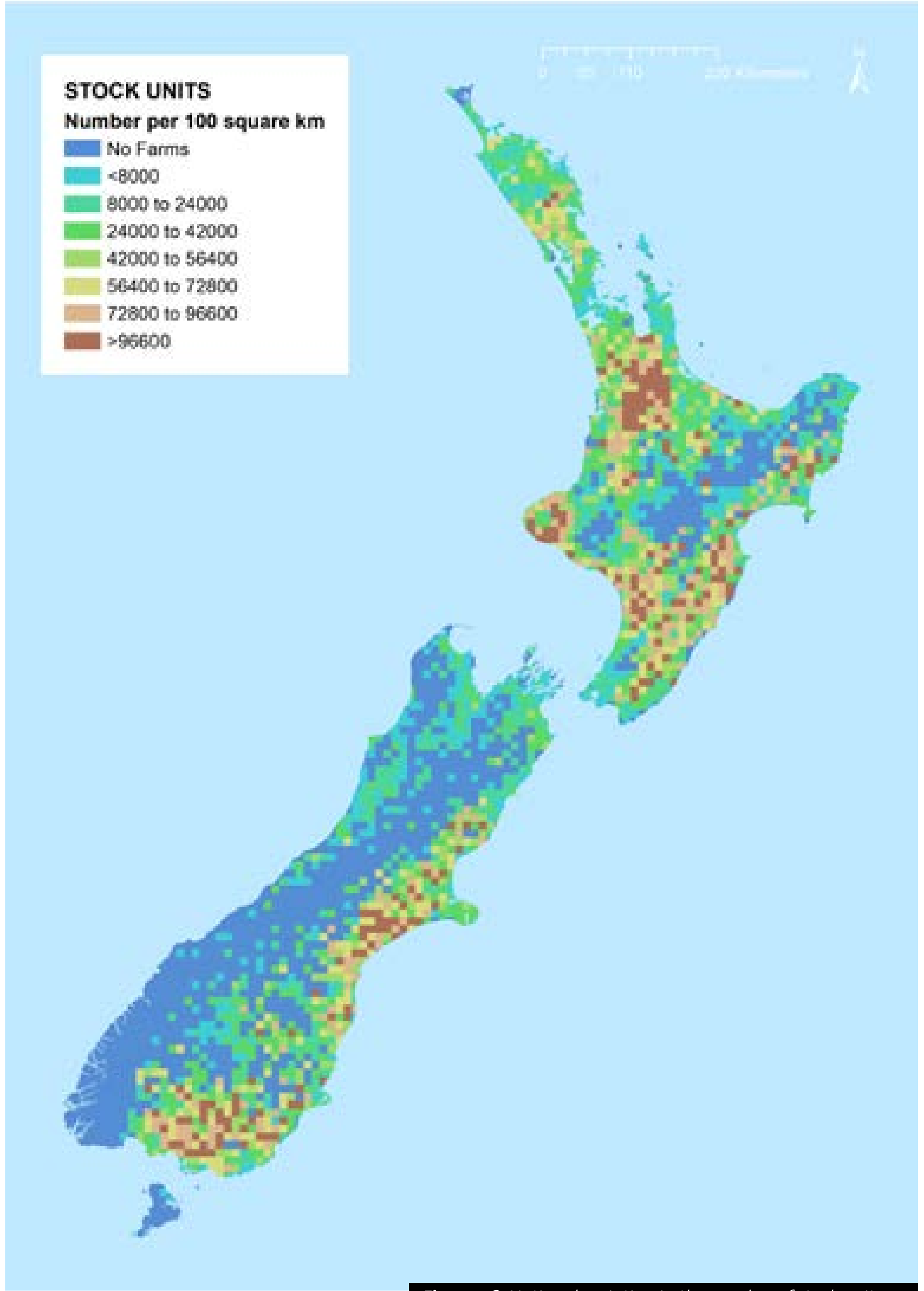


***Figure 5.8**: National variation in the number of stock units per 100 km2 in 2012 (data provided by Statistics NZ).*

HĪ IKA
5.1.4 FISHING

Overall, around 75 different finfish species are caught commercially in the Gulf. Snapper (tāmure) has historically been the main commercial species landed in terms of reported catch weight, but in recent years Jack mackerel landings in the broader Hauraki Gulf[11] have exceeded snapper landings (see ***Figure 6.10*** in section 6.1.6). Catches are reported by statistical reporting area (***Figure 5.9***).

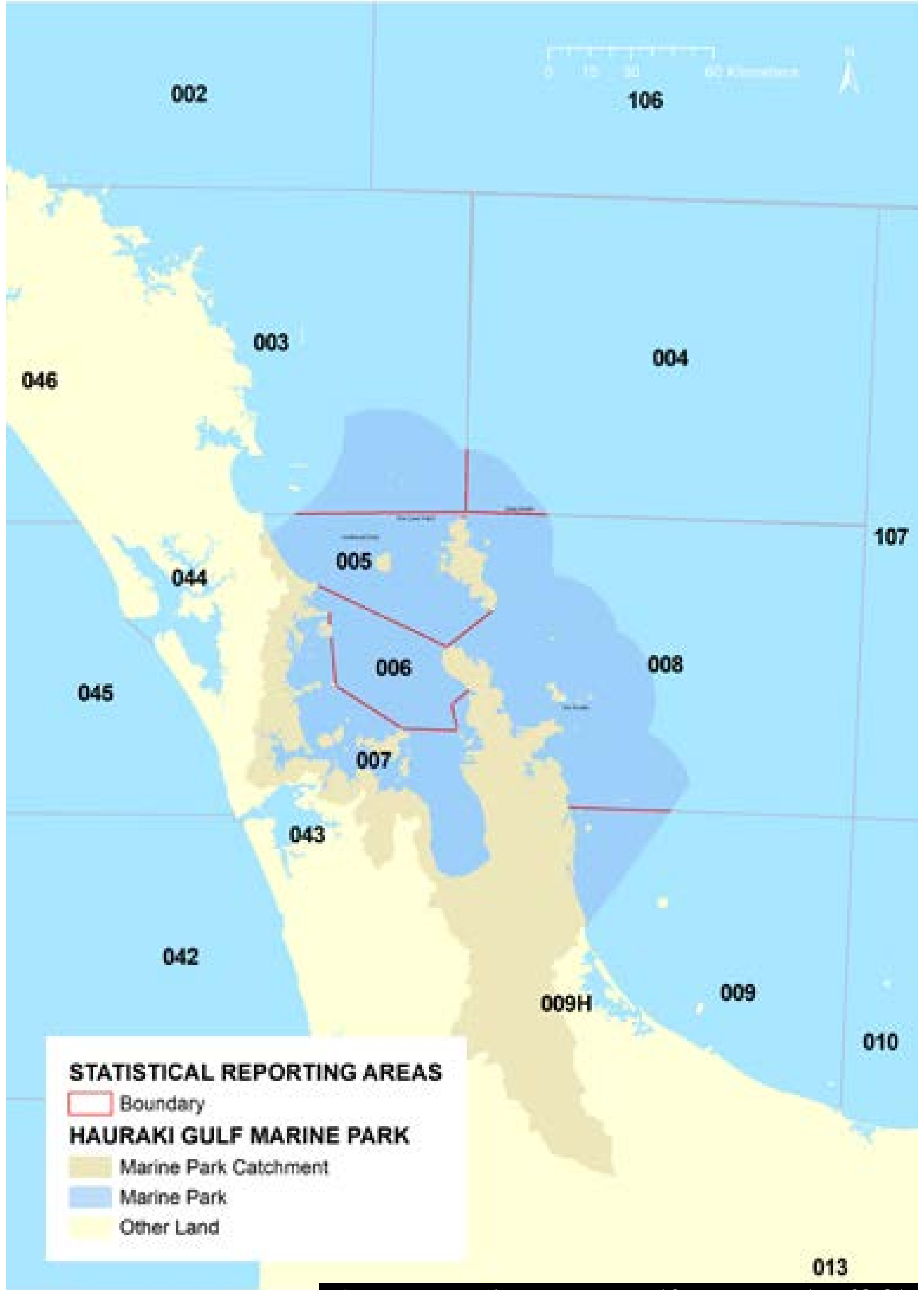


Figure 5.9*: Statistical reporting areas used for reporting catches of finfish.*

[11] Note that catch figures reported here and in previous State of Our Gulf reports are based on reported landings from statistical reporting areas wholly contained within the Hauraki Gulf Marine Park. Recently, Paul (2014) estimated landings from those areas, plus pro-rata landings from statistical reporting areas that partially overlap the Gulf (see fishing case study – section 6.1.6).

Figure 5.10*: 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 2013f).*

Reported commercial landings for the top 12 species (or species groups) obtained from statistical reporting areas 005, 006, 007 and 008 between 2007-2008 and 2015-2016 are provided in ***Figure 5.11***[12]. Snapper comprised 58% to 68% of commercial landings (by weight) over that period, with annual landings ranging from around 1977 to 2417 tonnes. Since 2007-2008, the combined landings of all 12 species has ranged from 3,949 tonnes in 2011-2012 to 2,905 tonnes in 2015-16, with lowest catches of 5 of the 12 species obtained in 2015-2016 (including four of the five species with the greatest landings[13]). Commercial landings of snapper, flounders, gurnard and john dory generally displayed declining trends between 2007-2008 and 2015-2016, while landings of other species fluctuated with no consistent trend.

[12] These figures differ from landing used in the fisheries case study (section 5.1.6), which also included all landings from area 004, and pro-rata catches (based on the length of coast) from areas 003 and 009.

[13] Variations in landings are caused by multiple factors. Landings are an indicator of pressure on the Gulf's fisheries, but they are not an indicator of stock size (although they can be affected by stock size).

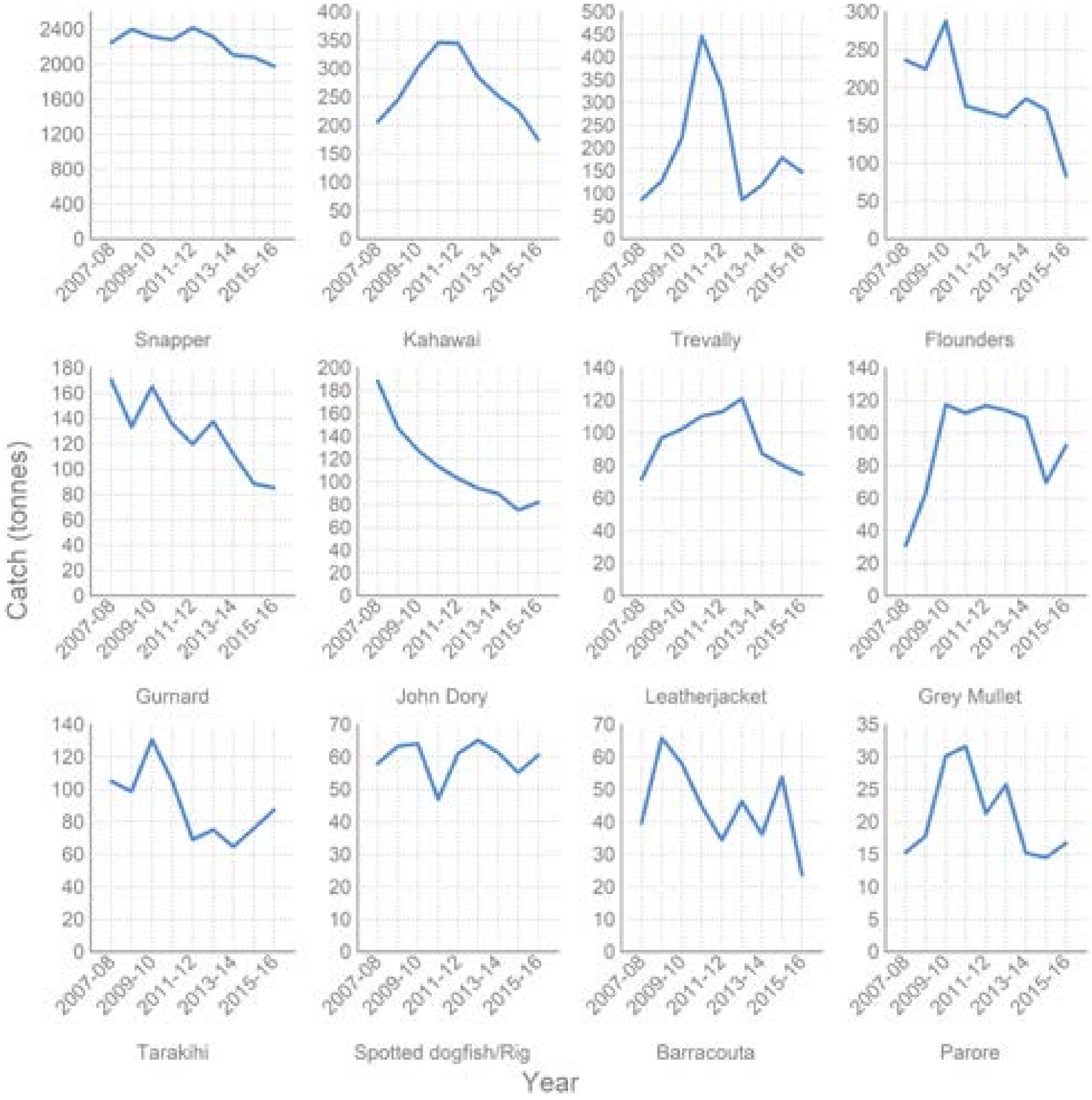


***Figure 5.11**: Reported landings for the top 12 finfish species caught in statistical reporting areas 005, 006, 007 and 008.*

A variety of invertebrates are also targeted in the Gulf. Of these, scallops, sea urchins and crayfish are the most intensively commercially fished species. Between 2007-2008 and 2015-2016, commercial fishers reported annual landings of 236 to 766 tonnes of scallops, 96 to 113 tonnes of sea urchins, and 80 to 123 tonnes of crayfish (MPI, unpub. data).

The commercial catch of finfish is mainly obtained through bottom trawling, Danish seining and bottom longlining, 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.

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 5.12***). Bottom trawling and Danish seining are confined to the central and outer parts of the Gulf (***Figure 5.13*** and ***Figure 5.14***), whereas commercial longlining is more widespread (***Figure 5.15***). A potential error in the Ministry of Primary Industries application of the Danish seining regulations was detected during the preparation of the 2014 State of Our Gulf Report, which appears to allow Danish seining to occur further into the Gulf than the regulations permit. MPI are getting a legal opinion to determine whether the area in question was correctly specified in the regulations. For reference, ***Figure 5.12*** shows both the area MPI have been enforcing, and the area that is actually specified in the fisheries regulations.

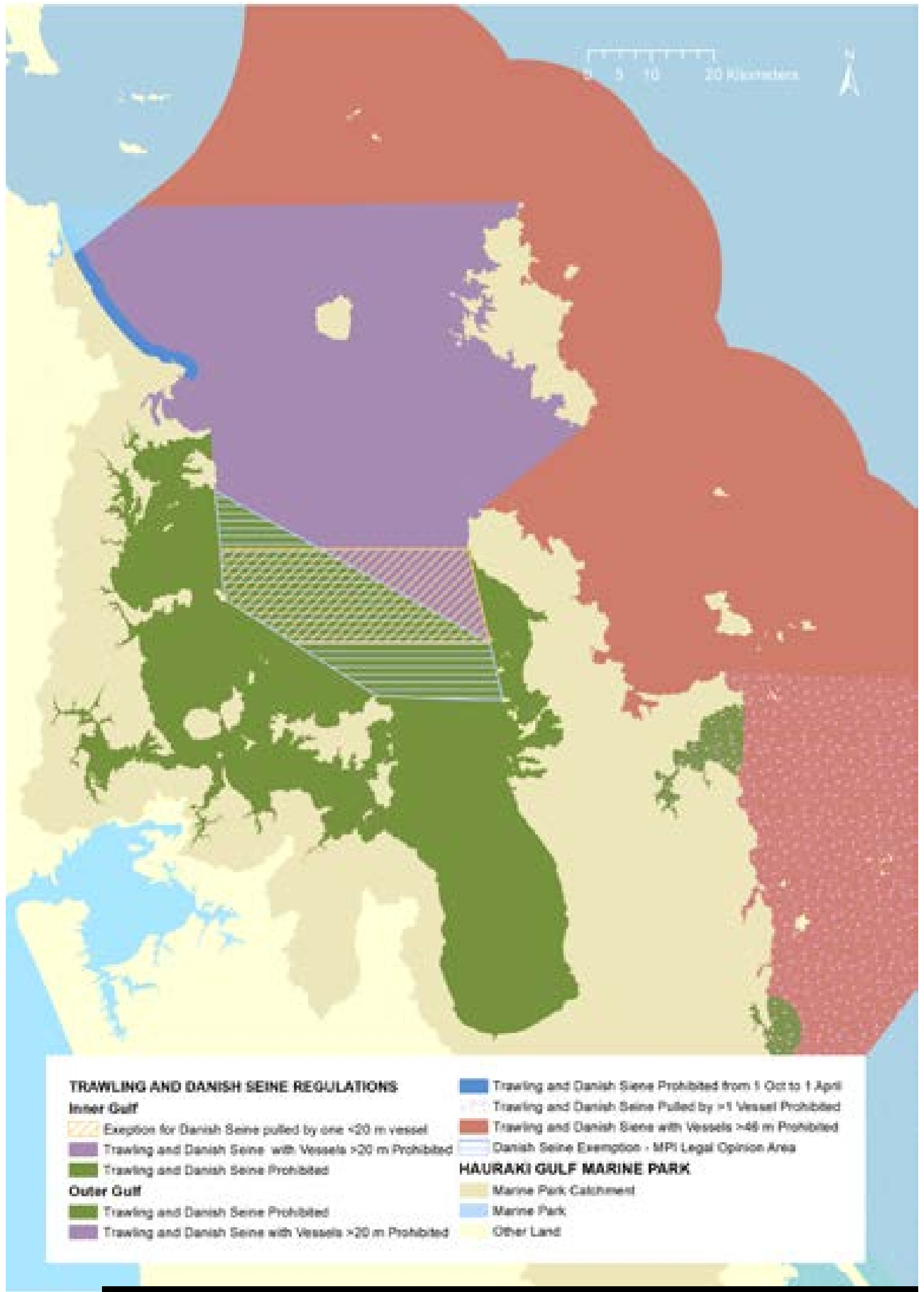


Figure 5.12: Areas where trawling and Danish seining is either prohibited or limits apply to the size of vessel, or times when trawling and Danish seining can occur.

Fishing affects non-target species and the physical and biological characteristics of habitats through the effects of incidental capture, physical injury and disturbance, and the alteration of ecosystem processes. Details on the incidental environmental effects of fishing are considered elsewhere in this report (see sections 6.1 and 6.10.3).

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 5.16***).

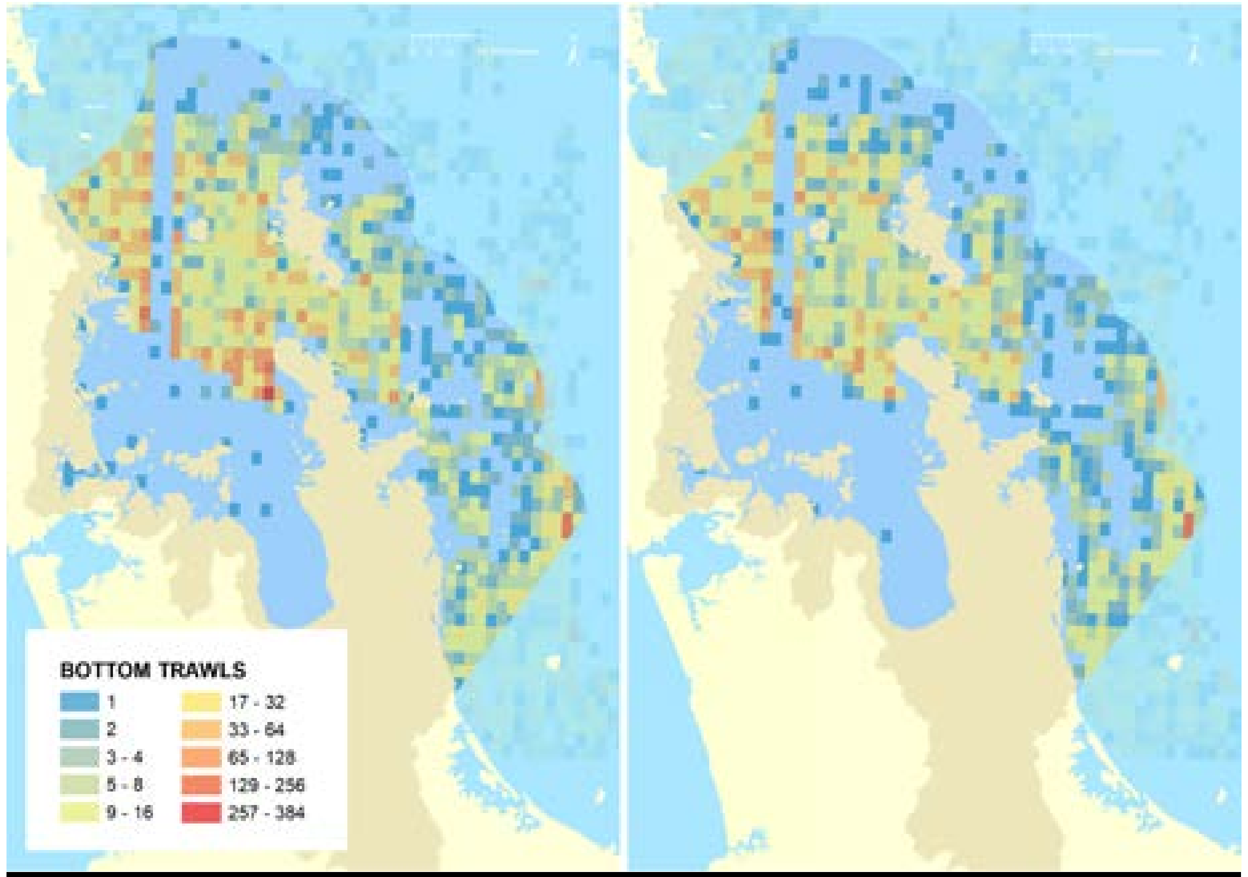


Figure 5.13: *Numbers of bottom trawls (single, pair and precision) carried out between 1 January 2011 and 31 December 2013 (left), and 1 January 2014 to 31 December 2016 (right).*

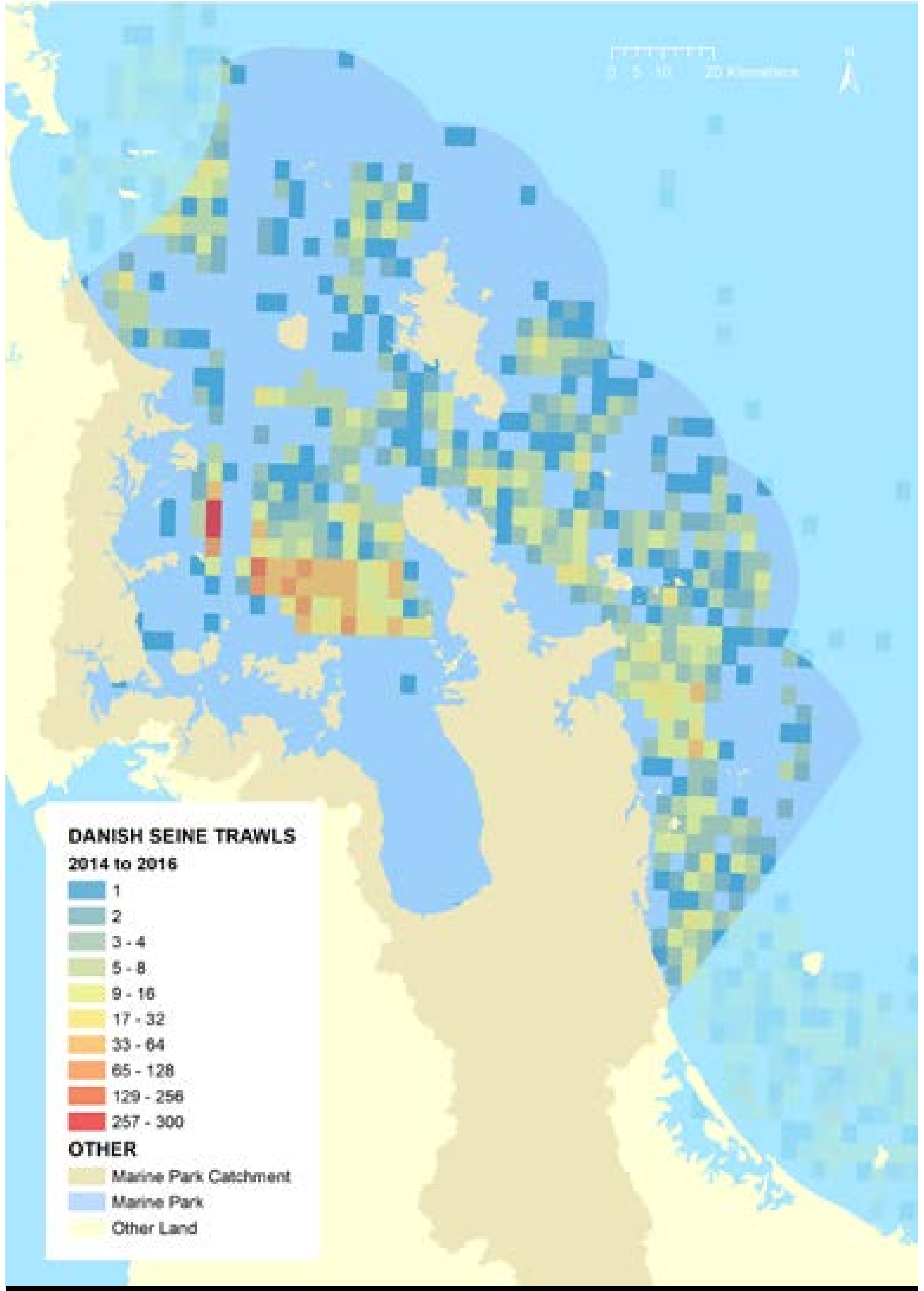


Figure 5.14: *Numbers of Danish seine trawls (single and pair) carried out between 1 January 2014 to 31 December 2016. Comparable data is not available for the 1 January 2011 and 31 December 2013 period.*

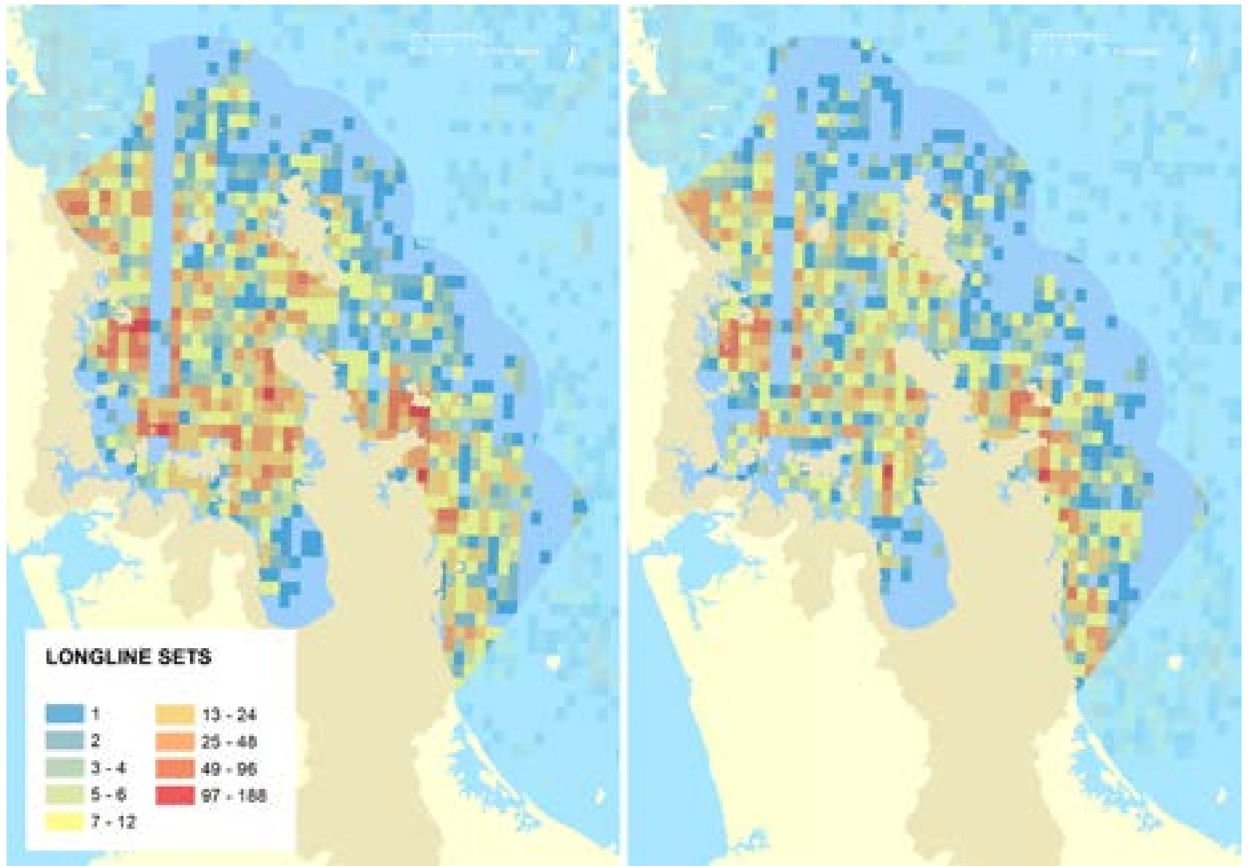


***Figure 5.15**: Numbers of commercial longline sets (surface and bottom) carried out between 1 January 2011 and 31 December 2013 (left), and from 1 January 2014 to 31 December 2016 (right).*

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is also New Zealand's most intensively targeted area by recreational fishers. Recreational fishers are not required to report their catches, but estimates obtained from surveys carried out in 2011-2012, indicated that the recreational sector landed around 3,754 tonnes of snapper from the SNA1 quota management area in that year (c.f. 4,614 tonnes landed from SNA1 by the commercial sector). Around 66% of the recreational landings came from the Hauraki Gulf sub-stock, with 19% coming from the East Northland sub-stock, and 15% from the Bay of Plenty sub-stock[14]. Kahawai were the second most common species landed by recreational fishers, with 51% of the estimated 942 tonnes landed by recreational fishers coming from the Hauraki Gulf sub-stock. A comparison of estimates obtained from surveys conducted in 2004-2005 and 2011-2012, indicated that recreational snapper landings were 85% higher in 2011-2012, while kahawai landings were 409% higher (Hartill et al. 2007; Hartill et al. 2013).

There are currently six marine reserves in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, which cover around 0.3% of the HGMP (***Figure 5.17***). All forms of fishing (apart from research fishing) are also prohibited in cable protection zones, which cover around 4.9% of the Gulf. However, there is little evidence of ecological change occurring within the largest cable protection zone in the Gulf (Shears & Usmar 2006; Morrison et al. 2016). Apart from the conversion of Tāwharanui Marine Park to a marine reserve in 2011, the last marine protected area to be approved was Te Matuku in 2003.

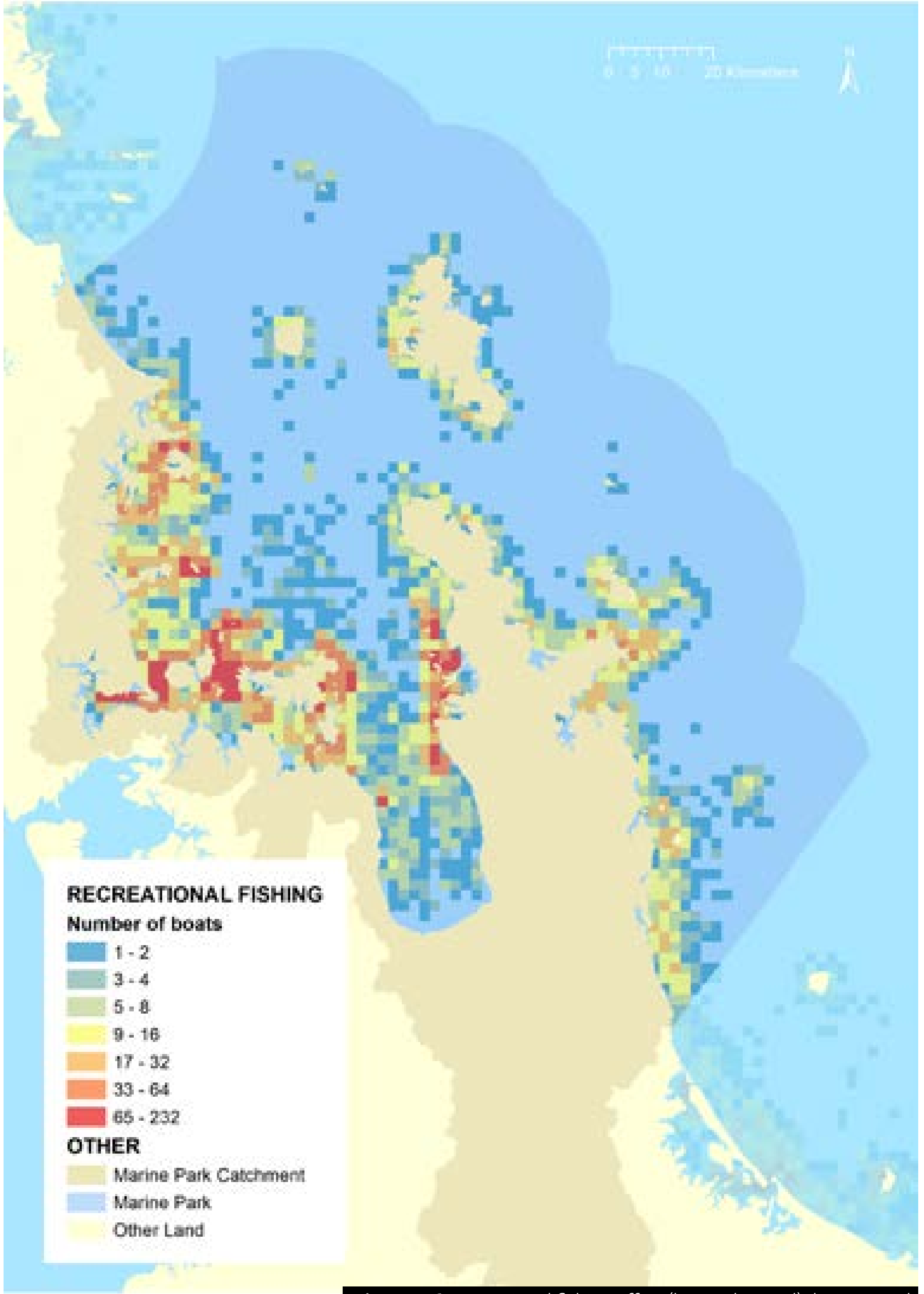


Figure 5.16: Recreational fishing effort (boats observed) during aerial surveys carried out in 2011-2012 (see Hartill et al. 2013).

[14] The HGMP fully contains the Hauraki Gulf sub-stock and straddles the other two sub-stocks – see section 5.1.2 for further information on snapper.

Figure 5.17: Marine reserves and cable protection zones in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Bottlenose dolphin jumping behind the Auckland Whale and Dolphin Safari boat. Photo by Shaun Lee.

5.1.5 MAHI TĀPOI ME TE HĀKINAKINA TOURISM AND RECREATION

The natural endowment of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is a key reason that people live around the Gulf. Natural amenities including beaches, parks, open spaces and coastal access and walkways increase the visitor experience and provide a playground for both residents and tourists. The Coromandel Peninsula is a very popular year-round destination for domestic and international visitors.

Auckland is a gateway to New Zealand. Tourism brings transient visitors to an area, which togeather with the usual resident population, produces the 'effective population' that infrastructure and services must cater for. In total, 2.6 million visitors arrived into Auckland, for the year ended August 2017 (68% of total international visitors). In 2016, Auckland also had a record number of summer international arrivals, with 715,000 guest nights in January (up 3.8% on 2015). Visitors came for a number of reasons: holiday (52%); visiting friends and family (29%); business (8%); or other (11%). Australians made up 40% of the total, followed by Chinese (11%) and Americans (9%) (Statistics NZ 2017a). The Auckland region undoubtedly benefits from both domestic and international tourism expenditure, receiving over $7.8 billion in expenditure from domestic and international visitors for the year ended July 2017 (Ministry of Business Innovation and Employment 2017).

Visitor numbers in the Thames-Coromandel District and the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands swell during the summer months, putting pressure on services such as wastewater networks, roading and accomodation. Around 498,000 people were estimated to visit the Thames-Coromandel District between 22 December 2016 to 9 January 2017 (QRIOS 2017).

Waiheke Island is the most popular visitor attraction in the Hauraki Gulf. The island is popular for its wineries, beaches and special events such as the Headland Sculpture Trail (Baragwanath et al. 2009). Ferry operators estimate that there are between 400,000 and 700,000 ferry visitors travel to Waiheke annually.

Between 30,000 and 32,000 people visit Tiritiri Matangi Island each year, while Rangitoto Island is estimated to have 100,000 visitors annually, with increased numbers forecast following the construction of a new wharf in 2014. Both islands are pest-free, open bird sanctuaries, and visitors place pressure on and increase risks to these island ecosystems.

Nature-based tourism is an important component of New Zealand's offering to visitors. Dolphin and whale watching (particularly of resident Bryde's whales – see section 6.10.2) are offered by tourism operators in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Cape Rodney to Okakari Marine Reserve (commonly called Leigh Marine Reserve) is the most visited marine reserve in New Zealand, with 375,000 visitors each year, and an estimated 6,000 people per day in the peak summer season. The recently completed Marine Discovery Centre offers interpretation of the Gulf's marine environment to visitors. Bird watching is another recreation activity that is dependent on the ecosystems in the Gulf, with 16,000 people reported to have visited the Pūkorokoro Miranda Shorebird Centre in 2008.

New Zealand tourism is a targeted industry for growth, with significant investment in marketing and infrastructure. The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi offers many amenities for visitors to explore. An increasing number of festivals and events are being developed around different themes associated with the Gulf, or using locations within the Gulf as a point of difference. These include the Tāmaki Herenga Waka Festival (see section 5.2), a scallop festival in Whitianga, music festivals in coastal regional parks, and the forthcoming America's Cup race in 2021. Such events put the Gulf centre stage domestically and internationally, and often act as a catalyst for investment in associated infrastructure. The downside is that they place additional pressures on the coastal environment.

5.1.6 NGĀ MOMO OROTĀ INVASIVE SPECIES

Auckland is not only a nationally significant gateway for people and products, it is a key gateway for unwanted arrivals to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi i.e. invasive species from other countries and regions of New Zealand. Conversely, it is a stepping stone in the spread of species around New Zealand and internationally. Invasive species pose a serious threat to the natural values of the Gulf and its economy. They can arrive on aeroplanes, ships, boats or through natural vectors. Upon arrival, they may establish populations and spread.

Asian paddle crab in the Tāmaki Estuary. Photo by Shaun Lee.

Exotic species new to New Zealand are regularly turning up in the Gulf, and the likelihoods of more arriving in the Gulf, establishing viable populations, and spreading within, and beyond, the Gulf remains high. Reasons for this are discussed below.

Marine pests are inadvertently spread through ballast water and hull fouling, while terrestrial, and freshwater pests can 'hitch-hike' in freight and the belongings people travelling to New Zealand (and are sometimes intentionally brought in). The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi handles the greatest volume of shipping in New Zealand, with roughly one third of commercial shipping passing through Ports of Auckland. In the year ended June 2017, Ports of Auckland serviced 1,572 freight ships (down from 1588 in 2015-2016 year), handled 952,331 containers over 20 foot (an increase of 5% in volume, on the previous year), and 6.5 million tonnes of break-bulk cargo (an increase of 12% on the previous year). One hundred cruise ships also visited Auckland via the port in the year ended June 2017.

Domestic shipping traffic can inadvertently spread marine pests around the country. Between 2002 and 2005[15], an average of 404 large vessels (exceeding 99 tonnes) per year arrived in the Port of Auckland from other New Zealand ports (Hayden et al. 2009b). The number of ferry trips has also steadily increased, with 6.15 million trips for the year ended July 2017 (up 4% on the previous year). A high number of recreational and small cruising vessels also undertake journeys between marinas and sites in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi and beyond. Modelling of 2002-2004 data, estimated that over that period 8,332 recreational vessel journeys per year originated from sites in the Gulf. The busiest sites were Westhaven (2,186 vessel movements), Gulf Harbour Marina (1,249 vessel movements) and Great Barrier Island (1,178 vessel movements) (Hayden et al. 2009b).

Marinas, marine farms, wharves and other engineered structures are scattered around the Gulf (see section 5.1.2). These act as stepping stones or conduits in the spread of marine invasive species. Engineered structures commonly become fouled with pest species, such as Mediterranean fan worm (*Sabella spallanzanii*), Asian kelp (*Undaria pinnatifida*), and clubbed sea squirt (*Styela clava*), which disperse naturally or via vessels, aquaculture stock and marine equipment.

The movement of people and vessels around the Gulf (see section 5.1.5) also increases the potential for disease-causing organisms (such as Phytophthora agathidicida, the pathogen that causes kauri dieback) and mammalian pests (such as rats, cats and stoats) to spread. Pests and pathogens also disperse naturally. For instance, the recently arrived myrtle rust (*Austropuccinia psidii*), which is a serious fungal disease that affects trees such as pōhutukawa, mānuka and rātā, is thought to have been blown over from Australia.

Detecting and responding to invasive species is labour intensive and costly. Detection and eradication of fruit fly from Grey Lynn in 2015 involved an intensive surveillance and eradication effort that cost around $13.6 million. Argentine ants were also eliminated from Tiritiri Matangi Island after 16 years of effort by the Department of Conservation and volunteers (Higham 2016). However, no introduced marine pests have been completely eradicated from New Zealand, and there are few examples of successful local eradications. Efforts are therefore targeted towards implementing measures to prevent new species from arriving.

[15] More recent data is unavailable.

Wairoa River, Clevedon, in flood. Photo by Shane Kelly.

REREKĒ TANGA O TE ĀHUARANGI
5.1.7 CLIMATE CHANGE

Climate change is a serious, emerging international issue and the HGMP will not be immune to its effects. There are four main concerns about the long-term impacts of climate change on the Gulf and its catchments:

1. The oceans are becoming warmer and more acidic. Increased ocean acidity is a consequence of increased levels of carbon dioxide in the atmosphere, as about a quarter of this is absorbed by the world's oceans. Increased acidity affects calcification, impeding the formation of carbonate shells and skeletal structures. Shellfish such and pāua, pipi, cockles, mussels and oysters would be particularly susceptible. Effects could include changes in the survival, growth, abundance and distribution of such species.

2. As the land and water become warmer, the risks from invasive exotic species from warmer waters increase. While the high profile species that will threaten horticulture (such as the Queensland fruit fly) and terrestrial species (such as myrtle rust) attract most attention, the marine environment, particularly in the north, is also highly susceptible to invasive species that can establish and displace native biota.

3. Sea level rise is a threat to coastal infrastructure (roads, bridges, flood-protection works, coastal protection works) and communities (such as Thames, Whangamatā and some Auckland beachside suburbs). These will become more vulnerable to the effects of inundation, flooding and erosion. Some areas may eventually become uninhabitable, and coastal highways (such as between Thames and Coromandel) are likely to require realignment. Rising sea levels and storm surge will also increase the risk of salt water intrusion in low-lying coastal areas. 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 Ōmaha are sensitive to coastal erosion (Goodhue et al. 2012; Stephens et al. 2016).

4. Droughts may become more frequent over the 21st century, but ironically, heavier rainfall will increase the risk of flooding, erosion and slips, particularly in Coromandel river catchments. The occurrence of ex-tropical cyclones is projected to decrease or remain unchanged, but those events are likely be more damaging because of stronger winds and heavier rain (Ministry for the Environment 2016a).

Some of these issues are already starting to emerge, and their effects are expected to become more pronounced throughout the 21st century. The extent of coastal development and the cumulative effects of other human impacts on the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, means that managing the additional risks of climate change is likely to present an escalating challenge in the coming years.

NGĀ REREKĒ TANGA MŌ NGĀ MANA WHENUA
5.2 CHANGES FOR MANA WHENUA

Mana whenua input into strategic policy development, the outcomes of treaty settlements, recognition of customary rights, and the growing Māori economy over the past three years, has reinforced the role of mana whenua as influential partners in the integrated management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Mana whenua have protected rights and interests in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, stemming from customary title and the Treaty of Waitangi / Te Tiriti o Waitangi, and as a result of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, the Māori Fisheries Act 2004 and other Acts. Consequently, mana whenua are now major players in aquaculture and commercial fisheries. They also maintain traditional harvesting practices and are recreational fishers.

There has been significant progress in the treaty settlement space over the past three years. Over 13 treaty settlements that relate to mana whenua of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi have progressed to deed of settlement and treaty settlement legislation. There are still a number of treaty negotiations still underway. The deeds of settlement completed to date do not provide for cultural redress in relation to the harbours and Hauraki Gulf / Tīkapa Moana. The Crown acknowledges that these will be developed in separate negotiations as soon as practicable.

Mana whenua are continuing to exercise their customary rights to apply for permits to take kai moana for tangi or hui. However, the amount of kai moana being taken is not currently accurately reported.

There has been a recent influx in applications for protected customary rights and customary title under the Marine and Coastal Areas (Takutai Moana) Act 2011, as the result of the deadline for applications closing. If successful, these will give mana whenua groups a greater say over how these areas are managed.

There are still no established mātaitai reserves or taiāpure within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, and one active rāhui prohibiting shellfish gathering in place at Umupuia.

It is not clear what the barriers are that are preventing the establishment of customary fisheries, such as mātaitai reserves and taiāpure, or customary protection mechanisms, such as rāhui, in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui- ā -Toi. It is noted that Sea Change – Tai Timu, Tai Pari had explored options for marine protected area models that are more aligned to mātauranga Māori.

Previous State of the Gulf reports and Sea Change – Tai Timu, Tai Pari, have identified the need to develop Māori cultural indicators, but these have not eventuated. This represents a significant gap in the ability for mana whenua to provide meaningful input on the delivery of integrated management for the Hauraki Gulf.

Significant milestones for 2014-2017 include:

Mana whenua work individually and collectively together with the agencies of the Hauraki Gulf Forum on a range of projects and initiatives within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. This information is not always readily accessible outside the mana whenua groups involved.

The following is intended as a snapshot of key changes, and does not fully represent the significant achievements of the over 25 mana whenua groups of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi for this period.

Treaty Settlements progress

Three new pieces of Treaty Settlement Legislation for:

- Ngā Mana Whenua o Tāmaki Makaurau;
- Te Kawerau a Maki;
- Ngāti Pūkenga.

Two Deeds of Settlement signed, and Treaty Settlement legislation introduced for:

- Ngāti Tamaoho;
- Ngāi Tai ki Tāmaki.

Ten new Deeds of Settlement signed between mana whenua and the Crown for:

- Pare Hauraki Collective;
- Ngaati Whanaunga;
- Ngāti Hei;
- Ngāti Maru;
- Ngāti Paoa;
- Ngāti Rāhiri Tumutumu;
- Ngāti Rehua-Ngātiwai ki Aotea;
- Ngāti Tara Tokanui;
- Ngāti Tama-te-rā;
- Te Patukirikiri.

One new Agreement in Principle between the Crown and Te Akitai-Waiohua.

One new Deed of Mandate between the Crown and Ngātiwai.

Māori Aquaculture and Fisheries Settlements

Completion of New Space Regional Aquaculture Agreements between the Crown and iwi Aquaculture Organisations (IAOs) in the Auckland region under the Māori Aquaculture Claims Settlement Act 2004.

Coastline agreements for the Auckland region were finalised and asset transfers worth over $9.5M were made from Te Ohu Kaimoana (Treaty of Waitangi Fisheries Commission) to the IAO's in the Auckland region.

Partnerships with mana whenua

Rangitoto, Motutapu, Te Motu-o-Ihenga / Motuihe, and Tiritiri Matangi of Tīkapa Moana / Hauraki Gulf were vested back to the Crown on 31 September 2015 by mana whenua, after a month in iwi ownership as part of the Tāmaki settlement legislated in 2014. A Conservation Management Plan for Rangitoto, Motutapu, Te Motu-o-Ihenga and Motukorea is being developed in partnership with mana whenua.

Te Hauturu-o-Toi / Little Barrier Island Nature Reserve Management Plan 2017 was co-approved by Ngāti Manuhiri (along with the Auckland Conservation Board) enabling co-governance of the island under the Ngāti Manuhiri Treaty Settlement legislation, a first for this type of planning arrangement.

Strategic policy

Sea Change – Tai Timu, Tai Pari, New Zealand's first Marine Spatial Plan was released in 2016. Mana whenua were a key partner in the unique collaborative process taken in the development of the plan.

Waikato Regional Policy Statement 2016 introduced updated Issues of Significance to mana whenua.

Auckland Unitary Plan became operative in part in November 2016. This introduced updated Issues of Significance to mana whenua and a suite of provisions to respond to those issues.

The Independent Māori Statutory Board was unsuccessful in its High Court appeal challenging the removal of 3,600 sites of value to mana whenua from the Auckland Unitary Plan.

Customary rights and practices

A total of 1241 permits were issued for customary take for tangi or hui within the Hauraki Gulf Marine Park and 1106 permits were issued partially within the HGMP during the period 2014-2017. Accurate figures of the actual take were not available.

No new applications for taiāpure or mahinga mātaitai received.

A rāhui (temporary ban) aligned to s186 of the Fisheries Act at Umupuia since 2007 has been extended and is seeing a significant improvement in the cockle populations in this location.

Over 17 applications lodged under the Marine and Coastal Areas (Takutai Moana) Act 2011, for protected customary rights and customary title within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

NGĀ AHU MUA O NGĀ WHAKATAU Ā-TIRITI
5.2.1 PROGRESS OF TREATY SETTLEMENTS

The Treaty of Waitangi was signed by Māori rangatira Māori / Māori chiefs, and representatives of the British Crown in 1840. The Treaty has three articles. The Treaty:

- gave sovereignty in New Zealand to the British Crown (or kāwanatanga in the Māori version);
- guaranteed Māori 'te tino rangatiratanga', or chieftainship, over their resources, while giving the Crown first rights to any land being sold after that time; and,
- provided Māori the rights and privileges of British citizens.

Historical claims are made by Māori against the Crown for breaches of the Treaty, with associated settlements seeking resolution the provision of redress.

Treaty settlements generally involve:

1. An historical account of the Treaty breaches, and Crown acknowledgement and apology.
2. Cultural redress, including the transfer of Crown land to the claimant group, co-governance over natural resources such as water bodies, and changes to place names.
3. Commercial and financial redress, in cash, property (or a mixture of both), and rights of first refusal to purchase surplus Crown property.

Within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, treaty settlements contribute towards the recognition of the historical, traditional, cultural and spiritual relationships of the mana whenua with Tīkapa Moana / Te Moana-nui-a-Toi and its islands.

Settlements made over the past three years have included:

- the return of Rangitoto;
- provision of statutory acknowledgements over a number of motu, waterways and coastal reserves;
- partnerships in conservation management; and,
- the enhancement of iwi participation in specified resource management act (RMA) processes.

Such mechanisms are required to be considered as part of RMA processes once the Treaty Settlement legislation is enacted.

Table 5.1 provides a summary of the status of Treaty Settlements across the relevant Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi mana whenua groups.

***Table 5.1**: Treaty Settlements Progress 2014-2017*
(as at 30 September 2017, from Office of Treaty Settlements - Te Tari Whakatau Take e pā ana ki te Tiriti o Waitangi (2017)).

Iwi group	Status	Changes during 2014-2017
Ngāti Whātua o Ōrakei	Ngāti Whātua o Ōrākei Claims Settlement Act 2012.	No change.
Te Uri o Hau	Te Uri o Hau Claims Settlement Act 2002.	No change.
Te Kawerau a Maki	Te Kawerau a Maki Claims Settlement Act 2015.	Settlement legislation passed on 9 September 2015.
Ngāti Te Ata Waiohua	Terms of Negotiation signed on 29 June 2011.	No change.
Ngāti Tamaoho	Deed of Settlement signed on 30 April 2017.	Settlement legislation introduced on 22 June 2017.
Ngāi Tai ki Tāmaki	Deed of Settlement signed on 7 November 2015.	Settlement legislation introduced on 9 August 2017.
Te Akitai-Waiohua	Agreement in Principle was signed on 16 December 2016.	Agreement in Principle.
Ngātiwai	Deed of Mandate recognised by the Crown on 21 Oct 2015.	Deed of Mandate. The Ngatiwai Mandate Inquiry Report of the Waitangi Tribunal on 26 October 2017 released.
Ngāti Manuhiri	Ngāti Manuhiri Claims Settlement Act 2012.	No change.
Ngāti Rehua-Ngātiwai ki Aotea	Deed of Settlement initialled on 19 December 2016.	Deed of Settlement initialled.
Ngāti Maru	Deed of Settlement initialled on 8 September 2017.	Deed of Settlement initialled.
Ngāti Tamaterā	Deed of Settlement initialled on 20 September 2017.	Deed of Settlement initialled.
Ngāti Paoa	Deed of Settlement initialled on 18 August 2017.	Deed of Settlement initialled.
Ngaati Whanaunga	Deed of Settlement initialled on 25 August 2017.	Deed of Settlement initialled.
Te Patukirikiri	Deed of Settlement initialled 8 September 2017.	Deed of Settlement initialled.
Ngāti Hako	Agreement in Principle Equivalent signed 22 July 2011.	Negotiations continue.
Ngāti Hei	Deed of Settlement signed on 17 August 2017.	Deed of Settlement signed.
Ngāti Porou ki Hauraki Mataroa	Agreement in Principle Equivalent signed on 22 July 2011.	No change.
Ngāti Pūkenga	Ngāti Pūkenga Claims Settlement Act 2017.	Settlement legislation for this settlement was passed on 10 August 2017.
...		

Iwi group	Status	Changes during 2014-2017
...		
Ngāti Rāhiri Tumutumu	Deed of Settlement initialled on 13 July 2017.	Deed of Settlement initialled.
Ngāti Tara Tokanui	Deed of Settlement initialled on 1 June 2017.	Deed of Settlement initialled.
Tāmaki Collective (Ngāi Tai ki Tāmaki; Ngāti Maru; Ngāti Paoa; Ngāti Tamaoho; Ngāti Tama-te-rā; Ngāti Te Ata; Ngāti Whanaunga; Ngāti Whātua o Kaipara; Ngāti Whātua o Ōrakei; Te Akitai-Waiohua; Te Kawerau a Maki; Te Patukirikiri; Te Rūnanga o Ngāti Whātua)	Ngā Mana Whenua o Tāmaki Makaurau Collective. Redress Act 2014.	Legislation for this settlement was passed on 24 July 2014.
Pare Hauraki Collective (Hako; Ngāi Tai ki Tāmaki; Ngāti Hei; Ngāti Maru; Ngāti Paoa; Ngāti Porou ki Hauraki; Ngāti Pūkenga; Ngāti Rāhiri Tumutumu; Ngāti Tama-te-rā; Ngāti Tara Tokanui; Ngaati Whanaunga and Te Patukirikiri)	Collective Redress Deed initialled on 22 December 2016.	Deed of Settlement initialled (and ratified).
Marutūahu Collective (Ngāti Maru; Ngāti Paoa; Ngāti Tama-te-rā; Ngaati Whanaunga and Te Patukirikiri)	Record of Agreement signed 17 May 2013.	No change.

NGĀ WHAKATAU MAHI AHUMOANA, TAUNGA HĪ IKA HOKI
5.2.2 MĀORI AQUACULTURE AND FISHERIES SETTLEMENTS

Mana whenua have a long maritime and fishing history associated to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, having been involved as pioneers in the aquaculture industry. As a result of treaty settlements they are large quota holders, which is a natural progression of their connection. Mana whenua have a vested interest in the success of customary and commercial fisheries and aquaculture within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi as kaitiaki. Taking a long-term view to maintaining and enhancing Māori customary and commercial fishing rights is an important outcome of the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992.

Two key pieces of Treaty settlement legislation implement the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992. They are the Māori Fisheries Act 2004 and the Māori Aquaculture Claims Settlement Act 2004.

The Māori Fisheries Act 2004, was established to implement the agreements made in the 1992 Treaty of Waitangi Fisheries Settlement, and to provide for the development of the collective and individual interests of iwi in fisheries, fishing and related activities, which would ultimately benefit all Māori. The Act establishes a framework for the allocation, transfer and management of fisheries assets arising from the settlement. This included the establishment of Te Ohu Kaimoana (the Treaty of Waitangi Fisheries Commission), which is dedicated to future advancement of Māori interests (collectively and individually) in the marine environment. Among its responsibilities was the allocation of fisheries assets from the 1989 and 1992 Māori Commercial Fisheries Settlements, which are held in trust until a basis for allocation is reached.

Te Ohu Kaimoana is tasked with assisting the Crown with discharging its settlement and Treaty obligations, and contributing to an enduring settlement of claims and grievances, and provides a technical advisory service to its iwi constituents.

The Māori Commercial Aquaculture Claims Settlement Act 2004 (MCACSA) purpose is to provide full and final settlement of Māori commercial aquaculture claims since 21 September 1992. It allocates 20% of aquaculture space to iwi (or comparable assets) that was granted between September 1992 and the commencement of the Act, or granted after October 2011.

Assets are transferred from the Crown through Te Ohu Kaimoana Trustee Ltd on a region-by-region basis. Te Ohu Kaimoana Trustee Ltd holds them on trust through the Māori Commercial Aquaculture Settlement Trust (also known as the Takutai Trustee). Settlements are distributed to iwi aquaculture organisations (IAOs), once all of the iwi within a region have attained IAO status and their entitlements have been determined. Iwi Aquaculture Organisations must be mandated under the Māori Fisheries Act and authorised by their iwi members as an IAO to receive aquaculture assets under the aquaculture settlement. The MCACSA sets a 12-month timeframe for getting agreement on the allocation of assets, once regional IAOs have been established. It provides a framework for distributing the assets if agreement cannot be reached within that timeframe.

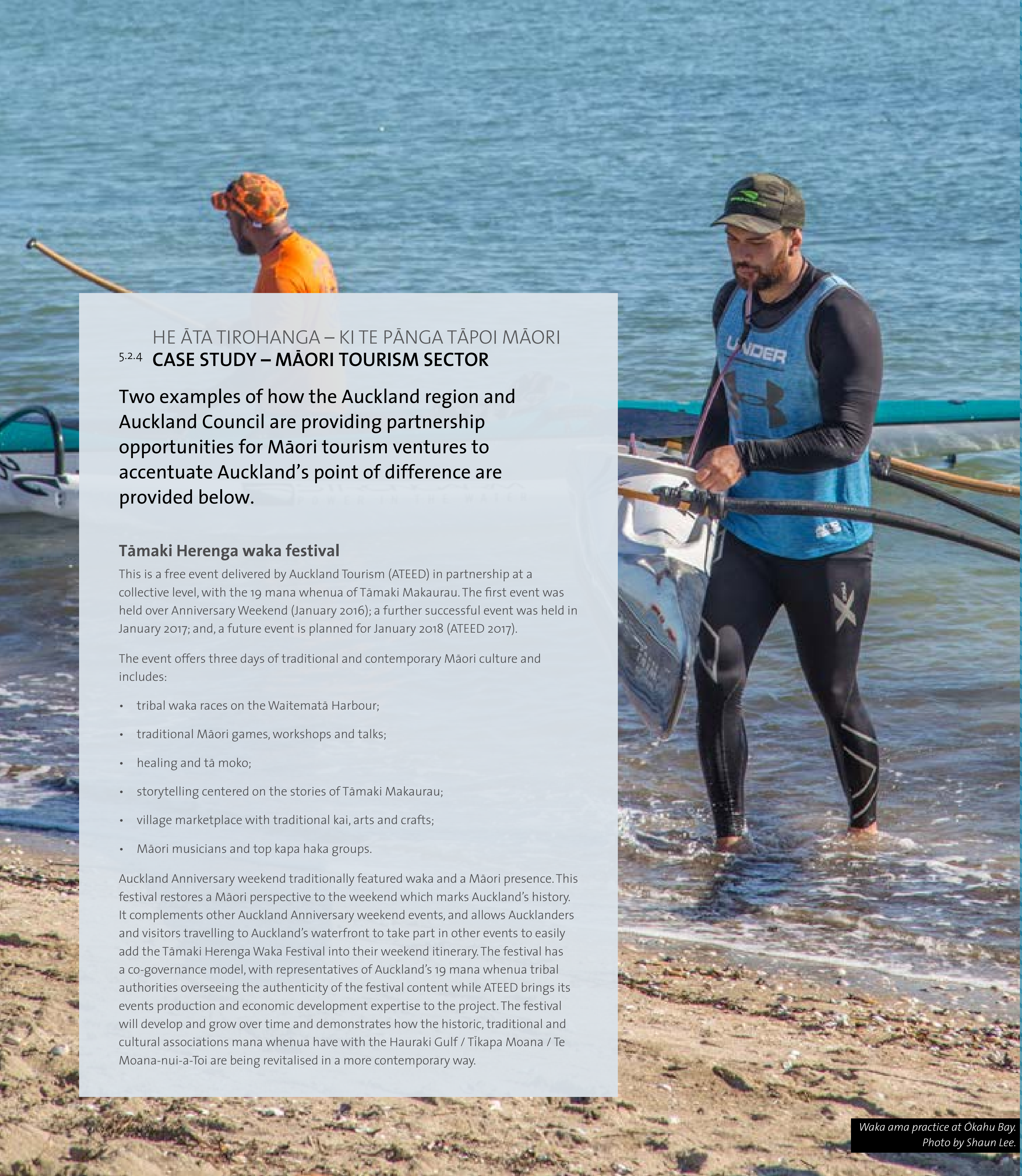
Within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, a number of new space regional aquaculture agreements and coastline agreements were completed in 2016:

- Hauraki iwi and Waikato–Tainui resolved an outstanding dispute over the remaining 13% of new space settlement assets for the Auckland region (Te Ohu Kaimoana 2016);
- coastline agreements for the Auckland region were finalised and asset transfers worth over $9.5M were made from the Te Ohu Kaimoana (Treaty of Waitangi Fisheries Commission) to IAOs in the Auckland region (iwi of Hauraki, Ngāti Whātua and Ngātiwai) (Te Ohu Kaimoana 2016).

TE TUPU O TE ŌHANGA MĀORI
5.2.3 THE GROWING MĀORI ECONOMY

There is limited information published on changes to the Māori economy that are specific to the mana whenua of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. However, there is anecdotal evidence that growth is occurring within the fisheries, aquaculture and tourism sectors.

The Auckland Economic Development Strategy 2012 highlights that investments from Treaty settlements and leveraging Auckland's unique Māori identity by supporting Māori business in the tourist and events area. Treaty settlements, as well as greater recognition of the Māori economy in strategic plans and processes is helping to stimulate this. The following case studies look at partnerships between Auckland Council and mana whenua that are supporting growth of the Māori tourism sector.



Waka ama practice at Ōkahu Bay. Photo by Shaun Lee.

HE ĀTA TIROHANGA – KI TE PĀNGA TĀPOI MĀORI

5.2.4 CASE STUDY – MĀORI TOURISM SECTOR

Two examples of how the Auckland region and Auckland Council are providing partnership opportunities for Māori tourism ventures to accentuate Auckland's point of difference are provided below.

Tāmaki Herenga waka festival

This is a free event delivered by Auckland Tourism (ATEED) in partnership at a collective level, with the 19 mana whenua of Tāmaki Makaurau. The first event was held over Anniversary Weekend (January 2016); a further successful event was held in January 2017; and, a future event is planned for January 2018 (ATEED 2017).

The event offers three days of traditional and contemporary Māori culture and includes:

- tribal waka races on the Waitematā Harbour;
- traditional Māori games, workshops and talks;
- healing and tā moko;
- storytelling centered on the stories of Tāmaki Makaurau;
- village marketplace with traditional kai, arts and crafts;
- Māori musicians and top kapa haka groups.

Auckland Anniversary weekend traditionally featured waka and a Māori presence. This festival restores a Māori perspective to the weekend which marks Auckland's history. It complements other Auckland Anniversary weekend events, and allows Aucklanders and visitors travelling to Auckland's waterfront to take part in other events to easily add the Tāmaki Herenga Waka Festival into their weekend itinerary. The festival has a co-governance model, with representatives of Auckland's 19 mana whenua tribal authorities overseeing the authenticity of the festival content while ATEED brings its events production and economic development expertise to the project. The festival will develop and grow over time and demonstrates how the historic, traditional and cultural associations mana whenua have with the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi are being revitalised in a more contemporary way.

Te Haerenga

A further example can be seen at an individual iwi level, with Ngāi Tai ki Tāmaki. Te Haerenga was launched in May 2016, and offers a guided journey on Auckland's iconic Rangitoto and neighbouring Motutapu. Ngāi Tai tribal guides share traditional and contemporary stories linked to the islands. The interactive nature of the tour enables participation in traditional practices, such as food harvesting, weaving, or learning about the medicinal properties of the island's flora and fauna.

Rangitoto Island. Photo by Shaun Lee.

This experience allows participants to view flora and fauna regeneration programs, where bird species from around the country have been relocated to Rangitoto and Motutapu. Te Haerenga has now hosted, among others, the Premiere of Guangzhou-China, Steven Adams and the Oklahoma City Thunder, Love My New Zealand, Bike Auckland and Air New Zealand (Ngāi Tai ki Tāmaki Tribal Trust 2016).

The [sic] Te Haerenga website provides an overview of what is offered:

"Te Haerenga is not only about educating visitors about Ngāi Tai's conservation values, customs and history but also an opportunity to advance and empower their own people through education, tertiary study, employment and the use of our unique language and customs.

Te Haerenga is a vehicle for internal Iwi development and capacity growth that ensures all staff are encouraged to progress through the internal structures of the business. This will then translate into a highly skilled workforce where these same skills can be put to good use both within the company and the wider community.

For Ngāi Tai, education and employment are the key to achieving self-determination as a people."

For both the Tāmaki Herenga Waka Festival and Te Haerenga the benefits extend beyond growing the capacity of the mana whenua groups involved, it helps to celebrate and enhance Auckland's unique Māori identity, and supports the growing Māori economy within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

5.2.5 NGĀ PANONITANGA Ā-TURE, Ā-KAUPAPA HERE, Ā-MAHERE HOKI
CHANGES IN LEGISLATION, POLICIES AND PLANS

Over the past three years a number of key statutory and non-statutory documents have been released that should see significant changes in the way mana whenua interests and values are considered in the integrated management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi into the future. ***Table 5.2*** summarises the key changes in legislation, policies and plans for the period 2014-2017.

***Table 5.2**: Summary of key changes in legislation, policies and plans for the period 2014 - 2017.*

Legislation/ Policy/Plan	Key changes	Region	Status
Sea Change – Tai Timu, Tai Pari	The first Marine Spatial Plan for the Hauraki Gulf finalised. The plan provides a Māori values based approach to the integrated management of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi). Further work is required by the agencies and mana whenua to work together to implement the actions identified by the plan.	Auckland/ Waikato	Final (Non-Statutory)
Waikato Regional Policy Statement 2016 (RPS)	Introduced updated issues of significance to mana whenua. The Integrated Management chapter of the RPS has policies covering integrated approach, collaborative approach and mana whenua.	Waikato	Operative
Auckland Unitary Plan (Operative in Part) 2016	New provisions include: • Regional Policy Statement–issues of significance to mana whenua. • sites and places of significance to mana whenua overlay (Māori values based framework for scheduling sites, a total of 75 sites of significance currently protected). • Māori land and Treaty settlement land objectives, policies and rules that recognise the unique constraints of developing this type of land; • Māori purpose zones, offering opportunities for a range of cultural uses; • triggers in the Plan through objectives, policies and assessment criteria to provide guidance on when effects on mana whenua values require consideration; • references to Treaty settlement legislation (statutory acknowledgements).	Auckland	Operative
Resource Legislation Amendment Act 2017	Key changes include: • Council's must engage with iwi authorities on plans and policy statements prior to notification and must take into account their feedback in the section 32 evaluation report. • For plan and policy hearings, councils can consult with iwi authorities on the appointment of a commissioner who understands tikanga Māori and the perspectives of local iwi and hapū. • New collaborative planning processes encourage greater front-end public participation and deliberation in order to produce plans that better reflect community values. A council must appoint a collaborative group using criteria set out in the Act. This includes at least one person chosen by iwi authorities to represent mana whenua. • New Mana Whakahono ā-Rohe: Iwi Participation Agreements provide a unique opportunity for councils and iwi authorities to review the way in which they work together in RMA processes and to deliver an integrated management approach across Council boundaries.	Nationwide	Effective

Girls at Karaka Bay. Photo by Shaun Lee.

5.2.6 KO TE MĀRAMA KI TE HAUORA O TĪKAPA MOANA
UNDERSTANDING THE CULTURAL HEALTH OF THE HAURAKI GULF

Previous State of the Gulf reports and Sea Change – Tai Timu, Tai Pari, have identified the need for cultural indicators to understand the current state and any changes to the cultural health of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi over time. Local authorities are required to monitor the state of the whole or part of the environment. Both Auckland Council and Waikato Regional Council prepare State of the Environment reports, but there is very little monitoring data available to understand or monitor the State of the Gulf from an Ao Māori perspective in them.

Sea Change – Tai Timu, Tai Pari provides guidance on what a location/hapū specific cultural indicators framework might look like for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (Sea Change Stakeholder Working Group 2017). The plan recommends that iwi and hapū develop their own cultural indicators, with support from central and local government agencies.

The integration of mātauranga Māori with science could stimulate progress towards understanding the cultural health of the marine environment. For example, the use of Tohu Māori (traditional Māori indicators) relating to the environment, derived through years of observation and tradition can help to provide a more holistic view of how to manage certain resources more appropriately (Kennedy 2014).

At a local scale iwi are, to varying degrees, already undertaking their own cultural monitoring, and utilise their own mātauranga Māori and tikanga to do this. This information is not always reported by mana whenua.

Mana whenua are becoming more involved in consent monitoring arising from resource consents. Unfortunately, the extent of cultural monitoring is not currently captured in formats or repositories suitable for consolidation, analysis and reporting.

The implementation of Sea Change – Tai Timu, Tai Pari could improve the uptake of mātauranga Māori and cultural health indicators in monitoring data. This would strengthen our understanding of the cultural health of the Gulf.

5.2.7 NGĀ TIKA, TIKANGA Ā-IWI TUKU IHO ME NGĀ WHAKAHAERE CUSTOMARY RIGHTS, PRACTICES AND MANAGEMENT

Customary take for hui or tangi

The Fisheries (Kaimoana Customary Fishing) Regulations 1998 provides for, amongst other matters, permits to be issued for mana whenua to take kaimoana for hui or tangi. These permits must be issued by authorised mana whenua representatives. The regulations require that permits are recorded and able to be produced if requested by a fishery officer.

For the period January 2014 to December 2017 a total of 1,241 permits were issued for customary take for hui or tangi within the HGMP, and 1,106 permits were issued partially within the HGMP. The records provided by MPI for the period January 2014 to December 2017 are not detailed enough to determine quantities authorised over this period.

Mātaitai reserves and taiāpure

No new applications for taiāpure or mahinga mātaitai were received during this period. It is not clear why customary management techniques such as mātaitai reserves, taiāpure and rāhui are not being established in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Rāhui

In 2007 a rāhui (temporary ban) was put in place by Ngāi Tai ki Tāmaki on the tuangi (cockle) in accordance with tikanga Māori. The rāhui was complimented by an interim closure issued under s186 of the Fisheries Act and has been extended, resulting in a significant improvement in the tuangi (cockle) populations in this location.

Dead tuangi (cockle). Photo by Shaun Lee.

5.2.8 HE ARONGA KI TE 'ĀRAITIA O NGĀ TIKA Ā-IWI' ME TE 'MANA Ā-HERE TUKU IHO' I TĪKAPA MOANA RECOGNITION OF 'PROTECTED CUSTOMARY RIGHTS' AND 'CUSTOMARY TITLE' IN THE HAURAKI GULF

The recognition of protected customary rights and customary title within the coastal marine area provides the opportunity for mana whenua to further exercise their customary interests in the common marine and coastal areas. If recognition is provided, they will be afforded greater involvement in decision-making processes for certain activities within, or with the potential to affect, those areas.

The opportunity to apply for recognition of protected customary rights and customary title within the coastal marine area has been available to mana whenua groups since the Marine and Coastal Area (Takutai Moana) Act came into force in April 2011. The deadline for applications to be made was 3 April 2017. This saw a major influx of applications being lodged with the Minister for Treaty of Waitangi Negotiations and the High Court. Over seventeen applications were received for areas within or partly within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. At the time of writing, no applications for recognition agreements and orders have been released.

Customary Marine Title

The Marine and Coastal Area (Takutai Moana) Act 2011 provides for iwi, hapū and whānau to determine their customary rights in the common marine area, through a customary marine title. In order to obtain customary marine title in a particular area, a group must have had exclusive use and occupation of the area since 1840 without substantial interruption, and have held the area in accordance with tikanga. Customary marine title gives certain rights under the Act within the area covered. They include affected parties' rights under the RMA, protection of wāhi tapu and wāhi tapu areas within the customary marine title, and more.

The interest in land does not allow the land to be sold or for the public to be excluded. The Act does not allow for additional rights to be negotiated beyond what is provided for in the Act.

Protected Customary Rights

Iwi, hapū or whānau can seek recognition of protected customary rights, which include certain customary activities such as waka launching and gathering natural materials. The activities must have existed at 1840 and have been continually undertaken since then. Where protected customary rights are recognised they are exempt from resource consent requirements and coastal occupation charges. A resource consent cannot be granted if it is likely to have adverse effects that are more than minor on the exercise of a protected customary right.

Customary Marine Title gives applicant groups the ability, with some exceptions, to say yes or no to activities that need resource consents or permits in the customary title area. Protected customary rights let the applicant group carry out the protected activity without needing a resource consent. Local authorities can't issue resource consents that would have adverse effects that are more than minor on a protected activity, unless the applicant group agrees.

Table 5.3 on the next page provides a summary of the groups that have applied for protected customary rights and customary marine title that affect areas within Tīkapa Moana / Te Moana-nui-a-Toi. At the time of writing not all of the applications were listed on the Ministry for Justice website and this list is subject to change. Copies of the maps prepared to date are provided at Ministry of Justice (2017).

***Table 5.3**: Applications made under the Marine and Coastal Area Act to the Ministry of Justice (Ministry of Justice 2017).*

Applicant Group	Application Area[16]	Region	Status
Ngāti Rehua Ngātiwai ki Aotea	On the landward side, from mean high water springs between Whananaki and Matapōuri at Ōkura Te Raki Pae out to the outer limits of the territorial sea. The application area includes Mokohīnau Islands, Te Hauturu-o-Toi / Little Barrier Island and surrounding islands. Aotea and the surrounding island, pinnacles and rocky outcrops.	Auckland	In process
Te Whānau o Hone Papita rāua ko Rewa Ataria Paama	On the landward side by the line of Helena Bay merging into Mimiwhangata and Pareparea Bays of the main island and other islands in other adjacent blocks; on the seaward side by the outer limits of the territorial sea; out to Poor Knights Islands and across to Aotea and Hauturu islands including the islands to the outer limits of the territorial sea; and including the common and marine coastal area around Tawhiti Rahi Aorangi known as Poor Knights, Mokohīnau Islands.	Auckland	In process
Te iwi, whānau and hapū of Ngātiwai	From Tāpeka Point, in the north, to the Matakanakana River in the south and encompasses the chain of islands from Motukōkako off Te Rāwhiti, Rimuriki off Mimiwhangata, Tawhiti-rahi and Aorangi (Poor Knights), High Peak Rocks, Sugar Loaf Rocks, the Marotiri Islands and Tāranga (the Hen and Chicken Group), Tūturu (Sail Rock), Pōkohinu and Motukino (Mokohīnau Islands), Te Hauturu-o-Toi / Little Barrier Island, Aotea / Great Barrier Island and its surrounding islets and rocky outcrops, Te Kawau-Tū -māro-o-Toi (Kawau Island) and Te Mau Tohorā-o-Manaia.	Auckland	In process
Te Hikutū whānau and hapū	With Hokianga Harbour from Te Ramaroa in the south look to Whiria in the west then north to Pou Whakakiwa at the mouth of the Whirinaki River, including Mahena Island, then east to Tāhere to the mouth of the Manaia River and then back to Te Ramaroa. PCR: The Hokianga Harbour, Matauri Bay down to Te Ngaere, Rangihōua, Pēwhairangi, through Ngātiwai rohe to Poor Knights Islands and down to Tāmaki Makaurau.	Auckland	In process
Ngāti Manuhiri	On the landward side, by the line of high water springs. On the seaward side by the outer limits of the territorial sea. On the northern end, by Paepae-o-Tū (Bream Tail). On the southern end by the Ōkura river mouth. Including the coastal marine areas surrounding the Mokohīnau Islands, Te Hauturu-o-Toi / Little Barrier Island, Kawau-o-Tū-Māro, Tiritiri Matangi, Motu Tohorā and other small islands and rocky outcrops.	Auckland	In process
Freda Pene Reweti Whānau Trust	Aotea / Great Barrier Island) including small islands and rocky outcrops that surround Aotea. To a point in the north that includes Mokohīnau Islands; to the east, to the extent of the territorial sea; to a point in the south that is approximately half way between Aotea and Coromandel Peninsula; to a point in the west that includes Te Hauturu-o-Toi / Little Barrier Island).	Auckland	In process
...			

Applicant Group	Application Area[16]	Region	Status
Ngāti Whātua o Ōrākei	Waitematā Harbour and Manukau Harbour: Māngere Inlet to Titirangi.	Auckland	In process
Te Kawerau a Maki	12 nautical miles out from all coastal areas between Te Ārai Point and the Waitematā Harbour and 12 nautical miles from all coastal areas between Muriwai and the Manukau Harbour.	Auckland	In process
Ngāti Tamaoho	Manukau Harbour. On the east coast, from Te Pūaha o Manukau in the north, to Te Pūaha o Waikato in the south. Tīkapa Moana / Te Moana-nui-a-Toi, Waitematā harbour and Firth of Thames.	Auckland	In process
Ngātiwai ki Aotea	On the landward side by the line of mean high-water springs of Aotea / Great Barrier Island, Hauturu / Little Barrier Island, Pōkohinu and Motukino (the Mokohīnau Islands), and the rocks and islets off Aotea; on the seaward side by the outer limits of the territorial sea.	Auckland	In process
Te Kupenga o Ngāti Hako	Area from Raukura to Kuramāia inclusive of all offshore islands.	Waikato	In process
Ngaati Whanaunga	Matakana in the north to Matakana in the south covering the eastern seaboard, and includes the Auckland isthmus as well as the islands within Tīkapa Moana / Te Moana-nui-a-Toi. Ngaati Whanaunga traditionally had interests in Hauturu and Aotea.	Auckland, Waikato	In process
Ngāti Hei	From Anarake point down to Ruahiwihiwi Point out to 12 nautical miles and including the islands within this area.	Waikato	In process
Ngāi Tai ki Tāmaki	The common marine and coastal area near the following land blocks: Maraetai 3B; Maraetai 3B2; Musick Point; Āwana; North Head Reserve; Te Kawakawa; Waitawa; Mātaitai; Poutō; Waiterata. The common marine and coastal area surrounding the following islands: Rangitoto; Motuihe; Motukaraka; Motutapu; Waiheke; Motukorea.	Auckland, Waikato	In process
Ngāti Tara Tokanui	From the northern end of Opoutere Beach in the Coromandel to the southern banks of the Aongatete River.	Waikato	In process
Ngāti Porou ki Hauraki	Area 1: Harataunga / Kennedy Bay, being westward of a straight line between a point 1.3 kilometres coastwise north east of Tokangawha Point in the north and Anarake Point in the south and tracking between these two points arount the interior of Harataunga at the line of mean high water springs. Area 2: Mataora: between Ōtonga Point in the north, southward along the line of mean high water springs to the southern boundary of the Part Mataora 4 Block and bounded on the seaward side to a distance of 3.5km.	Waikato	In process
Te Whānau a Haunui	In the Firth of Thames area between Wharekawa and Tāpapakanga Stream out to 4.8 nautical miles.	Auckland, Waikato	In process

[16] Note: some parts of applications extend beyond the HGMP.

TE PANONI MANA WHAKAHAERE
5.3 CHANGING MANAGEMENT

A number of significant changes have been made in the regulatory space since 2014.

The National Policy Statement for Freshwater Management has been amended, and a National Policy Statement for Urban Development Capacity has been introduced. An environmental standard for the harvesting of production forests comes into effect next year, while consultation on a proposed national environmental standard for marine aquaculture has closed.

The Auckland Unitary Plan is largely operative, and the Waikato Regional Policy Statement became operative in 2016.

A local bill has been introduced into Parliament on behalf of the TCDC and HDC to streamline the local management of mangroves.

The Ministry for Primary Industries (MPI) have conducted a review of New Zealand's fisheries management system with three strategic proposals arising from it: a Technical Advisory Group; a programme for the development of a new digital system for tracking, reporting and monitoring commercial fishing activity; and, regulatory changes to provide for the use of new trawl technologies on commercial fishing boats.

The Government set a target to make New Zealand free of identified predators, (namely possums, stoats, and rats by 2050), and released a consultation document seeking feedback on a new Marine Protected Areas Act.

An import health standard for ballast water came into effect in 2016, and craft risk management standard for biofouling comes into effect in 2018.

The Hauraki Gulf Marine Spatial Plan, Sea Change – Tai Timu, Tai Pari was released in December 2016.

Since 2014, there have been a number of significant developments in resource, fisheries and conservation management at national, regional and local levels.

Harvested forest. Photo by Shaun Lee.

WHAKAHAERE RAUEMI
5.3.1 RESOURCE MANAGEMENT

Amendments to the RMA in 2017 reinforced the role of tāngata whenua in decision-making processes, while treaty settlements have also included provision for co-management arrangements with various iwi, including the 12 Hauraki iwi in the catchments of the Waikato region that flow to the Gulf (see section 5.2).

Several national policy statements and environmental standards have been updated or introduced. The National Policy Statement for Freshwater Management (NPS-FM), which was first gazetted in 2011 and amended substantially in 2014, requires all regional authorities to maintain or improve overall freshwater quality in their regions, and meet *"national bottom lines"* (minimum acceptable states) in the National Objectives Framework (NOF). This has to be achieved by 2025, although this can be extended out to 2030. This will typically include regulatory controls on land use, which have been successfully introduced in many parts of the country in the last 10 years.

The NPS-FM was further amended in 2017 that, in summary, include:

- A target of having 90% of larger rivers *'swimmable'* by 2040. The target is embodied in the NPS, which gives it legal status, and makes it mandatory that regional authorities must work towards this target in rivers and streams that are large enough to swim in. Councils are required to set regional targets to meet the national target by the end of 2018, and state the improvements they will have to make and over what timeframes. The focus is on reducing levels of disease causing microbial contaminants (as reflected by the indicator species Escherichia coli) and potentially toxic cyanobacteria in watercourses that could be large enough to swim in.
- Councils must improve the quality of water in each Freshwater Management Unit for contact recreation. This includes small rivers that run directly to estuaries and/or the sea.
- The requirement to maintain or improve water quality in a region has been taken to a much smaller spatial scale so it applies to each Freshwater Management Unit. This makes it clear that regional 'trade offs' in different assemblages of water bodies cannot occur.
- It is now mandatory to include coastal lakes and lagoons in the freshwater planning process.
- There are additional monitoring requirements, including a five-year monitoring requirement for E. coli and cyanobacteria, and more nationally consistent criteria for microbiological standards and alerts at beaches used for swimming.
- Councils are now required to set instream concentration or load limits of dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorous (DRP)[17] in rivers and streams, and in doing so, must consider sensitive downstream environments (including estuaries). Limits must be set to control periphyton abundance, but there are no new *'national bottom lines'* set over and above those already in the NOF. The NPS also now prescribes how instream concentrations or loads of DIN and DRP are to be assessed.

A national policy statement for urban development capacity came into effect in December 2016. This had been developed jointly by the Ministry for the Environment (MfE) and Ministry of Business, Innovation and Employment (MBIE). It directs local authorities to provide sufficient development capacity in their resource management plans for housing and business growth to meet demand. In this context *'development capacity'* refers to the amount of development allowed by zoning and regulations in plans that is supported by infrastructure. Such development can be outwards (on greenfield sites) or upwards (by intensifying existing urban environments).

A national environmental standard for the harvesting of production forests will come into effect on 1 May 2018. It includes new national regulations that will standardise the treatment of forest related activities across the country, rather than there being different standards in regional and district plans. The standard covers eight core forestry activities, including earthworks, river crossings and harvesting. It sets performance standards for permitted activities relating to these and other


Cattle in a Coromandel estuary. Photo by Shaun Lee.

activities. Councils can make more strict rules, but only where there are significant natural areas, outstanding natural features or landscapes, specified geological areas or sensitive receiving environments.

MfE acknowledge that the national rules will be stricter in some jurisdictions. Their analysis from nine regions showed that the new national foresty standard will raise environmental performance for most effects when compared with existing council rules.

Consultation on a proposed national environmental standard for marine aquaculture has also been carried out by MfE, with the submission period closed in August 2017.

Another relevant initiative is that the Environmental Reporting Act came into effect in 2015. This places obligations on central government to report every five years on the state of our natural resources, including a new requirement to monitor and report on te ao Māori indicators (see section 5.2). The first two major national reports published under this Act have been *"Our Marine Environment"* published in 2016, and *"Our Fresh Water"* published in 2017. Both reports were collaborative efforts between MfE and Statistics NZ.

In terms of the regional planning and regulatory framework, provisions of the Auckland Unitary Plan, (which is now largely operative) have replaced the former ARC Regional Policy Statement, its Air, Land and Water Regional Plan, three other regional plans and nine district plans. A key focus of the Unitary Plan is on providing for urban growth, both by intensification within existing urban areas and extensions to the urban footprint within the region. Objectives in the Plan require that freshwater and coastal systems be maintained where they are in good condition or better, and enhancing them where they are degraded.

Some significant changes were made to the regulatory frameworks for water and coastal management in the Auckland region. In relation to the HGMP, provisions in the Unitary Plan of particular note include:

- Strengthening requirements related to mana whenua involvement, for example by establishing triggers for when consideration of mana whenua values is required (see section 5.2).
- Intermittent streams are now given the same protection status as permanent rivers and streams.
- Former regional and district earthworks provisions have been brought together, providing a more comprehensive approach to managing sediment run-off from earthworks and land disturbance activities. Some changes are also included on cultivation rules, which require greater setbacks from streams on steeper land.
- Permitted nitrogen application rates for dairy farms have been reduced, with resource consent now required for application above these thresholds.
- Provisions to reduce sediment run-off by managing peak stream flows, and phasing out livestock access to the coastal marine area, and to lakes, rivers, streams and wetlands on intensively grazed production land.
- Most coastal overflows from new wastewater networks are now covered by permitted activity rules. Where a discharge does not comply with the permitted activity standards it is a controlled activity (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, or an alternative discharge frequency is justified by a 'best practicable option' assessment. Dry weather overflows are limited to events largely beyond the control of the Council, such as power failures, third party damage or unforeseen blockages. There is an additional requirement for an 80% reduction in the average annual overflow volume in the Western Isthmus (Central Interceptor) catchment by 2030. For controlled activity discharges, a programme must be in place to ensure that these standards are met by 2040.
- The public stormwater network will continue to be operated using a 'best practicable option' approach. However, the plan places a greater emphasis on the on-site management of stormwater quality and runoff than the previous plans and policies.

In the longer term these changes, along with those that will be necessary to meet the provisions of the 2017 amendments to the NPS-FM, have the potential to improve environmental outcomes in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. However, these gains could be offset by continuing population growth and the associated sediment and stormwater discharges from new housing and roads. Additionally, further intensification of housing on the Auckland isthmus will place additional demands on aging stormwater and wastewater networks.

The Auckland Council has also prepared a coastal management framework for the region, largely in response to the risks posed by climate change. The main risks listed include rising sea levels, coastal erosion (including beaches and sea cliffs) and inundation, more extreme climate events and the seemingly inevitable long-term failure of beach protection works. The management framework divides the region into 12 coastal compartments, with Coastal Compartment Management Plans expected to be prepared for each of these. Priority will be given to number of 'hotspots', such as Orewa, and Whangaparāoa North and South.

The Waikato Regional Policy Statement became operative in 2016 and provides the regional framework for sustainable resource management. All local authorities in the Waikato Region are obliged to '*give effect to*' the Policy Statement. Among other things the policy statement includes objectives and policies seeking:

- the integrated management of natural and physical resources, including recognising the inter-relationships and values of water body catchments, riparian areas and wetlands, the coastal environment, the Hauraki Gulf and the Waikato River, and the complex interactions between air, water, land and all living things;
- to recognise and provide for the mauri and health of marine waters, and the mauri and identified values of fresh water bodies;
- to investigate opportunities for joint initiatives (including across regional boundaries) particularly in relation to managing the Hauraki Gulf;

[17] DIN and DRP are the biologically available forms of these nutrients in freshwater.

- to actively participate in and contribute to the Hauraki Gulf Forum, and advocate for the forum to play an active role in the management, research, advocacy and education in relation to the Hauraki Gulf and its catchments.

The Waikato Regional Coastal Plan is presently being reviewed, with the intention of integrating it with the council's overall Regional Plan (WRC, pers. comm.). Waikato Regional Council has also been focussed on a major change to their Regional Plan (Proposed Plan Change 1 in the Waikato catchment), but that does not relate to the Hauraki Gulf Catchment.

Notification of a regional plan for the Gulf's catchments is unlikely before about 2019. Consistent with the NPS-FM 2017, this plan will have to impose limits on nutrient losses to fresh water (and eventually the Gulf). Recent research has highlighted how difficult this will be given that over three-quarters of nutrient losses from farming to freshwater are from very small streams and drains (McDowell et al. 2017).

Waikato Regional Council (WRC) also plan to develop a Waikato Coastal and Marine Strategy and a Waikato Aquaculture Strategy. The former has been scoped but did not proceed as funding was committed to the Sea Change Spatial Plan programme. Work is being undertaken on an aquaculture strategy, which will assess the current state of aquaculture in the region, what its potential growth is over the next 30 years, and work programmes to facilitate or work towards meeting this growth potential. This work programme extends beyond the Hauraki Gulf.

WRC has committed to funding of $3.006 million over 10 years to coastal workstreams including: determining long-term monitoring parameters for the marine environment; installing water quality monitoring buoys in the Gulf; water quality monitoring at recreational swimming beaches; and, monitoring in harbours. The Council also committed funding of $575,000 between 2015-2016 and 2017-2018 on monitoring for invasive marine species, such as the Mediterranean fan worm, in Coromandel harbour and the Firth of Thames. Complimentary funding is being provided by MPI.

Mediterranean fanworm in a seagrass meadow. Photo by Shaun Lee.

Harbour and catchment management plans for Whangamatā, Wharekawa, Tairua and Whangapoua have also been completed and are in various stages of implementation. Two more plans are now proposed to be prepared in the next two years, the first for Whitianga / Mercury Bay and the other for Coromandel / Manaia. The plans look at a wide variety of matters, including compatibility and conflicts between users of the coastal marine area, the cumulative effects of development, maintaining or enhancing natural character, ecological values and public access, and the social, economic, cultural and recreational aspirations of the local and regional community. At present, the catchment management plans are non-statutory and non-regulatory, but Council could choose to incorporate at least parts of them into their Regional Coastal Plan (WRC, pers. comm.).

Two District Councils in the Waikato region border the HGMP (TCDC and the Hauraki District Council (HDC)). Waikato District and Matamata Piako District overlap the Gulf's catchment. District Councils provide most local services, including parks and reserves, roading, water supply, waste disposal, and sewerage networks and sewage treatment.

The TCDC is currently operating under two District Plans. These are the Operative Plan, which became operative in 2010, and a new Proposed Plan notified in December 2013, which is now partly operative. The Proposed Plan provides for development and growth in areas with capacity in existing or planned water, wastewater and stormwater infrastructure. Outside of these areas, development is provided for where it is self contained. The Proposed Plan recognises the national significance of the Hauraki Gulf. The chapter on the coastal environment has a focus on implementing the provisions of the New Zealand Coastal Policy Statement 2010, and places additional controls on activities to protect the special values of the coastal environment. Both of these chapters are subject to a number of appeals to the Environment Court that are yet to be resolved.

The current District Plan of the HDC became operative on 26 September 2014. It establishes 18 different zones in the District, but contains little material of direct relevance to the management of the HGMP.

A Local Bill has also been introduced into Parliament on behalf of the TCDC and HDC to streamline the local management of mangroves. The TCDC and HDC Mangrove Management Bill seeks to facilitate the removal of mangrove vegetation to *"achieve and maintain appropriate levels"* of mangroves; and to *"restore, protect, and enhance any amenity values or ecosystems of the coastal area from which mangrove vegetation is removed"*. The Bill passed its first reading in Parliament in August 2017 and has been sent to the Local Government and Environment Select Committee for further consideration. WRC and TCDC have also formed a 'partnership' for mangrove management in Coromandel harbours by signing up to a joint Statement of Intent and Action List.

WHAKAHAERE TAUNGA HĪ IKA
5.3.2 FISHERIES MANAGEMENT

Key developments for fisheries management in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, since 2014 have included:

- the adoption of the Snapper (SNA1) management plan (SNA1 Strategy Group 2016), and a start being made on the roll-out of its recommendations (see section 6.1.2);
- a 36.1 tonne reduction in the total allowable commercial catch (TACC) of crayfish in the CRA2 quota management area (which includes the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi) in 2014, followed by the voluntary shelving of an addition 50 tonnes in 2016 (see section 6.1.3);
- the dropping of in-season surveys and TACC adjustments for scallops in the Coromandel management area, in favour of setting a 50 tonne TACC and applying a voluntary catch per unit effort (CPUE) limit rule run by the commercial fishers (see section 6.1.5);
- the establishment of a black petrel working group in 2014, that seeks to decrease catch rates of black petrel in FMA1, due to grave concerns about the sustainability of the species (see section 6.10.3).

More broadly, MPI have conducted a review of New Zealand's fisheries management system, for the purpose of ensuring that it *"is future focused and able to provide for a sustainable fisheries resource for all of New Zealand"*. Several elements of fisheries management were specifically excluded from the review (Ministry for Primary Industries 2016d):

- the purpose of the Fisheries Act (to provide for the utilisation of fisheries resources while ensuring sustainability);
- the Crown's obligations under Treaty settlements and the rights and interests of tangata whenua, including customary management;
- the right to fish recreationally in coastal waters;
- the key Quota Management System (QMS) tools, including the rights associated with the ownership of quota.

The overall conclusion of the review was that *"New Zealand's fisheries management system is sound, and independent assessments show that overall our fisheries are doing well"*. However, the review still concluded that the fisheries management system had to adapt to future challenges and can be improved in a number of areas, including:

- *"strengthening incentives (for example, incentives to reduce discarding);*
- *enhanced management frameworks (for example, finer geographic scale and ecosystem-based fisheries management);*
- *greater focus on building and maintaining abundance which means, potentially, managing some fish stocks above current sustainability levels;*
- *cost of managing the fisheries system and how this would be paid for;*
- *protection of the marine environment (managing the environmental impact of fishing and the broader ecosystem);*
- *greater involvement of local communities;*
- *minimising waste such as discarding;*
- *increased shared responsibilities (greater involvement of users in decisions that affect them)".*

Three strategic proposals fell out of the review, which led to the creation of a Technical Advisory Group; a programme for the development of a new digital system for tracking, reporting and monitoring commercial fishing activity; and, regulatory changes to provide for the use of new trawl technologies on commercial fishing boats. The latter two initiatives came into effect on 1 October 2017.


Commercial fishing boats. Photo by Shaun Lee.

The review coincided with a period when a clear divergence of opinion was emerging between marine ecologists, economists, Māori academics, industry participants and fishery scientists about the current efficacy of New Zealand's fisheries management system. Much of this has been played out in international science and policy journals. Recent examples include papers in a special issue of 'Marine Policy' that covered the impact of neoliberal policies on small-scale fisheries around the world. Contributors from New Zealand argued that New Zealand's QMS:

- Has *"embedded a perverse, rent-based management system that has created incentives for dominant actors to maximise low value added extractive activity, often in very wasteful ways"* (Torkington 2016).
- Has created a situation where elements of sustainability are directed towards sustaining the wealth generating potential of quota holdings, and legitimising the privatisation and marketisation of marine environments to protect the income stream of quota investors (McCormack 2017). McCormack (2017) argues this has had significant social and cultural cost, stating *"The fulfilment of cultural obligations around the supply of kaimoana [seafood] to kin and guests has been increasingly difficult to accomplish"*.
- Creates a disproportionate risk for small fishers without their own quota holdings and associated annual catch entitlement (ACE). They can potentially face financial ruin from a misfortunate trawl that lands fish they do not have, or cannot get, ACE for (because they are required to pay deemed value costs for fish in excess of their ACE) (Stewart & Leaver 2015).
- Has reduced Māori participation in the fishing industry despite significant Māori quota ownership. This is attributed to policies that incentivise the use of quota as an investment asset by non-fishers, and other policies that create obstacles for small-scale fishers seeking market access (Bodwitch 2017).

Other examples have:

- Questioned international comparisons of New Zealand's fisheries management performance. Apparent bias was highlighted in a 2016 comparison (Melnychuk et al. 2017b), which overall, ranked New Zealand's system highly (5th out of 28 countries) (Slooten et al. 2017 – note that the bias was subsequently disputed by Melnychuk et al. (2017a)). A key issue highlighted by Slooten et al. (2017) was that the analysis relied on an opinion survey, with the seven New Zealand respondents comprised of three fishing industry employees or consultants, one person working for MPI, one person working for the agency responsible for stock assessment, and two anonymous respondents. They went on to state that other New Zealand fisheries experts are

Pufferfish on Te Ārai Beach. Photo by Shaun Lee.

much less optimistic, and provided examples of local fishery management issues to support their concerns.

- Highlighted omissions in New Zealand fishing catch statistics between 1950 and 2010, related to unreported catch by commercial fishers, discarded fish, and of fish taken by recreational and customary fishers (Simmons et al. 2016). The findings of the report were considered during an independent review of three, high-profile decisions around prosecutions by MPI/Ministry of Fisheries (MFish) for commercial fishers that under-reported and discarded bycatch (Heron 2016). In his summary of findings Michael Heron, QC stated *"The issues raised in the Simmons report have long been recognised by MFish/MPI and industry. A coherent rationale to the rules around discards is not obvious. The fisheries management system is under review at present and provides an opportunity examine this. In the meantime, it is incumbent on commercial fishing to improve their performance and comply with the current law"* (Heron 2016).

Conversely, other publications have highlighted key strengths of the New Zealand's fisheries management system, and the progress made since the introduction of the QMS. For instance:

- Cryer et al. (2016) recounts the history of the New Zealand's QMS and lists major achievements in the move towards ecosystem based fisheries management. They acknowledge that we remain at the lower end of an ecosystem based framework, and highlight the challenges that need to be overcome to progress up the ecosystem-based continuum. Moving to an ecosystem-based fishing framework is one of the key recommendations in the Sea Change report.
- An MPI review by Mace et al. (2014) highlighted key positive elements of New Zealand's fisheries management, including: preventing overfishing; the current lack of significant over capacity; the development of biological reference points and a harvest strategy standard; the favourable stock status for the majority of stocks with known status; and the development and implementation of comprehensive risk assessments and management plans to protect seabirds and marine mammals.

5.3.3 WHAKAHAERE MAHI TIAKI I TE TAIA CONSERVATION MANAGEMENT

Key developments for conservation management since 2014 include a Government-led initiative to free New Zealand of introduced predators by 2050, and local initiatives seeking to create new marine reserves.

In July 2016 the Government set a target to make New Zealand free of identified predators, namely possums, stoats, and rats by 2050. A new organisation known as 'Predator-free New Zealand' was set up as part of this initiative, and $7 million of funding was assigned annually. Four interim goals were set by 2025: these include having a million hectares of land where pests are suppressed or removed; the development of a scientific breakthrough enabling the eradication of one mammalian predator; having at least 20,000 hectares on the mainland predator-free without the use of fences; and, the eradication of introduced predators from all offshore island nature reserves.

Both the interim and long-term targets are very ambitious, and will rely on long-term funding from successive governments. The 2050 target would be impossible to meet using present technology (such as poison drops and trapping of stoats), and is very likely to rely on research work leading to innovative biological methods of predator control.

Tāmure (snapper) at the Leigh Marine Reserve. Photo by Darryl Torckler.

The Government released a consultation document in 2016 seeking feedback on a new Marine Protected Areas Act (Ministry for the Environment 2016b). The consultation document outlined the Government's desire to reform legislation around marine protected areas, with a proposal to create four categories of marine protected area:

- ***"Marine reserves** would be the same as under the current Marine Reserves Act 1971, being strictly protected with the purpose of conserving biodiversity in its natural state;*
- ***species-specific sanctuaries** would be similar to marine mammal sanctuaries but would also be available to other marine life like albatross or great white sharks, with rules focused on the specific protection needs of that species;*
- ***seabed reserves** would protect areas of the sea floor and would include prohibitions on seabed mining, bottom trawl fishing and dredging;*
- ***recreational fishing parks** would recognise that there are areas where the recreational fishing experience could be improved by providing a preference for non-commercial fishing for some species."*

Other options for new marine protected areas in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi have also been investigated since 2014, but Te Matuku Marine Reserve remains the only new protected area established since the HGMP Act came into effect. The Hauraki Gulf Marine Spatial Plan – Sea Change – Tai Timu, Tai Pari proposed three categories for marine protected areas, and an additional nearshore zone to be jointly managed by mana whenua and the community:

1. **Type 1** or no take marine reserves, with the exception of customary harvest on a case-by-case basis by special permit.
2. **Type 2** or benthic protection areas where all commercial and recreational fishing methods that have an impact on benthic habitat are restricted.
3. **Special Management Areas** where no commercial is allowed but limited recreational and targeted sports fishing is permitted.
4. **Ahu moana** areas that are co-managed by mana whenua and the community.

Fifteen marine protected areas were identified in the spatial plan.

Waiheke Island Local Board commissioned a survey to determine the level of support for a reserve network around Waiheke and surrounding islands (Bing 2015). Subsequently, an investigation of five areas identified as potential no-take reserves around Waiheke Island was commission by the Local Board and in association with the Hauraki Gulf Conservation Trust (Haggitt 2016). Survey results indicated that the majority of registered voters (67%) and off-island ratepayers (54%) support the establishment a network of marine protected areas. All of the options investigated had some merit, but conservation outcomes for options on the southern side of Waiheke were likely to be less certain. Haggitt (2016) therefore concluded that effort should be focussed on options for the northern side of Waiheke.

Friends of Motuketekete Reef have also proposed establishing a stand-alone marine reserve to protect reef habitat towards the north-eastern side of Motuketekete Island (Hauraki Gulf Forum 2017).

Conservation Management Strategies for the Auckland and Waikato conservancies were released in 2014. Both strategies include objectives related to supporting the HGMP Act and activities of the Hauraki Gulf Forum, including in the development and implementation of a marine spatial plan. Other objectives seek to work with tangata whenua, councils, and other organisations on matters related to the park. In addition, specific policies are provided covering the use, management and promotion of marine reserves and islands of the Gulf.

5.3.4 TE ĀRAI KOIORA BIOSECURITY

In order to minimise the risk of incursions of non-indigenous species, MPI have recently implemented new standards for ballast water (Ministry for Primary Industries 2016b) and hull biofouling (Ministry for Primary Industries 2014a). The import health standard 'Ballast water from all countries' came into force in 2016. This standard requires all vessels arriving into New Zealand to meet one for the following options:

1. Exchange their water in mid-ocean (> 200 nautical miles from land and in water > 200 m deep) prior to arriving in New Zealand.
2. Use freshwater for ballast.
3. Treat their ballast water using an approved ballast water treatment system (Ministry for Primary Industries 2016b).

Clubbed tunicate in Karaka Bay. Photo by Shaun Lee

The Craft Risk Management Standard 'Biofouling on vessels arriving to New Zealand' will come into force in May 2018, following a four year lead-in period, during which, compliance with the standard was voluntary. This standard requires all vessels arriving into New Zealand to have a 'clean' hull and to demonstrate approved hull maintenance practices. Vessels intending on staying for longer than 21 days are only permitted to have goose barnacles and a slime layer on their hull, while vessels staying for less than 21 days are permitted to have goose barnacles and a small quantity of seaweed, tubeworms, bryozoans and barnacles on their hull and in niche areas (Ministry for Primary Industries 2014a). After May 2018, non-compliant recreational vessels will be hauled out and cleaned at the owner's expense (Ministry for Primary Industries 2014b).

HE HURIHANGA HŌU – TAI TIMU, TAI PARI
5.3.5 SEA CHANGE – TAI TIMU, TAI PARI

The Hauraki Gulf Marine Spatial Plan, Sea Change – Tai Timu, Tai Pari was released in December 2016. The Plan was the culmination of around three years of collaborative, stakeholder-driven work by mana whenua and representatives from key sectors, with support from central and local government. Its genesis was the Hauraki Gulf Forum's 2011 State of the Environment Report, which concluded that existing management practises were not sufficient to reverse the long-term degradation of the HGMP. The Spatial Plan attempts to integrate the management of catchment and marine issues, and to also integrate mātauranga Māori with western science. Sea Change – Tai Timu, Tai Pari has no statutory status, but there is an expectation that it will be implemented in large part. The plan is underpinned by four overarching concepts and includes around 100 distinct actions across 18 themes. The collaborative approach allowed all perspectives to be considered and fostered compromise among working group members. This allowed agreement to be reached on the management of some of the most challenging issues.

Swimmer with tāmure (snapper) at the Leigh Marine Reserve. Photo by Shaun Lee.

The Spatial Plan's recommendations were summarised in an introduction and overview report that accompanied the release of the plan (Sea Change Stakeholder Working Group 2016). In short, they include a combination of 'business as usual' practices, modifications of existing practices, and new actions. The latter category includes two of the boldest initiatives:

- phasing trawling, Danish seining, and dredging out of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi;
- establishing new categories for marine protected areas including ahu moana areas, and identifying where 15 of them should be established (see section 5.3.3).

Other notable recommendations include:

- support for greater restoration efforts where habitats have been degraded or lost;
- establishing a separate fisheries management area and quota management area for the HGMP and specifying principles to be applied to fisheries decisions in the HGMP;
- the identification of areas that should be prioritised for future aquaculture development, including both shellfish and finfish;
- developing a new management regime for managing the non-commercial harvest of intertidal species;
- banning the use of set nets for fishing on reefs.

PANONI MĀTAURANGA
5.4 CHANGING KNOWLEDGE

The 2011 State of our Gulf report identified five core knowledge needs for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi:

1. Mapping and classifying the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi ecosystems and defining its status.
2. Defining the ecological infrastructure of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.
3. Getting the best return on resource exploitation.
4. Defining the interrelationships between land and sea.
5. Adapting to the future.

Information on cultural health has also been highlighted as a significant gap (see section 5.2).

Recent examples of projects that have advanced our understanding of the needs identified in 2011 are summarised below.

TE WHAKAMAHERE ME TE RARAU I NGĀ PŪNAHA HAUROPI O TĪKAPA MOANA
5.4.1 MAPPING AND CLASSIFYING THE HAURAKI GULF ECOSYSTEMS

- The natural character of the entire Waikato coastal environment has been assessed to provide information for the identification of areas of high and outstanding natural character (Boffa Miskell Ltd 2016). A summary of studies that include inventories or surveys of marine communites and biota present in the Waikato region has also been compiled, with particular regard to threatened species, vulnerable life stages, and sensitivity to specific pressures such as sedimentation, climate change, human disturbance and predation (Bouma 2015).
- A recent review of drop camera footage of deep reefs collected in 2008 by the Department of Conservation has identified diverse deep reefs to the east of Mercury Islands that contain rare, slow growing and fragile species such as black coral and flask and glass sponges. These reefs also appear to be heavily impacted by terrestrial sediments, which are most likely to be derived from catchments along the east of Coromandel Peninsula (C. Duffy, DOC, pers. comm.).
- Biogenic habitats in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (and elsewhere) were identified and mapped through interviewing and recording the knowledge of trawl fishers (Jones et al. 2016, ***Figure 5.19***).

TE WHAKARITE I NGĀ TIKANGA WHAKAHAERE O TĪKAPA MOANA

5.4.2 DEFINING THE ECOLOGICAL INFRASTRUCTURE OF THE HAURAKI GULF

- A large, multi-year project estimated the changes that have occurred in marine animal populations in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi since the arrival of humans, and how these changes have affected the structure of the food-web in the Gulf, and the trophic groups that are most influential on the dynamics of the ecosystem (see Case Study: section 5.4.6).

- Annual monitoring of rocky reef communities along Auckland's east coast between 2007 and 2013 found that the monitored reef communities are relatively stable. Most changes observed over the sampling period were evident across locations indicating that they were driven by regional-scale processes. There was no sign of degradation in the reef systems other than an increase in the occurrence of invasive species e.g. clubbed tunicate (*Styela clava*), Asian paddle crab (*Charybdis japonica*), Japanese kelp (*Undaria pinnatifida*) and Mediterranean fan worm (*Styela spallanzanii*) (Shears 2017). Research is also being conducted on how native kelp (*Ecklonia radiata*) response to disturbance and their pattern of recovery (PhD project, Auckland University).

- Marine reserves and other no-fishing areas can provide a reservoir for marine species that are negatively affected by fishing activity. However, research on the Cable Protection Area (a no-fishing zone) within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi found little difference between the species assemblages within the Cable Protection Area and that of the surrounding area. The lack of large soft-sediment epifauna e.g. sponges, horse mussels, bryozoans in the protected area may be due to their absence from the area in the first place, or slow recovery due to no/low recruitment or habitat change, while the lack of difference between fish species may be due to the Cable Protection Area being smaller than the home range of fish, or illegal fishing occurring within the protected area (Morrison et al. 2016).

- A NIWA project is underway to identify and map juvenile snapper (tāmure) nurseries in the greater Hauraki Gulf. Seafloor mapping using multibeam sonar (see ***Figure 5.18*** for the areas covered), together with fish and habitat data were collected from over 300 stations in water depths from 3 to 30 m from March to May 2017. Juvenile snapper (1-7 cm) dominated catches in the fine mesh nets used for the fish survey, with nurseries containing large numbers of snapper juveniles being identified in: Kawau Bay to Whangaparāoa Peninsula; Pōnui channel south to Kawakawa Bay; Coromandel Harbour north up to inside the Motukawao Islands group, and in Port Fitzroy, Great Barrier Island. Lower juvenile densities were found throughout the wider, central and outer Gulf (excluding Te Hauturu-o-Toi / Little Barrier Island). However, few juveniles were obtained from the east Coromandel coast, with the exception of small dense 'pockets' in Kennedy Bay and at Port Charles (both sheltered inlets); and low densities in inner Whitianga Bay. The locations of the four high-density nurseries were consistent with descriptions provided by commercial fisher's who recalled snapper spawning aggregations in nearby areas. This suggests that both larval supply and habitat associations are important parts of the nursery story. Invasive species were a large component of the bycatch. These included Mediterranean fan worm, ascidians (including *Styella clava*), large red algae, Asian gobies, and the green greasy-back prawn (*Metapenaeus bennettae*). Large habitat features identified during the survey included an extensive sponge garden and dog cockle bed in northern Kawau Bay, seaweed meadows at Great Barrier Island, dense green algae (*Caulerpa sp.*) beds at Great Mercury Islands, and surprisingly, a large bed of big cockles in 4 m water depth in the inner Firth of Thames. Juvenile snapper were also found around logs that had been washed down from the forest surrounding Port Fitzroy (M. Morrison and T. Anderson, NIWA, pers. comm.).

- Recent research conducted or currently underway in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi for key species include the distribution and feeding ecology of Bryde's whales and other megafauna in the Gulf (Dwyer et al. 2016, PhD projects, Auckland University); seabird population biology and their role as ecosystem engineers (Borrelle et al. 2016; Orwin et al. 2016; Towns et al. 2016); and, the dispersal of mussel larvae in the Gulf (PhD projects, Auckland University).

Figure 5.18*: Multibeam sonar run-lines surveyed during a NIWA study on snapper nurseries (data provided by M. Morrison, NIWA).*

TE WHIWHI KI NGĀ TINO HUA O TE RAWEKE RAWA
5.4.3 GETTING THE BEST RETURN ON RESOURCE EXPLOITATION

- Commercial fishing poses a risk to the populations of a number of threatened bycatch species including birds, reptiles and marine mammals. Fisheries within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi pose a particular risk to black petrels and flesh-footed shearwaters, which are in the top four most 'at risk' bird species from commercial fishing. Recent research commissioned by DOC and MPI includes the interactions of reptiles, marine mammals and birds with commercial fisheries (Abraham et al. 2016; Godoy 2016), indirect effects of fishing on bycatch species (Frost 2017; Gaskin 2017a), populations assessments (Waugh et al. 2014; Bell et al. 2015; Bell et al. 2016; Mischler 2016), and mitigation measures to reduce bycatch numbers (Goad & Williamson 2014; Pierre & Goad 2016; Goad 2017).

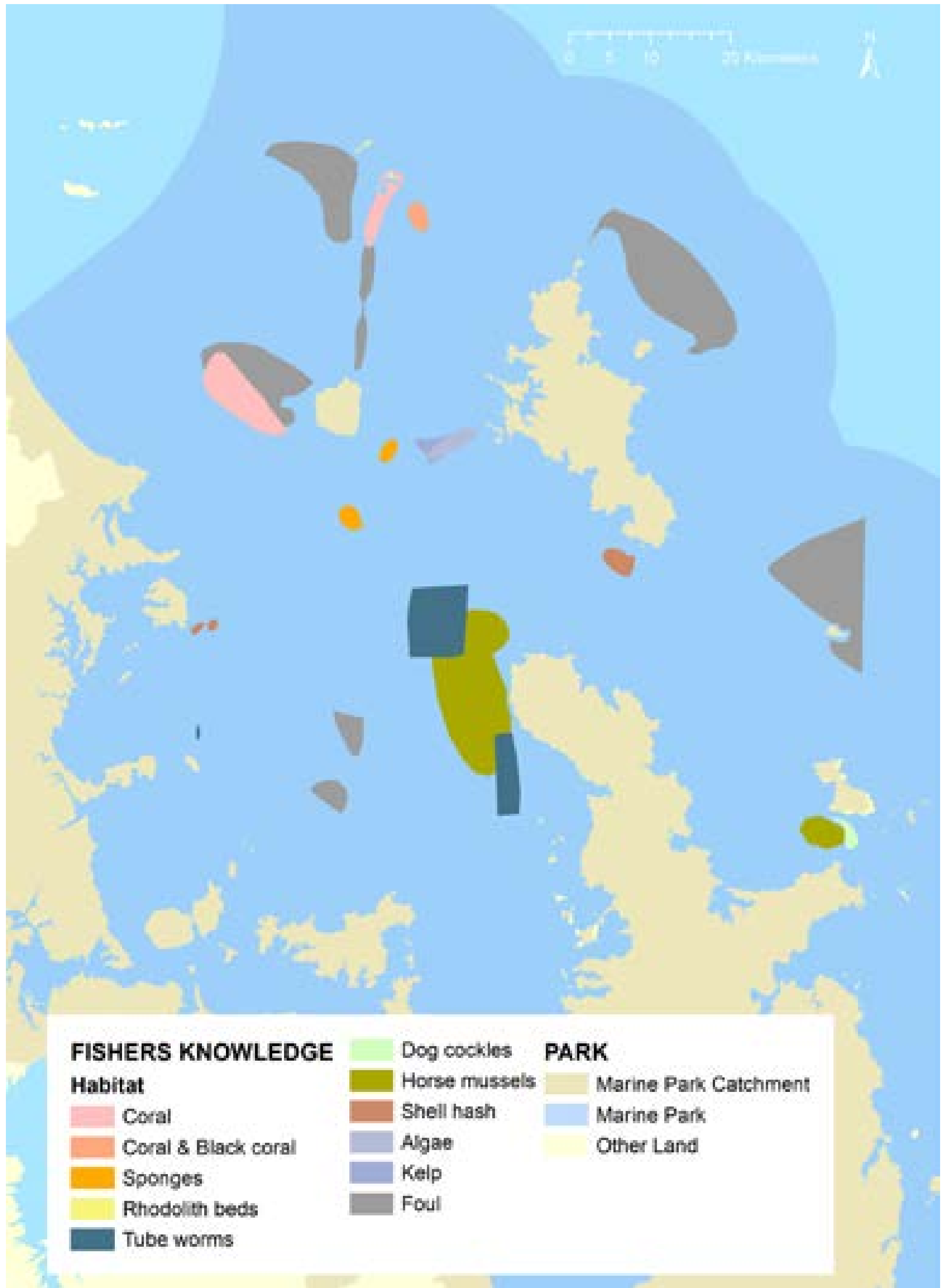


***Figure 5.19**: Biogenic habitats identified by active and retired fishers with a history of working in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (adapted from Jones et al. 2016).*

TE WHAKARITE I TE WHANAUNGATANGA I WAENGA I TE TUAWHENUA ME TE MOANA
5.4.4 DEFINING THE INTERRELATIONSHIPS BETWEEN LAND AND SEA

- Analysis of turbidity levels across a range of sites in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi over a 22-year period found that suspended sediments were generally the major determinant of turbidity in the Gulf. High turbidity was most frequently associated with high wave action and high rainfall due to higher volumes of sediment washed into waterways, and resuspension of bottom sediment. Chlorophyll a concentrations were also correlated to turbidity at inner harbour sites, where higher nutrient concentrations from land run-off can cause phytoplankton blooms. There was some evidence that turbidity levels in upper harbour urban locations had improved over the 22-year period, which is possibly due to improved land management practices and an increase in impervious surfaces, but there were no trends at most sites (Seers & Shears 2015). Improvement in catchment management practices, particularly in rural areas is needed to reduce land sediment inputs into coastal waters.

- The inputs of sediment and nutrients into the Firth of Thames have contributed to an increasingly muddy seabed in the inner Firth, a loss of water clarity, seasonal low dissolved oxygen levels near the seabed and a decrease in pH. Deposition of resuspended sediment is now a major source of sediment deposited on the inner Firth, and it is highly unlikely that the Firth will naturally recover to its previous state (see Case Study: section 5.4.6).

Green-lipped mussels in sediment. Photo by Shaun Lee.

- High nutrient and sediment loads also have the potential to negatively affect marine organisms. Research is currently being conducted on the resilience of seagrass to high sediment, high nutrients, and low oxygen conditions (PhD project, University of Auckland).

- Sedimentation also facilities increased mangrove cover though raising the seabed and the accumulation of fine, muddy sediment (Swales et al. 2015). However, reversal to a sandflat community and substrate cannot simply be achieved by the removal of mangroves, with very few cleared sites showing a recovery towards a typical sandflat over a period of up to eight years (Lundquist et al. 2014; Lundquist et al. 2017). This suggests that sedimentation of estuaries creates a step-change that is difficult to reverse (see section 6.4).

5.4.5 TE WHAKARITE MŌ NGĀ RĀ E TŪ MAI NEI ADAPTING TO THE FUTURE

- The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is subject to increasing human-derived noise, particularly from recreational and commercial vessels. Noise has the potential to affect the behaviour of numerous marine animals including cetaceans, crustaceans and fish (Williams et al. 2015). Recent research aims to quantify the level and spatial distribution of noise in the Hauraki Gulf so that we have a better understanding on the potential negative impacts it may have (Pine et al. 2016, PhD project, Auckland University).

Bigeye communicate using a 'popping' sound. Photo by Daryl Torckler.

- Marine areas allocated to aquaculture within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi are slowly increasing, with the creation of new farming areas, particularly in the Coromandel region. However, marine farms can facilitate the growth of invasive species that prefer to grow on hard substrates such as Japanese kelp, Mediterranean fan worm, and clubbed tunicate (James & Shears 2016), which may pose an increased biosecurity risk, particularly if new farms are located near sensitive rocky reef areas.

Mussel reef restoration. Photos by Revive our Gulf.

- Marine restoration projects within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi seek to improve the ecosystem function of the region. Research and trials are being carried out on the seeding of soft-sediment mussel beds in the Firth of Thames and Ōkahu Bay and around Mahurangi Harbour (Aguirre et al. 2016; Mussel Reef Restoration Trust no date).

HE ĀTA TIROHANGA: NGĀ RANGAHAU HŌU MŌ NGĀ NEKE KĒTANGA – NGĀ PANONI KI TE PŪNAHA HAUROPI Ā-TAIMOANA O TĪKAPA MOANA MAI I TE TAENGA MAI O TE TANGATA

5.4.6 CASE STUDY: RESEARCH UPDATES ON SHIFTING STATUS – CHANGES TO THE HAURAKI GULF MARINE ECOSYSTEM SINCE THE ARRIVAL OF HUMANS

Hauraki Gulf's marine ecosystem has undergone a profound change since the arrival of the first humans. The region was a major settlement area, first for Māori who arrived around 1250, and later for the Europeans, who arrived in the late 18th century. Recent studies have used information from oral histories, historical fisheries records, middens and scientific research to estimate the changes that have occurred in the Hauraki Gulf since people first arrived (Pinkerton et al. 2015; Zeldis et al. 2015; MacDiarmid et al. 2016a). These changes include changes in the abundance of marine animals, particularly exploited species, changes in the structure of the food-web, and changes to marine environments. The results of Pinkerton et al. (2015), Zeldis et al. (2015) and MacDiarmid et al. (2016a) are summarised below.

Changes to marine animal populations

Abundances of marine animals was noted to be extremely high by the early European settlers. Direct exploitation, loss of prey, introduction of predators and environmental changes have resulted in huge declines in the biomass of marine animals in the Hauraki Gulf, particularly for marine mammals, seabirds, sharks, exploited fish species and rock lobsters. The dramatic reduction of these top-level predators has led to changes in the structure of the food-web, which was modelled by estimating 'trophic importance'. This is an assessment of how important a group may be to the dynamics of an ecosystem. Groups with high trophic importance are considered to be keystone groups that have a large impact on the structure and function of the whole food-web (Pinkerton et al. 2015; MacDiarmid et al. 2016a).

Bottlenose dolphins at the bow of a boat. Photo by Darryl Torckler.

The most dramatic changes in trophic groups are discussed below.

Cetaceans. Early European whalers had a brief but intense period of whaling in New Zealand, with Southern right whales hunted to commercial extinction in only 20 years (1830–1849). Though little whaling occurred in the Hauraki Gulf, the decimation of 97% of New Zealand's cetacean population now makes the occurrence of most cetaceans in the Gulf a rare event. Cetaceans have been reduced from the third most importance trophic group in the Hauraki Gulf prior to human arrival, to the 21st trophic group (present day).

Seals and sea lions. Seals were once the fifth most important trophic group in the Hauraki Gulf, but fur seals and sea lions were hunted to local extinction by Māori by around 1550. Early Europeans eliminated fur seals from the rest of mainland New Zealand and most of the sub-Antarctic Islands by the 1830s. This depletion in seal numbers would have removed an important food supply for other top predators such as orca and sharks. Marine mammal protection was only introduced in 1978, and it is only very recently that fur sea populations have started to recover, with small numbers now occasionally present in the Hauraki Gulf. Sea lions populations remain at a 'Nationally Critical' status, and they are no longer found in the Hauraki Gulf.

Seabirds. Seabird populations in the Hauraki Gulf are estimated to have decline by 69% since pre-human times. Māori hunted seabirds for food, particularly blue penguins, albatrosses and spotted shags, and it is estimated that they harvested up to 56 t per year. The greatest decline in seabird populations are likely have been caused by introduced predators, reduction in prey availability, and loss of habitat. Sea bird populations reached their lowest in the 1950s, and were estimated to be around two thirds of the current abundance. Following the implementation of legal protection in 1953 and conservation programmes, seabird numbers have been gradually rebuilding.

Snapper body. Photo by Shaun Lee.

Fish. Large declines were already noted in some exploited fish populations by the late 19th century, particularly grey mullet and flat fishes that were found in shallow, easily accessible areas, and later, snapper and hāpuku from coastal regions. Overall, the fish biomass in the Hauraki Gulf is estimated to have declined by 60%, with particularly high reductions in the abundances of sharks (86%), trevally (86%) and snapper (83%). Harvest of snapper from the Hauraki Gulf increased from a modest 72 t in 1400 to around 1000 t by the end of the 18th century, to a peak of 8000 t in 1971 prior to the introduction of the QMS. Overall, it is estimated that around 880,000 t of snapper have been extracted from the Hauraki Gulf over 700 years of fishing, with 50% of this extracted in the last 100 years. Despite the large reduction in the abundance of snapper, they were, and still are, the most important fish species in the Hauraki Gulf ecosystem.

Rock lobsters (crayfish). Abundance of rock lobsters in the Hauraki Gulf has declined by 76% since the arrival of humans. This large decline in biomass has reduced their trophic importance from the 6th of 12 benthic invertebrate groups in the Gulf to the least important. Their trophic importance has also slipped from 24th out of 46 groups in the broader ecosystem, to the 42nd group.

Shellfish. Native rock oyster and mussel beds were once abundant in the Hauraki Gulf, but are now largely absent. Native rock oysters were heavily exploited in the late 19th century and the first fishing controls were introduced in 1866 due to the decline in oyster populations. Commercial mussel harvesting didn't start until the early 20th century, with dredging of soft-sediment mussels occurring in the inner Hauraki Gulf. Overharvesting lead to the collapse of this fishery in 1965, and more than 50 years later the soft-sediment mussel beds haven't regenerated. This lack of recovery is generally thought to be due to the complete destruction of adult beds, which are used by larval mussels as a settlement substrate.

Soft-sediment green-lipped mussel bed. Photo by Shaun Lee.

Overall, while the structure of the lower food-web (e.g. plankton, bacteria) is essentially the same today as it was in pre-human times, there have been large reductions in the abundance of upper-level predators (seals, cetaceans, seabirds, sharks, rock lobsters and some fish species), which has led to substantial declines in their trophic importance. The food-web in the Hauraki Gulf has changed from one that was heavily influenced by upper-level predators prior to human arrival, to a food-web where the impact of these upper-level predators is small to negligible. Currently, the trophic groups with highest importance are (in decreasing order): phytoplankton; benthic macrofauna (especially small crustaceans and worms); mesozooplankton; bivalves; and, snapper. These results suggest that the factors that govern ecosystem dynamics in the Hauraki Gulf today are likely to be different to those of the past.

Changes to marine systems–The Firth of Thames

Changes to the Firth of Thames marine system is probably the most dramatic, large-scale change that has occurred in the Hauraki Gulf over the last couple of centuries. These changes have been caused by increased sedimentation, increased nutrients and a large-scale loss of biogenic reefs (Zeldis et al. 2015).

Sedimentation. The Firth of Thames is a wide, shallow basin that has a catchment area of 4200 km2, including three major rivers, the Waihōu River, Piako River and Kauaeranga River. Prior to humans, this catchment was primarily podocarp–hardwood forests on the Coromandel and Hunua Ranges, and freshwater marshes and swamp forests on the Hauraki Plains. Widespread deforestation of the area occurred in the late 19th century and early 20th century as a result of timber logging, gold mining and agriculture, which resulted in large quantities of sediment deposited into the Firth. Conversion of most of the Hauraki Plains into pastural land has contributed to the continuing input of sediment and nutrients into the Firth of Thames, with sediment accumulation rates in the Firth up to ten times higher than 90 years ago. This accumulation of mud has also permitted widespread mangrove expansion in the Firth. However, present-day inputs from the Waihōu and Piakao Rivers only accounts for 40% of the sediment currently deposited in the southern Firth of Thames. It is thought that the majority of sediment deposited is due to the resuspension of sediment that was washed into the Firth during the large-scale deforestation that occurred in the late 19th and early 20th century. Thus, fine sediments in the Firth of Thames are largely the legacy of past human activities, and as a result, there are limited opportunities to mitigate sediment effects.

Nutrients. Nutrient inputs from land are the dominant source of nutrients to the Firth of Thames, and the conversion of the Hauraki Plains into agricultural land has contributed to the increase in nutrients inputs since pre-human times. Measurements taken in the Firth over the last 15 years are consistent with increasing nutrient concentrations in the waters of the Firth. These include:

- increasing dissolved inorganic nitrogen concentrations at a rate of 5% per year;
- increasing abundances of phytoplankton;
- seasonal dissolved oxygen depletions in bottom waters in autumn, which is thought to be mainly due to the consumption of sinking organic matter (that has accrued over the preceding spring/summer) by bacteria.

Soft-sediment community. Photo by Shaun Lee.

Loss of biogenic habitats. Mussel beds once carpeted more than 500 km2 of the seafloor of the Hauraki Gulf, with dense beds present throughout much of the Firth of Thames (Paul 2012). Subtidal mussel reefs have the highest secondary productivity of any marine habitat every recorded in New Zealand, and had high abundances of attached fauna (e.g. sponges, ascidians, bryozoans and cnidarians), invertebrates (e.g. gastropods, starfish, crabs), and small fishes (McLeod 2014). The dredge fishery for mussels in the Firth of Thames between the 1920s and 1965 resulted in the almost complete destruction of the mussels reefs in the Firth, and loss of associated fauna that lived on the reefs. It is conservatively estimated that on top of the loss of the mussels, up to 33,000 tons of small invertebrates would have been lost, which could have supported an additional biomass of up to 16,000 tons per year of predatory fish (McLeod 2009). The mussel community has now been replaced with a soft-sediment community of moderately low species diversity and richness that is adapted to the very muddy conditions present today (Morrisey et al. 2016).

In summary, the change in status that has occurred in the Hauraki Gulf over the last two centuries has been so great that even if catchment sediment inputs were immediately stopped, the likelihood of a natural recovery of the Firth benthic ecosystem to a pre-reef-collapse state are slim (Zeldis et al. 2015).

NGĀ TOHU Ā-TAIAO
6. ENVIRONMENTAL INDICATORS

Tāmaki kainga ika me nga wheua katoa

Tāmaki, where you eat the fish, bones and all

(in reference to how plentiful and succulent the fish in Tāmaki once were).

Photo: Trevally in a marine reserve by Darryl Torckler.

NGĀ TAUNGA HĪ IKA

6.1 FISHERIES

According to MPI's categorisation system, of the top 15 species of fish commercially caught in the Hauraki Gulf:

- Three are very likely to be at or above their target biomass, and one species is 'about as likely as not' to be at or above its target biomass.
- Two species are below their target biomass. One of these species is also 'likely' to be below its 'soft limit', and one is 'about as likely as not' to be below its 'soft limit'. 'Overfishing' of the latter species is 'likely' to be occurring.
- The current status of nine species relative to their target levels is unknown. The current status of eight of these nine species relative to their soft and hard limits is also unknown.

Fishing has reduced the biomass of snapper and crayfish populations by around 70-80% in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. 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 / Tīkapa Moana / Te Moana-nui-a-Toi. 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 indicated that snapper biomass had increased since the late 1980s, but it remained below the soft limit and further rebuilding is required.

The Minister has approved the SNA1 Strategy Group's plan to rebuild the snapper stock, with a target of reaching 40% of the unfished biomass within 25 years, and an intermediate milestone of rebuilding the stock to 30% of the unfished biomass within 10 years (i.e. by 2025).

The SNA1 plan recommended that no change be made to the TAC in 2016-17, but it provided a list of over 70 other recommendations. Some of these recommendations have, or are, being rolled-out including the installation of monitoring cameras on trawlers, and a tag-recapture programme to update estimates of snapper abundance and movements.

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 remain about the impacts of longlining on seabirds, and bottom trawling occurs in areas known to contain sensitive marine species.

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 / Tīkapa Moana / Te Moana-nui-a-Toi to sustain snapper populations at historic levels.

Crayfish have gone from being the third-most ecologically important benthic invertebrate group in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, 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).

Commercial catch rates in the CRA2 quota management area have steadily declined since 2007, and are currently at the lowest levels since at least the 1979-1980 fishing year. Catch rates in CRA2 are also the lowest of the nine crayfish quota management areas in New Zealand. The CRA2 TACC was reduced by 36.1 tonnes in 2014 and industry voluntarily shelved a further 50 tonnes of their quota for the 2016 fishing season. In 2014, the densities of legal-sized crayfish in unprotected areas around the Cape Rodney to Okakari Point and Tāwharanui Marine Reserves were 4% to 5.6% of those in the reserves.

A stock assessment for CRA2 was completed on 30 October 2017. The assessment suggests that the abundance of legally harvestable rock lobsters in 2016 had declined to around 21% of the agreed reference level. It is very likely that the stock is below the soft limit; the level at which it is MPI policy to implement a formal, time-constrained rebuilding plan. However, it is very unlikely that biomass is below the hard limit; the level at which closure of the fishery should be considered. Work is underway to review management of the CRA2 fishery in response to the new information.

In 2011, commercial fishers discovered a large scallop bed that had previously been unfished. It was not known whether the large biomass of scallops in the new bed was a persistent feature, or the product of successful recruitment in recent years. The discovery led to the TACC increasing from 22 tonnes meat weight at the start of the 2009-2010 to in-season adjustments reaching 325 tonnes meat weight in 2012-2013 (although only 73 tonnes were landed in 2012-13). The scallop population of the newly discovered bed has subsequently collapsed.

The use of scallop surveys and in-season TACC adjustments have been dropped in favour of setting a 50 tonne TACC and applying a voluntary 'CPUE limit rule' run by the commercial fishers. Fishers can voluntarily cease fishing a statistical reporting area, or smaller sub-statistical area for the remainder of the season if catch per hour falls below the previously-agreed limit; and/or the ratio of scallops less than the minimum legal size per catch exceeds a previously-agreed limit.

Trawled areas and areas dredged for scallops are known to contain sensitive marine habitats. However, no discernible difference was found between the occurrence of larger invertebrates dwelling on the surface of the seafloor, inside (an untrawled area) and outside (a trawled area) the main cable protection area in the Gulf.

Trends in cockle abundance have varied at the six sites that are regularly monitored by MPI in the Gulf. Five sites have displayed declining trends in the number of harvestable sized cockles. The only site that has showed an increase in the number of cockles since is 2000 is Umupuia, which has been closed to harvesting since 2007.

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). MPI 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 (B_{MSY}) well below its unfished state, because higher 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 B_{MSY} 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.

Leatherjacket in the Alderman Islands. Photo by Darryl Torckler.

The Minister tightly regulates the amount of fish able to be commercially harvested by setting an annual 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 / Tīkapa Moana / Te Moana-nui-a-Toi (see section 5.2). Māori are also commercial and recreational fishers, and are required to conduct those activities in accordance with the appropriate regulations (see section 5.2 for more information on Māori fisheries).

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 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 / Tīkapa Moana / Te Moana-nui-a-Toi. Sustainability indicators developed by MPI are therefore provided in section 6.1.1 opposite. These are complemented by more detailed information on:

- the state of three ecologically, economically and culturally important species (snapper, crayfish and cockles);
- fishing activities that adversely affect seafloor communities.

6.1.1 NGĀ TOHU TOKONGA ROA O NGĀ TAUNGA HĪ IKA
INDICATORS OF FISHERIES SUSTAINABILITY

Each year, MPI convenes a large number of Fisheries Assessment Working Group meetings where the results of scientific research are combined with catch and effort reports from commercial fisheries, data from their on-board observer programme, and other information to produce assessments of the status of New Zealand fish stocks. This information is summarised in two annual Fisheries Assessment Plenary Reports, a larger report published in May comprising stocks subject to a 1 October to 30 September fishing year, and a smaller report published in November comprising stocks subject to a 1 April to 31 March fishing year. The reports summarise the status of New Zealand's fish stocks relative to the requirements of the 'Harvest Strategy Standard' (HSS) (Ministry of Fisheries 2008).

The HSS aligns with the Fisheries Act, and various fisheries plans to guide the management of fish stocks. The HSS specifies four performance measures that are used to evaluate the status of New Zealand's fish stocks and fisheries, with the highest priority being given to the first three of these:

1. **The soft limit**. A biomass level below which a stock is deemed to be 'overfished' or depleted and needs to be actively rebuilt. The HSS specifies that for stocks falling below the soft limit, a formal, time-constrained rebuilding plan is triggered.
2. **The hard limit**. A biomass level below which a stock is deemed to be 'collapsed', where fishery closures should be considered in order to rebuild a stock at the fastest possible rate.
3. **The overfishing threshold**. A rate of extraction (percentage of a stock removed each year) that should not be exceeded as it will ultimately lead to the stock biomass declining below management targets and/or biomass limits, if this hasn't already happened.
4. **The management target**. Usually a biomass level, but sometimes a fishing mortality rate, that stocks are expected to fluctuate around, with at least a 50% probability of achieving the target.

MPI have adapted the assessment criteria developed by the Intergovernmental Panel on Climate Change (IPCC) for reporting the status of fish stocks. Stock status is reported in accordance with the scheme provided in ***Table 6.1***.

***Table 6.1**: Classification system used by the Ministry for Primary Industries for reporting the status of fish stocks. Green circles indicate a favourable status, orange squares indicate an unfavourable status, and the number of circles or squares indicating the degree to which the status is favourable or unfavourable.*

At or above target levels?	Probability	Description	Below the soft limit? Below the hard limit? Overfishing?
●●●●	> 99%	Virtually certain	■■■■
●●●	> 90%	Very likely	■■■
●●	> 60%	Likely	■■
●	40-60%	About as likely as not	■
■■	< 40%	Unlikely	●●
■■■	< 10%	Very unlikely	●●●
■■■■	< 1%	Exceptionally unlikely	●●●●

The current status of 15 heavily-targeted finfish species is provided in ***Table 6.2.*** Note that:

- depending on the species, stock status is assessed in relation to:
  - quota management areas, which are much larger than the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi; or,
  - north-eastern New Zealand, Hauraki Gulf and Bay of Plenty sub-stocks, which are contained within, or include parts of the Hauraki Gulf.
- the 15 species included in State of Our Gulf reports has changed over time, due to variation in reported landings (see the Case Study on changes to commercial fishing in the Hauraki Gulf over the 20th century, section 5.1.5).

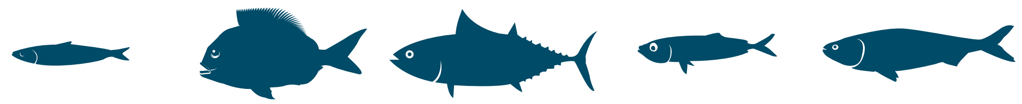
Of the 15 species:

- Three species (barracouta, kahawai and skipjack tuna) are very likely to be at or above their target levels and are not considered to be depleted or at risk of collapse.
- Gurnard catches undergo cyclical fluctuations with the most recent assessment indicating they have recently been in a declining phase. The GUR1E substock (which covers the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi) is about as likely as not to be at or above its target level, and it is unlikely to be depleted and very unlikely to have collapsed.
- John dory is below its target level in the northeast New Zealand–Hauraki Gulf substock. The substock is about as likely as not to be depleted, but it is unlikely to be at risk of collapse.
- The Hauraki Gulf–Bay of Plenty snapper stock is below its target level and slightly below its soft limit (indicating a need for it to be rebuilt). 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.
- For the remaining nine species or species groups (blue mackerel, jack mackerel, tarakihi, trevally, flounders, leatherjacket, rig, grey mullet 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 reported in both the 2014 and 2017 State of our Gulf reports are listed below.

- The status of john dory has been downgraded. The stock has changed from:
  - 'unlikely' to 'very unlikely' to be at or above its target level;
  - 'unlikely' to 'about as likely as not' to be depleted;
  - 'about as likely as not' to 'unlikely' of being overfished.
- The status of the kahawai stock has been upgraded. The stock has changed from being:
  - 'likely' to 'very likely' to be at or above its target level;
  - 'unlikely' to 'very unlikely' to be depleted;
  - 'very unlikely' to 'exceptionally unlikely' to have collapsed.
- Information on the baracoutta stock has improved. As a result, the status of the stock against its target level has been assessed as being:
  - 'very likely' to be at or above the target (it was previously undetermined);
  - 'very unlikely' to be depleted or collapsed (previously graded as 'unlikely').

***Table 6.2**: Status of major Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi commercial finfish stocks reported in the 2017 plenary reports (Ministry for Primary Industries 2017d, e). Note that the extent of quota management areas vary among species, but are generally larger than the Hauraki Gulf. A question mark indicates that the stock status relative to an indicator is not known.*



	Blue mackerel	Snapper	Skipjack tuna	Jack mackerels	Kahawai
Last assessed	2006	2013	2016	1993	2015
Management target	B40%	B40% set	Not set	Default	B52% set
At target level	?	■■■	●●●	?	●●●
Above soft limit	●●	■	●●●●	?	●●●
Above hard limit	●●	●●●	●●●●	?	●●●●
Over fishing	?	■■	●●●	?	●●●
Monitoring and management action	No estimates of current or reference biomass or yield; unknown if recent catch levels are sustainable, although the age composition data and large number of age classes that comprise the catches suggest EMA1 may be capable of sustaining current fishing mortality, at least in the short-term. Managed in QMS.	A package of monitoring and management measures implemented in 2013; recreational daily bag limit reduced and minimum legal size increased. Managed in QMS.	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 2011-2012 only 14% of 2003-2004 landings.	Not known if current TACCs or recent catch levels are sustainable in the long-term. Maximum Constant Yield (MCY) estimate 2400 tonne. Managed in QMS as a species assemblage.	Target 52% B_0 (set 2010) very likely (> 90%) to be at or above target. Managed in QMS.

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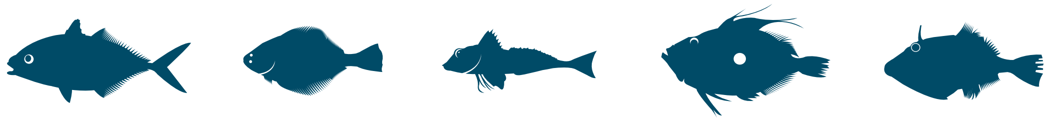
6.1.2 TĀMURE SNAPPER

Snapper are the dominant fish in northern inshore marine communities. They occupy a wide range of habitats, including rocky reefs and areas of sand and mud bottom. 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 / Tīkapa Moana / Te Moana-nui-a-Toi through the consumption of kina (*Evechinus chloroticus*) (Babcock et al. 1999; Shears & Babcock 2002). Kina grazing creates and maintains 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).



	Trevally	Flounders	Gurnard	John Dory	Leatherjacket
Last assessed	2006	2015	2013	2015	
QMA or substocks	B40%	BCPUE ref	BCPUE ref	BCPUE ref	Default
At or above target levels	?	?	●	■■■	?
Overfishing	?	?	?	■	?
Depleted	?	?	●●●	●●	?
Collapsed	?	?	●●	●●	?
Comments	New assessment under development. Managed in QMS.	Hauraki Gulf yellowbelly flounder CPUE index is currently near the long-term mean; CPUE for sand flounder is fluctuating about its lowest point. CPUE to be updated in 2018. Managed in QMS as species assemblage.	New CPUE based assessment under development. Managed in QMS.	CPUE has broadly declined, the 2013-2014 index is below the target CPUE. New CPUE information will be reported in May 2018. Managed in QMS.	No estimates of reference or current biomass; unknown whether stock is at above or below B_{MSY}. Managed in QMS.

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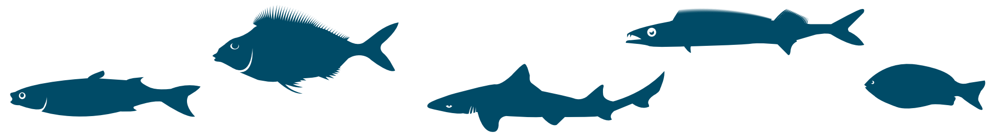


	Grey mullet	Tarakihi	Rig	Baracoutta	Parore
Last assessed	2012	2012	2016		
QMA or substocks	Default	B40%	BCPUE ref	BCPUE ref	Default
At or above target levels	?	?	?	●●●	?
Overfishing	?	?	?	●●●	?
Depleted	●●	?	?	●●●	?
Collapsed	?	?	?	●●	?
Comments	Status in regard to MSY unknown. Landings have fluctuated around MCY estimate in recent years. CPUE unlikely to reflect relative abundance. Managed in QMS.	New assessment will become available in November 2017. Managed in QMS.	CPUE based assessment updated in 2016. Managed in QMS.	B_{MSY}-compatible proxy based on CPUE-to be updated in 2018. Managed in QMS.	Catch fluctuating without trend about a TACC of 61 tonne. Managed in QMS.

Snapper are a highly prized and intensively fished species. The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is nationally significant for its large contribution to the overall snapper stock. Snapper are the most targeted commercial species in the Gulf and are also New Zealand's most popular recreational saltwater fish species. As a result, fishing has had a major effect on the size and characteristics of the Hauraki Gulf snapper population.

The effects of fishing are readily apparent in the results of marine reserve surveys carried out in the Gulf. Reserve populations have been found to have higher numbers of snapper than surrounding fished populations, 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 outside the Cape Rodney to Okakari Point Marine Reserve (CROP) 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 Whanga-nui-a-Hei (Hāhei) Marine Reserve varied from 0% to 28% of mean densities within the reserve (Haggitt et al. 2010, T. Haggitt, unpublished data). In contrast, densities of undersized snapper outside these reserves frequently exceeded mean densities inside the reserves. Mean snapper size is also higher inside reserves than outside reserves. For example, mean size ranged from 289 mm to 404 mm in CROP (cf. 148 mm to 242 mm outside) between spring 2000 and autumn 2007, and 233 mm to 323 mm in the Hāhei Marine Reserve (cf. 144 mm to 290 mm outside) between spring 2000 and autumn 2010. Snapper are no longer monitored in these marine reserves.

A recent study has also highlighted the large contribution CROP makes to snapper populations in the surrounding fishery (Le Port et al. 2017). Estimates derived from genetic determination of parentage, population estimates, and dispersal modelling indicated that the 5.2 km2 marine reserve contributed 10.6% of newly settled snapper to a surrounding area of around 400 km2, with no decrease detected in the contribution of the reserve up to 40km away.

Other factors besides fishing are also likely to affect snapper populations. The existing quality of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is markedly different from its historical condition. Changes such as reductions in biogenic habitats are likely to have affected the productivity of snapper, but these effects are poorly understood (Morrison et al. 2014). Notably snapper growth rates have been declining in recent years, which will 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).

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 5.10***). The most recent fisheries assessment of the SNA1 stock in 2013, indicated that the overall spawning stock biomass of snapper in the combined Hauraki Gulf and Bay of Plenty substocks had been reduced by around 80% (Ministry for Primary Industries 2013a, Francis & McKenzie 2015, ***Figure 6.1***), and was below

Tāmure (snapper) at the Leigh Marine Reserve. Photo by Shaun Lee.

its soft limit (as defined in accordance with MPI's HSS; Ministry of Fisheries 2008). That situation triggered the need for a formal, time-constrained rebuilding plan, with an interim target for the SNA1 stock set at 40% of the unfished biomass. Modelling estimates predicted that for the Hauraki Gulf–Bay of Plenty sub-stocks, the interim target:

- 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.

Adverse responses by fishers to potential options for rebuilding the stock and tensions among fishing sectors, led to the creation of a SNA1 strategy group, made up of representatives from the customary, recreational and commercial fishing sectors. It did not include broader representation from other stakeholder groups with a potential, but non-extractive, interest in the fishery (such as environmental groups, Council's or DOC). MPI tasked the group with:

- establishing objectives and appropriate target levels for the SNA1 fishery;
- setting research and monitoring priorities;
- determining catch allocation;
- establishing appropriate responses to the impacts of fishing on productivity, other fish stocks, and the marine environment.

The plan produced by the Strategy Group (and subsequently approved by the Minister), included a time-constrained rebuilding plan of reaching 40% of the unfished biomass within 25 years (i.e. by 2040) (SNA1 Strategy Group 2016). It further proposed an intermediate milestone of rebuilding the stock to 30% of the unfished biomass within 10 years (i.e. by 2025).

The plan recommended that no change be made to the TAC in 2016-2017, but provided a list of over 70 other recommendations. These included actions aimed at:

- reducing incidental mortality and broader environmental effects;
- updating estimates of snapper abundance and movements between sub-stocks through a tag-recapture programme (MPI is currently working on the design of the programme);
- obtaining better information on the capture of undersized snapper, and promoting measures to reduce the mortality of returned fish;
- close monitoring of catch levels by all sectors;
- disseminating information;
- reviewing stock assessment information by 2021-2022 to assess the need for subsequent actions to achieve the milestone and biomass targets.

Timeframes were provided for implementing a number of the plan's recommendations.

With regards to the monitoring of commercial catch, camera technology has been installed on the entire SNA1 trawl fleet as part of a programme to implement digital monitoring. The decision to use electronic monitoring in SNA1 was a response to concerns about issues such as juvenile mortality, discarding and waste. The programme is designed to validate mandatory catch reporting of undersized snapper and evaluate the efficacy of measures to mitigate the catch of undersized fish.

Overall, 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. Snapper growth rates have also slowed. 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 6.1.5). Seabird mortality from snapper longlining is also a serious concern (see section 6.10.3). A snapper management plan has been approved for the SNA1 stock, which includes the Hauraki Gulf and Bay of Plenty sub-stocks. That plan has set a timeframe of rebuilding the stock to 40% of B_0 by 2040, with an intermediate milestone of 30% of B_0 by 2025.

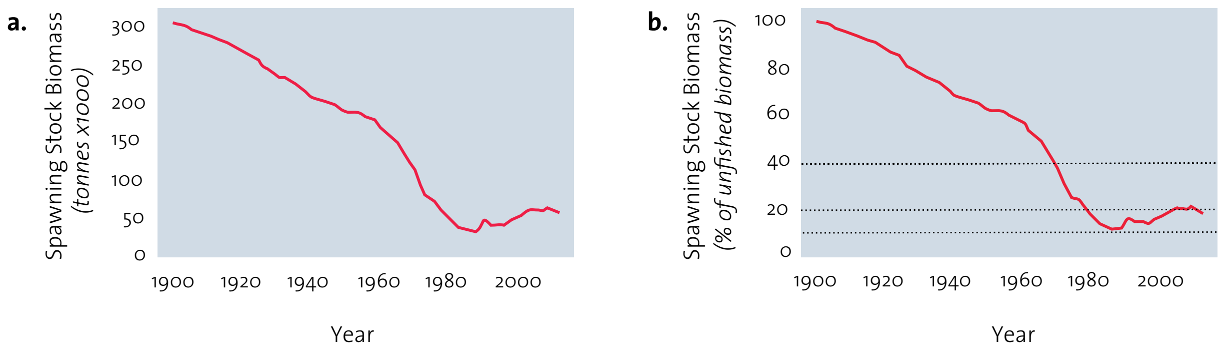


***Figure 6.1**: Model reconstruction of the biomass of the Hauraki Gulf snapper substock in a) tonnes, and b) as a percentage of the unfished biomass (adapted from Ministry for Primary Industries 2013b). The dotted lines represent the interim target (40% B_0), the soft limit (20% B_0) and the hard limit (10% B_0).*

6.1.3 KŌURA CRAYFISH

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.

Crayfish at Tāwharanui marine reserve. Photo by Darryl Torckler.

Published research indicates that fishing has had a major effect on both crayfish populations and the broader ecosystem in northeast New Zealand (Shears & Babcock 2002; Kelly & MacDiarmid 2003; MacDiarmid et al. 2013b; Eddy et al. 2015; Pinkerton et al. 2015; MacDiarmid et al. 2016b). Modelling predicts that the current Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi crayfish biomass is only around 24% of that estimated to be present in 1000 AD. As a result, crayfish have gone from being the sixth-most tropically important[18] of 12 benthic invertebrate groups in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, to the least important, and from mid-level trophic importance (24th out of 46 groups – excluding seals) to almost the lowest trophic importance for the whole ecosystem (42nd out of 46 groups, Pinkerton et al. 2015). In areas of low biomass, MacDiarmid et al. (2013b) suggest that crayfish could be regarded as being ecologically extinct.

A fisheries stock assessment carried out in 2013, indicated that the biomass of crayfish above the legal-size limit (i.e. the recruited biomass) in the CRA2 quota management area, had been reduced to around 20% of its 1945 level. The stock was estimated to be 36% above the biomass required to produce the maximum sustainable yield (B_{MSY}), but 21% below its current management target of 459.6 tonnes (B_{REF}). The current target is based on the biomass of legal sized males for the period 1979 to 1981. Neither the 2013 biomass, nor the projected biomass were estimated to be near the soft limit of 20% of the unfished spawning stock biomass (SSB_0, i.e. the unfished biomass of mature females), which would trigger the need for the stock to be re-built.

However, a more recent stock assessment suggests that the abundance of legally harvestable rock lobsters has declined to around 21% of the agreed reference level (Ministry for Primary Industries 2017c). It is now very likely that the stock is below the soft limit – the level at which it is MPI policy to implement a formal, time-constrained rebuilding plan. However, it is very unlikely that biomass is below the hard limit – the level at which closure of the fishery should be considered.

Apart from a small spike in 2011, commercial catch rates in the CRA2 quota management area have steadily declined since 2007, and are currently at the lowest levels since at least the 1979-1980 fishing year (***Figure 5.2***). Catch rates are also the lowest of the nine crayfish quota management areas in New Zealand (Ministry for Primary Industries 2016a). A 36.1 tonne reduction in the TACC occurred in 2014, but changes to the TACC have not been triggered since the introduction of new management procedures in the same year. The procedures trigger catch adjustments when:

[18] Trophic importance relates to the degree that a change the biomass of one species (or species group – in this case crayfish) is likely to affect the biomass of other species in the ecosystem.

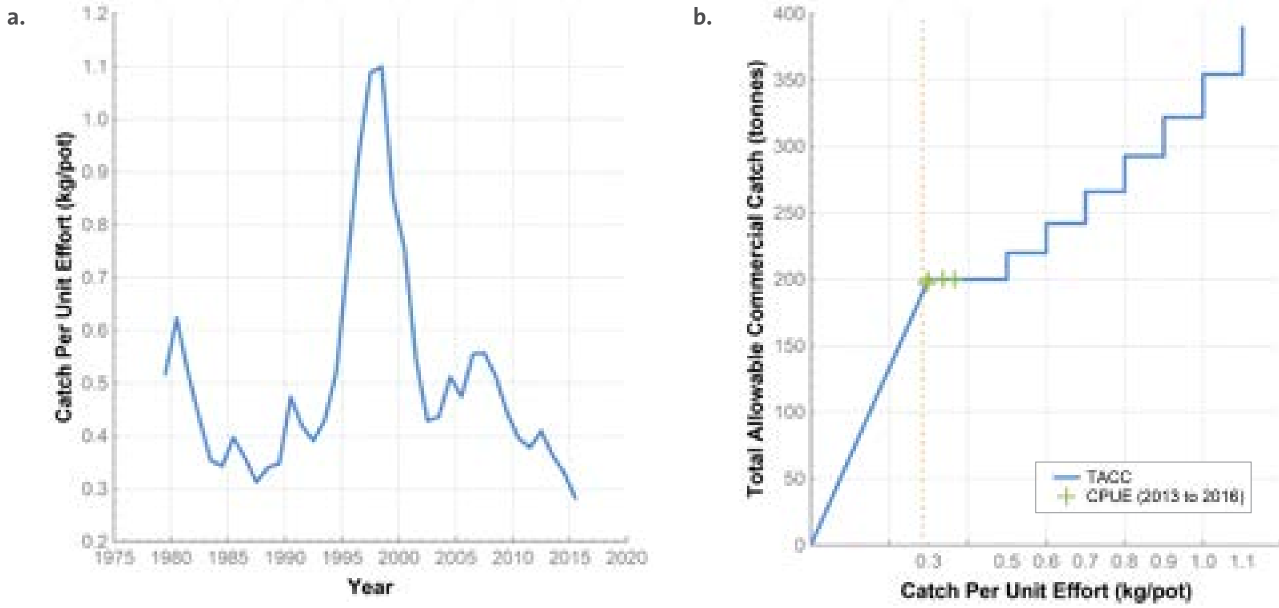


Figure 6.2*: Changes in standardised catch per unit effort (CPUE) between a) the 1979-1980 and 2015-2016 fishing years, and b) the management rule for adjusting the total allowable commercial catch of crayfish in the CRA2 quota management area. The orange reference line indicates the CPUE threshold for triggering a drop in the TACC, while the green crosses show annual CPUE figures from November 2013 to November 2016.*

- CPUE varies beyond specified bands (see ***Figure 6.2***); and,
- if the change would result in the TACC being altered by 5% or more[19].

Despite this, commercial crayfishers voluntarily shelved 25% (49 tonnes) of their catch in both the 2016 and 2017 fishing seasons, producing a functional TACC of 151 tonnes.

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 (CROP) fluctuated between 6% and 28% of that within the reserve, while densities outside the Te Whanga-nui-a-Hei (Hāhei) Marine Reserve fluctuated between 5% and 15% of those inside. Updated monitoring carried out in the CROP and Tāwharanui Marine Reserves (Haggitt & Freeman 2014; T. Haggitt, unpublished data) found that in 2014, average lobster densities were 7.9 and 5.3 times higher in the Tāwharanui and CROP Marine Reserves, respectively, compared to densities in surrounding, unprotected areas. Differences were much greater for legal-sized lobsters, which were approximately 18 and 25 times higher in the Tāwharanui and CROP Marine Reserves than those in surrounding unprotected areas. Similar findings, albeit with lower overall numbers, were obtained in a 2016 survey (T. Haggitt, unpublished data, ***Figure 6.3***).

Removing large lobsters affects the functioning of lobster populations. 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 / Tīkapa Moana / Te Moana-nui-a-Toi appear to mainly remain within reef habitat.

The current management procedures for the CRA2 quota management area do not explicitly consider the role of lobsters in the broader ecosystem processes, nor do they consider values other than those related to fishing, such as the intrinsic values of large crayfish or seasonal offshore migrations and aggregations (Kelly et al. 1999; Kelly & MacDiarmid 2003). It is also notable that the

[19] Note that the minimum adjustment that can be triggered when CPUE drops below the lower limit of the current band (0.3 kg/pot) is 10 tonnes.

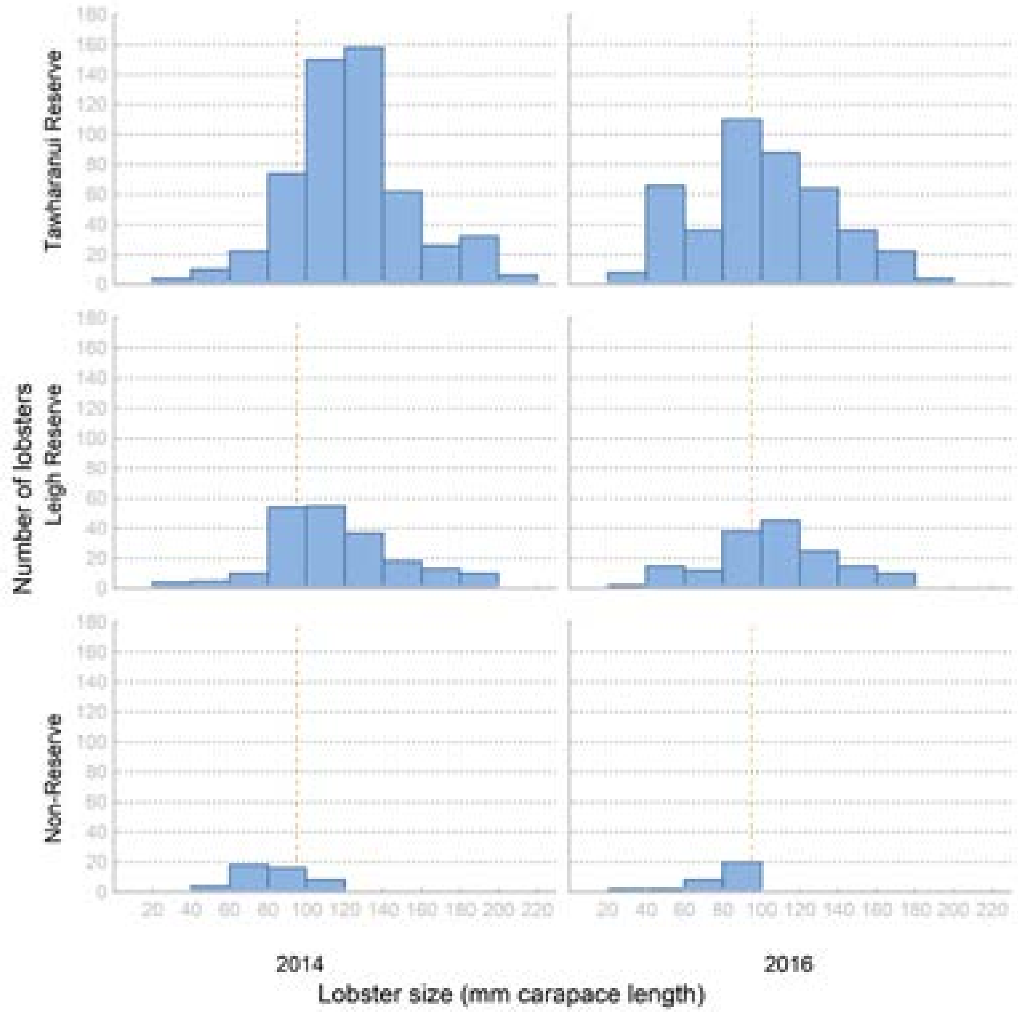


***Figure 6.3**: Size frequency distributions of lobsters recorded during the 2014 and 2016 surveys of the Cape Rodney to Okakari Point (Leigh) and Tāwharanui Marine Reserves (Data provided by T. Haggitt, eCoast Ltd). The approximate legal size limit for male lobsters is provided for reference (dashed orange line).*

broader ecosystem effects of reducing snapper and crayfish populations were first 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 those ecosystem processes.

Concerns about the availability of rock lobster in the Hauraki Gulf have been expressed to MPI by iwi interests, individual recreational fishers, NZ Sports Fishing Council/LegaSea, NZ Recreational Fishing Council, commercial fishers and the general public. The MPI have indicated that they are also concerned about the fishery, and are serious about its rebuild (G. McGregor, MPI, pers. comm.). In response the Ministry has brought a full scientific review of the fishery forward from 2018 to later this year.

Overall, the existing data suggests that fishing has reduced lobster populations by over 70% in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, 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 Gulf. Despite reducing the TACC in 2014 by 36.1 tonnes, commercial catch rates have continued to decline, leading to commercial fishers voluntarily shelving an additional 50 tonnes in 2016.

6.1.4 TUANGI COCKLES

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 2013c). 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 2013c). They form a major part of the diet for a range of different animals, including mud whelks (*Cominella glandiformis*), sand flounder (*Rhombolsolea 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, widespread distribution, high abundance, and their role in mixing the upper 2-3 cm of the sediment (Sandwell et al. 2009).

Cockle shells at Pollen Island. Photo by Darryl Torckler.

Cockles are not commercially harvested in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, but they do support recreational and customary fisheries. Coastal middens indicate that cockles and pipis (*Paphies australis*) 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 a study in Whangateau Harbour found that 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[20] (Kearney 1999).

MPI (and its predecessor, MFish) have monitored cockle populations at 14 popular harvest sites in the HGMP since the late 1990s. Monitoring has occurred regularly at six sites, and intermittently at the remaining eight sites (***Figure 6.4***). Key results from sites that have been regularly monitored are outlined below. In the most recent monitoring reports (Berkenbusch & Neubauer 2015, 2016), historic abundances were recalculated from the data in the MPI database. It is noted that there are a few large unexplained discrepancies between the recalculated data and earlier published reports, particularly for 1999-2000, 2000-2001 and 2006-2007, but the reason for these discrepancies is unknown. Following MPI's advice, we have used the most recent abundance calculations in this report (M. Pomarede, MPI, pers. comm.).

[20] 150 cockles per day at time of study. This has subsequently been reduced to 50 cockles per day in the Auckland and Coromandel areas. Harvesting in Whangateau is currently prohibited.

Figure 6.4 *A: Sites that are regularly or occasionally monitored by the Ministry for Primary Industries*

Figure 6.4 *B: Sites that are regularly or occasionally monitored by community groups coordinated by the Auckland Council, Waikato Regional Council or Department of Conservation.*

- There has been no consistent Gulf-wide trend in total cockle abundance, rather individual beaches display varying patterns over time. However, at five of the six regularly monitored sites, the number of harvestable cockles (> 30 mm) is now lower than in 2000. This is likely to be due to the selective harvesting of large cockles at sites where harvesting is permitted. Harvestable cockles have only increased at Umupuia Beach, where harvesting has been prohibited since 2007.
- 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 6.5***).
- Cockle numbers at Okoromai Bay decreased markedly between 2000 and 2002, and then have been relatively stable, both in abundance and the proportion of harvestable cockles.
- Cockle numbers at Umupuia Beach gradually declined between 2001 and 2009. A rāhui was imposed in 2007 and the population increased markedly to a peak of 44.3 million in 2014. Juvenile cockles currently dominate the population at Umupuia and harvesting is still prohibited (Ministry for Primary Industries 2017a).
- 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 (Ministry for Primary Industries 2013c). Juvenile cockle numbers have increased markedly since 2012, but there has been no increase in the number of harvestable cockles since the die-off, despite the ban on harvesting. The harbour is still closed to cockle and pipi harvesting (Ministry for Primary Industries 2017a).
- Cockle numbers at Tairua Harbour have varied widely through time, with peaks in abundance in 2000 and 2009. However, the proportion of harvestable cockles in the population has steadily declined from 17.6 million in 2000 to 80,000 in 2016.
- Cockle numbers at Whangamatā Beach declined between 2000 and 2003. The number of juvenile cockles has increased markedly since 2009, but there has been no increase in the number of harvestable cockles.
- The cockle population at Whangapoua Harbour is relatively small. While the total number of cockles has increased by three-fold since 2003, the number of harvestable cockles has continued to decline.

Cockle (and in some cases other shellfish) harvesting is also banned at a number of other beaches in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Eastern and Cheltenham Beaches were permanently closed in the early 1990s because of substantial declines in shellfish populations. The population in Eastern Beach is slowly recovering, but the population at Cheltenham Beach remains very low. The lack of recovery at Cheltenham suggests that environmental changes have occurred that inhibit recruitment, or the spawning population is too low allow the population to recover (Berkenbusch & Neubauer 2016). Since 2008, shellfish harvesting has also been banned from Cockle Bay between 1 October and 30 April. Unusually, while the total number of cockles at Cockle Bay has declined from 59.5 million in 2010 to 21.5 million in 2016, the number of harvestable cockles has increased from 6.3 million to 15.3 million over the same period. No new closures have been implemented since the 2014 State of Our Gulf Report was produced, and none of the beaches closed in 2014 have been reopened.

New Zealand cockle filter feeding. Photo by Shaun Lee.

Many communities have also established shellfish monitoring programmes in their areas, with the assistance of the Hauraki Gulf Forum, DOC, councils and MPI. Up to 20 sites in the Gulf have been monitored by community groups, though the monitored sites varies each year and some sites are now inactive (***Figure 6.4***). The community monitoring programme complements the MPI monitoring programme by providing information on sites that are not or only infrequently monitored by MPI. The community programme also generates local community support, which assists with the implementation and enforcement of management responses such as harvest closures. In 2014-2015, nine sites were monitored by 523 volunteers from 10 schools and four community groups. No region-wide trends in density are apparent in the community monitoring data. In the last few years there have been strong recruitment events at Pine Harbour, Ōkahu Bay, Wharekawa, and Whitianga, while cockle numbers at Motukaraka Island have declined (Inshore Fisheries Management Team 2013; Ross et al. 2014; Meadows & Ford 2015). Funding cuts in 2015-16 have resulted in Auckland Council reducing its support to only four sites, and DOC will no longer provide support for any sites, even though strong community interest remains (Meadows & Ford 2015).

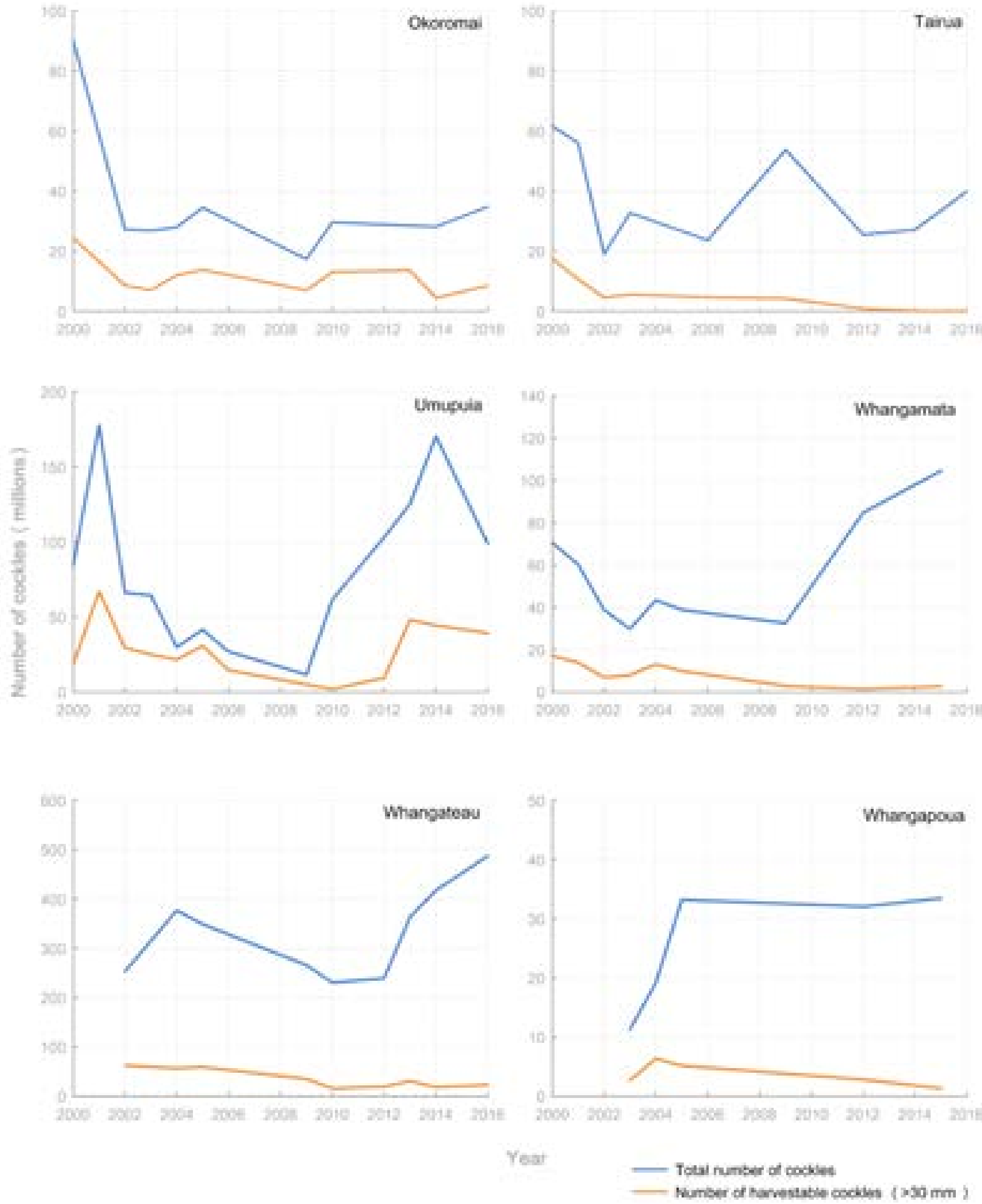


Figure 6.5*: Variation in estimated total number of cockles and harvestable cockles (> 30 mm) at sites that have been regularly monitored by MPI (or MFish) since 2000[21] (Data from Berkenbusch & Neubauer 2015, 2016). Note that the Y-axis scale varies among graphs.*

[21] The year plotted is the year that sampling was conducted, not the reported fishing year. For example, sampling for the 1999-2000 fishing year was conducted (and plotted) in 2000.

6.1.5 NGĀ MAHI HĪ IKA E RUKE ANA I NGĀ HAPORI PAPA MOANA FISHING ACTIVITIES THAT DISTURB SEAFLOOR COMMUNITIES

Bottom trawling and dredging are relatively indiscriminate methods of fishing, which capture, disturb and injure both target and non-target species. They also affect habitats by removing emergent biota (e.g. see ***Figure 6.7***) and physical features, and flattening the seabed topography. A recent assessment of the effects of fishing on soft sediment communities found that the severity of impact depends on fishing intensity, but impacts commonly include reductions in species diversity and changes in the composition of both surface dwelling (i.e. species that live on top of sediments) and sediment dwelling seafloor communities (Tuck et al. 2017). Erect species (such as horse mussels, sponges, bryozoans, hydroids, sea pens and tube-building polychaetes) and other species living on the surface of the seabed are particularly sensitive. They are affected by direct physical impact, smothering and increased vulnerability to predation after disturbance. Even modest levels of disturbance can have a marked effect on some of these groups. In contrast, effects on species that live within seafloor sediments are less consistent (Tuck et al. 2017). 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, respectively[22] (MacDiarmid et al. 2012).

Hydrozoans. Photo by Shaun Lee.

The main fishing activities involved in seabed disturbance in the Gulf are bottom trawling and scallop dredging. Commercial trawling has been carried out in the Gulf for nearly 120 years, starting with the steam trawler, 'Minnie Casey' in 1899 (Paul 2014). The activities of the Minnie Casey quickly raised concerns about the effects of trawling, with a petition being presented to Parliament in 1899 calling for a thirteen mile limit for trawlers and the closing of the Firth of Thames *"before it is too late and schnapper in the Gulf utterly annihilated"* (Anon. 1899). By 1902 trawling had been prohibited from the inner and much of the central Gulf. Restrictions on trawling in the Gulf have changed over time, but the foundations for current trawling limits have their roots in those actions taken more than a century ago (Paul 2014).

Bottom trawling is currently 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 section 5.1.4). Trawling is also prohibited in a number of cable zones in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. However, it is still one of the most commonly used methods of catching fish in the Gulf, accounting for around 30% to 40% of the total catch (Ministry of Fisheries 2009; Hauraki Gulf Forum 2010), and occurring over a wide area (***Figure 5.12***). Around 9,200 bottom trawls (single, pair and precision) occurred in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi during the three year period from 1 January 2014 to 31 December 2016, which is 23% fewer than the previous three year period from 1 January 2011 to 31 December 2013 (MPI, unpublished data; ***Figure 5.13***). In addition, around 4,800 Danish seine trawls were carried out between 1 January 2014 and 31 December 2016 (see ***Figure 5.14***)[23].

The commercial scallop fishery in the Coromandel management area started in the 1970s and was introduced into the QMS in 2002. Until recently, this fishery has been managed with the ability to provide for an in-season increase to the TAC/TACC after considering survey information about scallop abundance within a fishing year. At the close of that fishing year, the TAC/TACC reverted back to the catch limits applied at the beginning of the fishing year. The management approach was reviewed in 2014 at the request of the commercial scallop fishers. The main objectives sought by industry were changes to ensure high annual catches with low inter-annual variability, and to reduce the costs of fisheries management (Haist & Middleton 2014).

Commercial fishers have historically dredged for scallops in discrete beds scattered throughout the Gulf (Tuck et al. 2006). Recent effort has been mainly targeted towards beds around Little Barrier Island, Great Barrier Island, Colville, Mercury Bay and Waihi (***Figure 6.6***).

In 2011, a large, previously unfished scallop bed in 45-50m water was also discovered. The bed initially contained good densities of large scallops and was located mainly within statistical reporting area 2W, with a smaller portion in area 2S (see ***Figure 6.6***). When the 2014 State of Our Gulf Report was released it was not known whether the large biomass of scallops in the new bed was a persistent feature, or the product of successful recruitment in recent years (Ministry for Primary Industries 2013b). However, the discovery of the new scallop bed led to in-season increases of the TACC from 22 tonnes meat weight to 100 tonnes, 50 tonnes and 325 tonnes in the 2010-2011, 2011-2012 and 2012-2013 fishing seasons, respectively(although only 73 tonnes was actually landed in 2012-2013, Ministry for Primary Industries 2017c).

Since 2014, the scallop population of the newly discovered bed has collapsed, and in-season surveys and TACC adjustments have been dropped in favour of setting a 50 tonne TACC and applying a voluntary 'CPUE limit rule' run by the commercial fishers (Ministry for Primary Industries 2016c). Fishers can voluntarily cease fishing a statistical reporting areas, or smaller sub-statistical areas for the remainder of the season if:

- catch per hour falls below the previously-agreed limit; and/or,
- the ratio of scallops less than the minimum legal size per catch exceeds a previously-agreed limit.

Commercial scallop dredging effort in key areas[24] has also reduced from around 33,400 to 34,400 dredge tows in the 3-year periods from 2008 to 2010 and from 2011 to 2013, to around 20,500 tows from 2014 to 2016 (MPI, unpublished data).

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, contained diverse communities of emergent species (***Figure 6.8,*** see Ayson 1901, 1908). Long-term trawler fishers have also identified a number of areas containing biogenic habitats in the Gulf (***Figure 5.19,*** Jones et al. 2016).

Rudimentary bycatch data collected during a scallop survey in 2012 (Williams 2013) indicates that a variety of ecologically significant and sensitive species are still present in the 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 (***Figure 6.9***). MfE has included 'beds

[22] Ocean acidification and climate change were ranked greatest and second greatest threats.

[23] Comparable estimates are not available for the 1 January 2011 to 31 December 2013 period.

[24] Statistical reporting areas 2F, 2K 2L, 2R, 2Q, 2S, 2W, and 2X.

a. b. c.

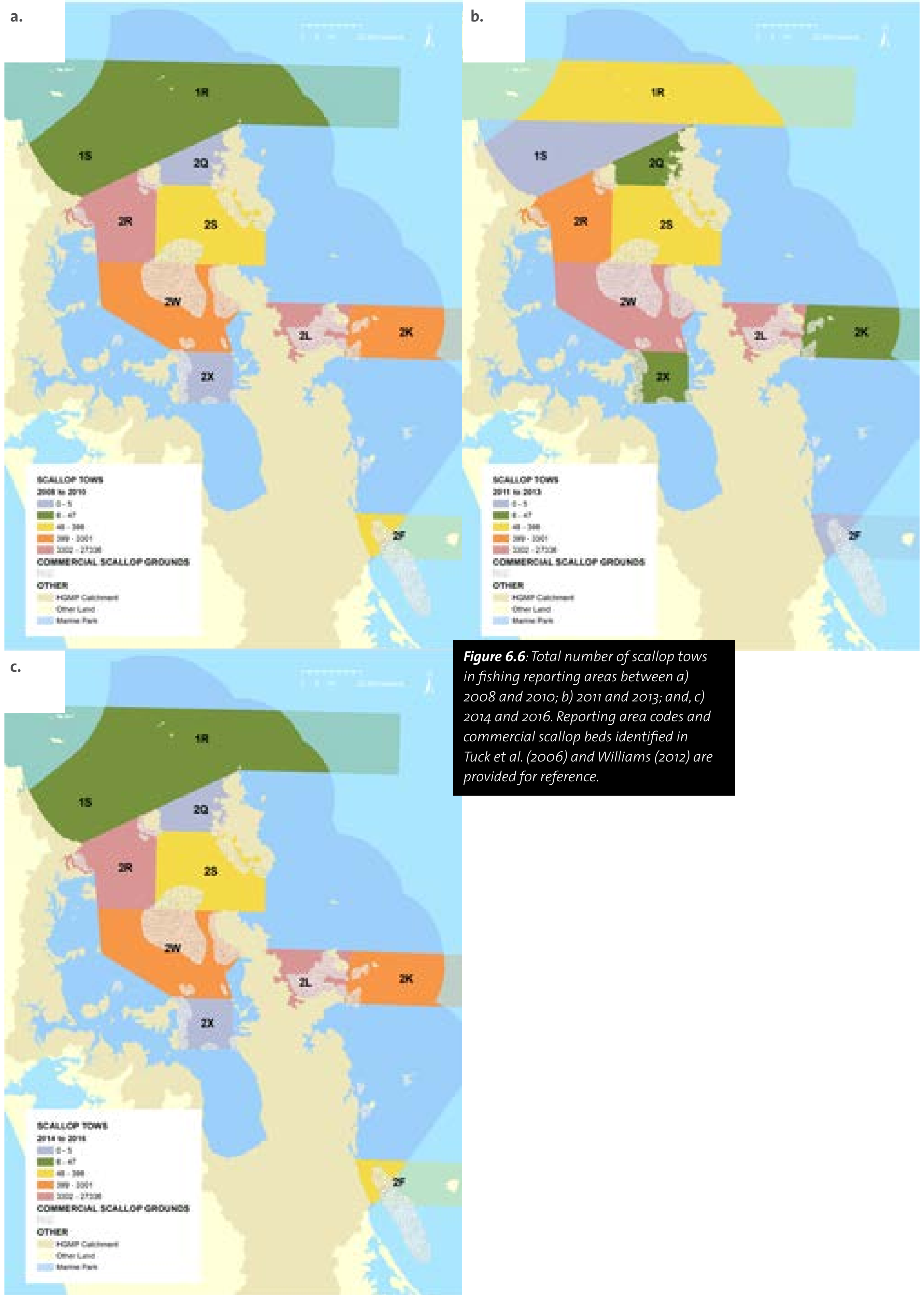


Figure 6.6*: Total number of scallop tows in fishing reporting areas between a) 2008 and 2010; b) 2011 and 2013; and, c) 2014 and 2016. Reporting area codes and commercial scallop beds identified in Tuck et al. (2006) and Williams (2012) are provided for reference.*

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 New Zealand's Exclusive Economic Zone (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, resulting in increased 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).

Interestingly, no discernible difference was found between the occurrence of larger invertebrates dwelling on the surface of the seafloor, inside (an un-trawled area) and outside (a trawled area) the main cable protection area in the Gulf (Morrison et al. 2016). However, the diversity and abundance of invertebrates in both areas were moderate. No horse mussels were observed despite the habitat looking suitable, the area being within the depth range of horse mussels, and present-day populations still being common in nearby shallower areas. The lack of discernible differences in larger benthic invertebrates between the fished and unfished areas was attributed to:

- the rarity of larger invertebrates in and around the cable protection area; or,
- a lack of recovery following the historic removal of larger benthic invertebrates by fishing (as occurred with extensive green-lipped mussel beds historically dredged from in the inner Gulf (Paul 2012)).

The lack of historic data on the ecology and human activities carried out in the area, meant the actual cause could not be determined. But, the report did recount anecdotes of horse mussel beds being historically 'conditioned' (removed) from Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi fishing grounds by fishers towing steel hawsers, water-filled steel drums and bobbins.

Figure 6.7*: Emergent species, such as these sponges and horse mussels in Kawau Bay are very sensitive to fishing or other activities that disturb the seabed. Photo by Shane Kelly.*

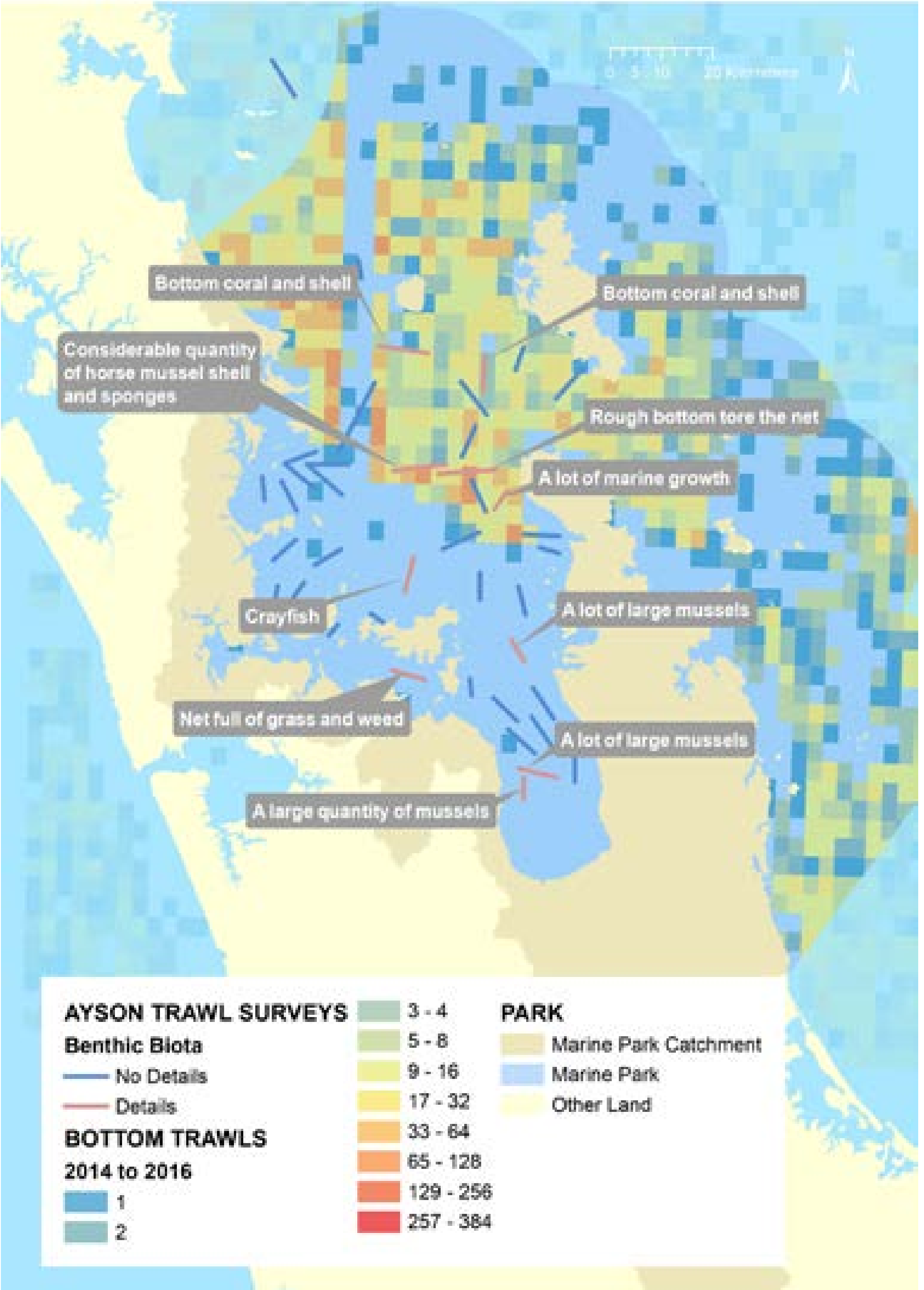


***Figure 6.8**: Bottom biota recorded during trawl surveys carried out in 1901 and 1907 by the Inspector of Fisheries, L. F. Ayson (Ayson 1901, 1908). Trawl lines are overlaid on a grid showing the number of bottom trawls undertaken between 1 January 2014 to 31 December 2016. Details about the bottom biota were provided for the red trawl lines, as indicated.*

***Figure 6.9**: Scallop survey tows where: a) kelp (Ecklonia radiata); b) sponges; c) horse mussels; d) dog cockles were obtained as bycatch (data obtained from MPI, see Williams 2013 for details on the survey).*

Commercial fishing boat in the Gulf. Photo by Shaun Lee.

HE ĀTA TIROHANGA: NGĀ PANONI O NGĀ MAHI HĪ IKA TAUHOKOHOKO I TĪKAPA MOANA PUTA NOA I TE RAUTAU RUA NGAHURU

6.1.6 CASE STUDY: CHANGES TO COMMERCIAL FISHING IN THE HAURAKI GULF OVER THE 20TH CENTURY

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi has always been an important source of seafood for people. Commercial fishing in the Gulf slowly evolved during the 19th century, but shortages in shallow water fish stocks (rock oysters, grey mullet and flatfish) were already apparent in the late 19th century and early 20th century. For example, Fisheries Inspector J. P Bennett reported in the 1914 annual report on Auckland's fishing industry *'mullet are doomed to extinction if something is not done in the near future to conserve them'* (MacDiarmid et al. 2016a). In the first half of the 20th century the wider Gulf was New Zealand's most important inshore fishing region providing 25-35% of the country's total commercial landings. There have been massive changes to commercial fishing methods, total catch levels, and the types of species caught in the Gulf over the 20th century. With the development of offshore fisheries, commercial landings in the Gulf have reduced in national importance to the point where they now only account for less than 5% of the country's total commercial landings (Paul 2014).

Changes in the way we fish in the Gulf

Prior to the 20th century, all commercial fishing in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi was conducted by handlines or nets from sailing boats or row boats. A common trend has been seen over the years. The mechanisation of boats and equipment, and growing numbers of fishers has enabled catch rates to increase until they became restricted by a lack of fish or regulation.

***Table 6.3**: Timeline of commercial fishing methods used in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi*

1900-1904	Steam trawling in the Gulf commenced at the start of the century by one vessel, but was quickly prohibited from the inner Gulf in 1902 due to fears of overfishing (mainly by competitors). Restrictions on trawling in the Gulf have changed over time, but the foundations for current trawling limits have their roots in those actions taken more than century ago. Steam trawling ceased altogether in the Gulf in 1904.
1912	Longlining replaced handlining.
1915-1951	Steam trawling recommenced and continued until 1951, apart from the World War II years.
1923-1980s	Danish seining commenced and becomes the dominant method for catching snapper until the 1950s when it became increasing uneconomic. Danish seining was prohibited from the Firth of Thames in 1924 and from the western Gulf in 1926.
1948	Motor trawling commenced.
1970s	Purse-seining for pelagic species (e.g. skipjack tuna, mackerels and trevally) commenced.

Changes in the species caught

In 1931, snapper (tāmure), tarakihi and flatfish comprised 95% of the fish landed in the Gulf. Snapper comprised 50-80% of the total landings in the Gulf up until 1983, though this figure is likely to be inflated due to the under-reporting of minor species (see below). However, snapper was the main species landed in the Gulf until 1998, when it was overtaken by jack mackerels[25]. The number of species commercially fished in the Gulf has gradually increased from around 12 species in 1931 to 31 species in 2006, and the composition of landings has also diversified. In 2006, the main species landed in the Gulf were blue mackerel, jack mackerels (three similar species), snapper and pilchards (***Figure 5.10***). This change in the species composition and diversity over time is likely to be due to a number of factors:

- **Under reporting of minor species caught**. Prior to 1983, only the main species landed at port were often recorded. In 1983 the reporting system changed and commercial fishers were required to report species caught by fishing area, rather than species landed at port, which resulted in a higher reporting rate of the minor species captured.
- **Introduction of the QMS**. In 1986 the QMS was introduced to improve the management of fish stocks, with TACCs set significantly lower than the quantities landed in the preceding years for the primary exploited species (***Figure 5.11***). This resulted in commercial fishers diversifying their catch to include other species, particularly those that were not included in the QMS, to compensate for the decrease in the catch of the main species. Another result of the QMS was a restructure of the fishing industry with a reduction in the fishing fleet and an increase in bulk fishing of pelagic species (e.g. mackerels, pilchards and kahawai) (Paul 2014).

[25] Reported jack mackerel catches actually comprise three very similar looking species.

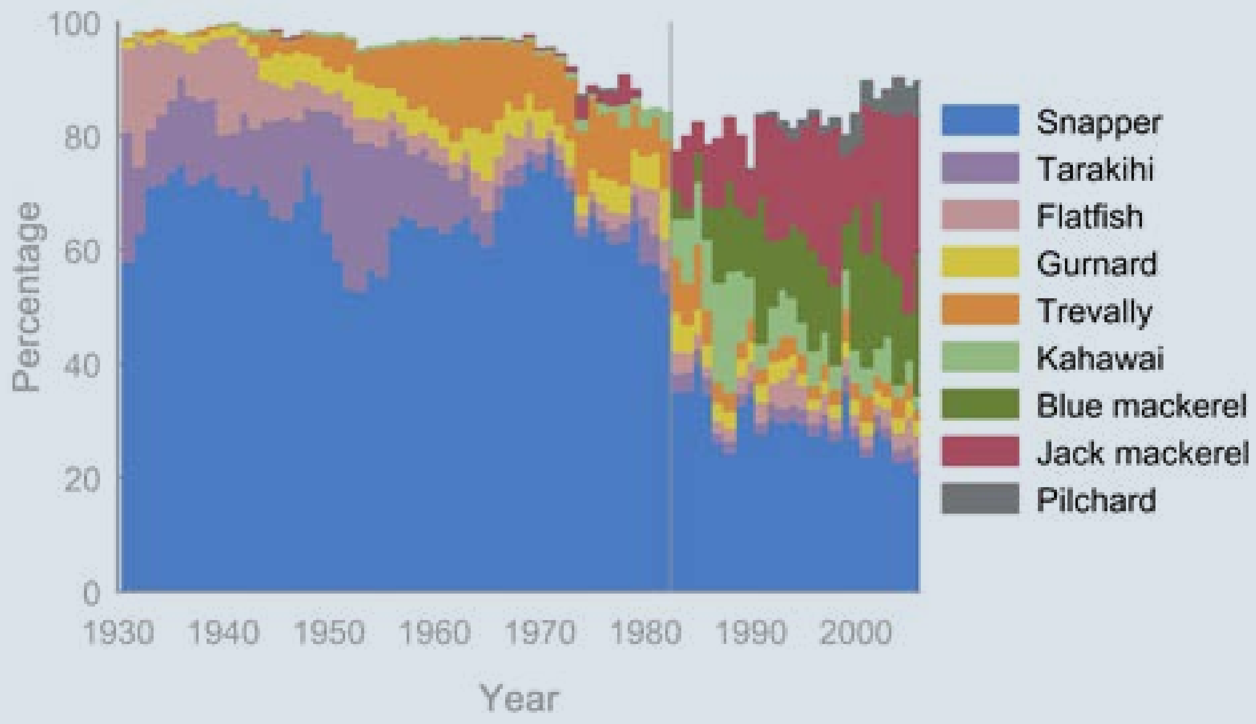


***Figure 6.10**: The main nine species that make up the majority of the total commercial catch from the Hauraki Gulf between 1931 and 2006 (data from Paul 2014). A vertical reference line is added at 1983 when the statistical reporting system changed that resulted in an increase in the number of species reported. Note that recent catch figures differ from those reported in section 5.1.4, which are based on reported landings from statistical reporting areas wholly contained within the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Paul (2014) also includes pro-rata landings from statistical reporting areas that partially overlap the Gulf.*

- **Decreases in the abundance of the main exploited species.** Stock assessment models and CPUE data show that the populations of heavily targeted species such as snapper and trevally have decreased significantly over the 20th century (Francis & McKenzie 2015; McKenzie et al. 2016).
- **Development of new markets.** The increase in commercial landings of minor species is partially due to the increasing price of the main species, the increasing in multiculturalism in New Zealand, and access to or development of new markets. For example, jack mackerel landings have increased markedly since the 1980s, but very little jack mackerel is consumed in New Zealand with the majority exported to Asia, Africa and Eastern Europe (Field 2012). Similarly, the New Zealand pilchard bait industry has grown rapidly since the decimation of the Australian pilchard industry by disease (Thomas 2000).
- **Changing consumer preferences.** Changing consumer preferences to more sustainably caught seafood is potentially increasing demand for middle trophic level species like mackerel and pilchards that were traditionally considered as bait species. For example, Forest and Bird's 'Best Fish Guide' gives pilchards a green status, blue mackerel and grey mullet a yellow status, and snapper, kingfish and groper a red status (Forest & Bird 2017).

Changes in the quantities taken

Total commercial landings in the Hauraki Gulf have increased from around 3,800 t in 1931 to 12,000 t in 2006. Common trends in the commercial catch data amongst species include the:

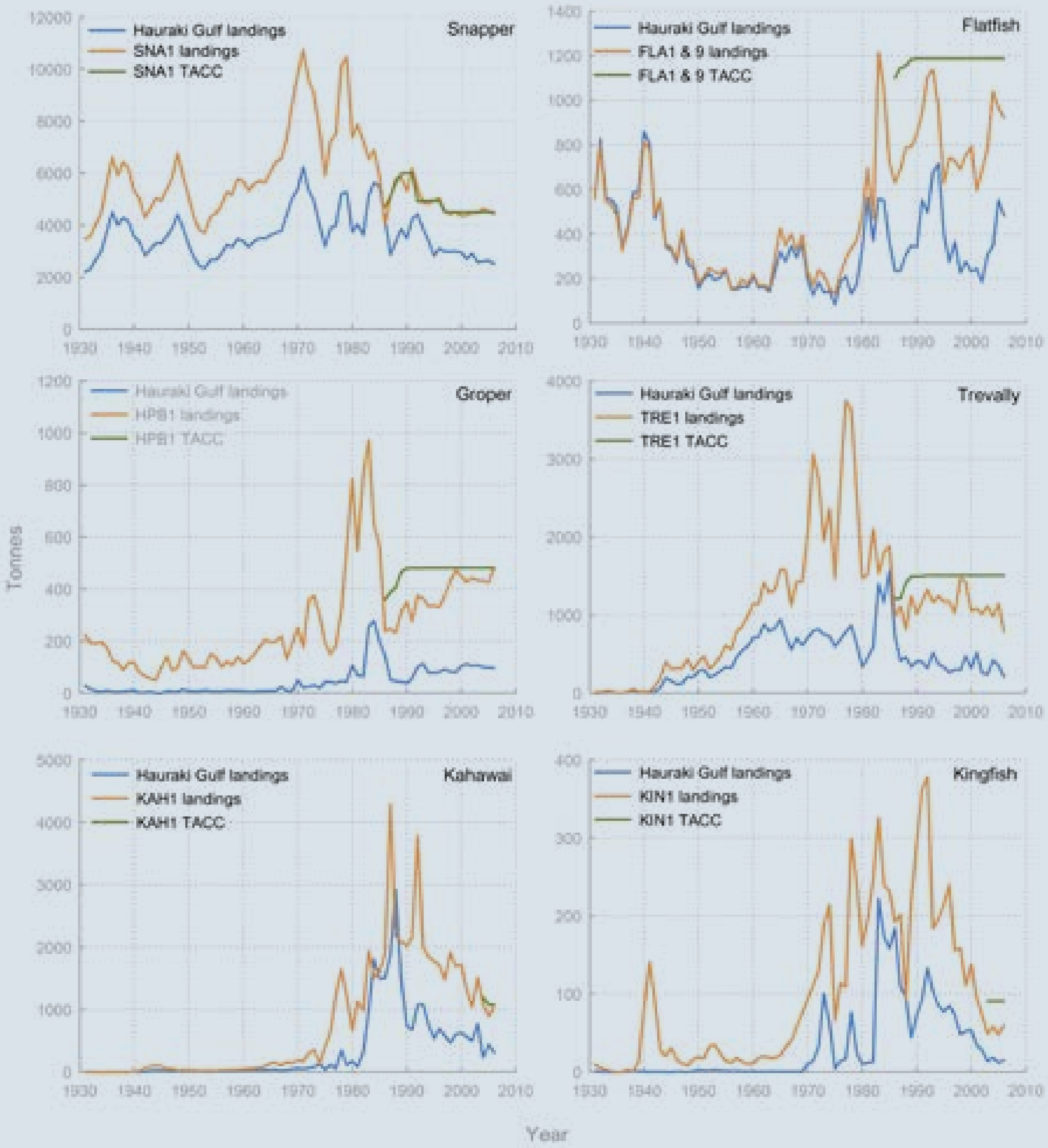
- **Overharvest of primary species up to introduction to the QMS.** Snapper, groper, trevally, kahawai and kingfish show a similar pattern of rapidly increasing commercial landings to unsustainable levels, introduction of a substantially lower TACC, and then maintenance of commercial landings around the level of the TACC (***Figure 6.11***).
- **Increasing harvests of once-minor species.** Since the 1980s there has been an increase in the commercial landings of once-minor species in the Hauraki Gulf including blue mackerel, jack mackerel, pilchards, grey mullet and leatherjackets. These species were traditionally low value or bait species, but development of new markets has facilitated the increase in commercial landings. The development of large fishing vessels has also allowed high volume catches of these lower value species, making fishing for them more commercially viable (Field 2012).
- **Decreasing contribution of the Hauraki Gulf to FMA1 landings.** Several species show a trend of decreasing contribution of Hauraki Gulf landings to total FMA1 landings with the development of offshore fisheries (***Figure 6.11***). Groper, trevally, blue mackerel, jack mackerel and gurnard are now mainly fished in more offshore waters (Paul 2014).

There is little doubt that fish stocks in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi were substantially reduced following the advent of commercial fishing (MacDiarmid et al. 2016a). More recently, we are seeing the progressive targeting of lower-value species from mid-trophic levels, such as mackerel and pilchards. Prior to the 1980s the contribution that these species made to the overall catch is likely to have been small, but mackerels are now among the most heavily harvested species in the Gulf. The increase in the landings of such species is not confined to the Gulf. Nationally, jack mackerel landings in 2013–2014 were 50,388 tonnes, which is the highest level reported since records began in 1931. Jack mackerel in the Bay of Plenty and east Northland (JMA 1) fishery (which includes the Hauraki Gulf) are predominantly caught by purse seine, with recent annual landings of 8,000–12,000 tonnes (Anderson et al. 2017).

Increased landings of lower-value species represents a significant shift in the targeting of finfish. It also signals the potential for further disturbance of the Gulf's marine ecosystem by altering the relative abundance of target and non-target species (i.e. bycatch); and by reducing the availability of prey. Recent research highlights the importance of mid-trophic level species (i.e. those in mid-levels of the food chain), and recommends that this group (which includes small and large pelagic fishes) should be carefully monitored, due to their role in maintaining ecosystem resilience (MacDiarmid et al. 2016a). Similar recommendations have been made for monitoring of top level predators that consume prey from this group (e.g. dolphins), because of their susceptibility to prey depletion (Dwyer et al. 2016). The importance of these prey species has also been recognised when setting catch limits. For instance, the TACC for pilchards was conservatively set to maintain stocks well above the biomass that is estimated to produce the maximum sustainable yield due to their role as a prey species (Cryer et al. 2016).

Figure 6.11: *Commercial landings of key fish species in the Hauraki Gulf and the wider fishery management area that includes the Hauraki Gulf, and the total allowable commercial catch (TACC) for the fishery management area between 1931–2006 (data from Paul 2014 and Francis & Paul 2013).*

a.



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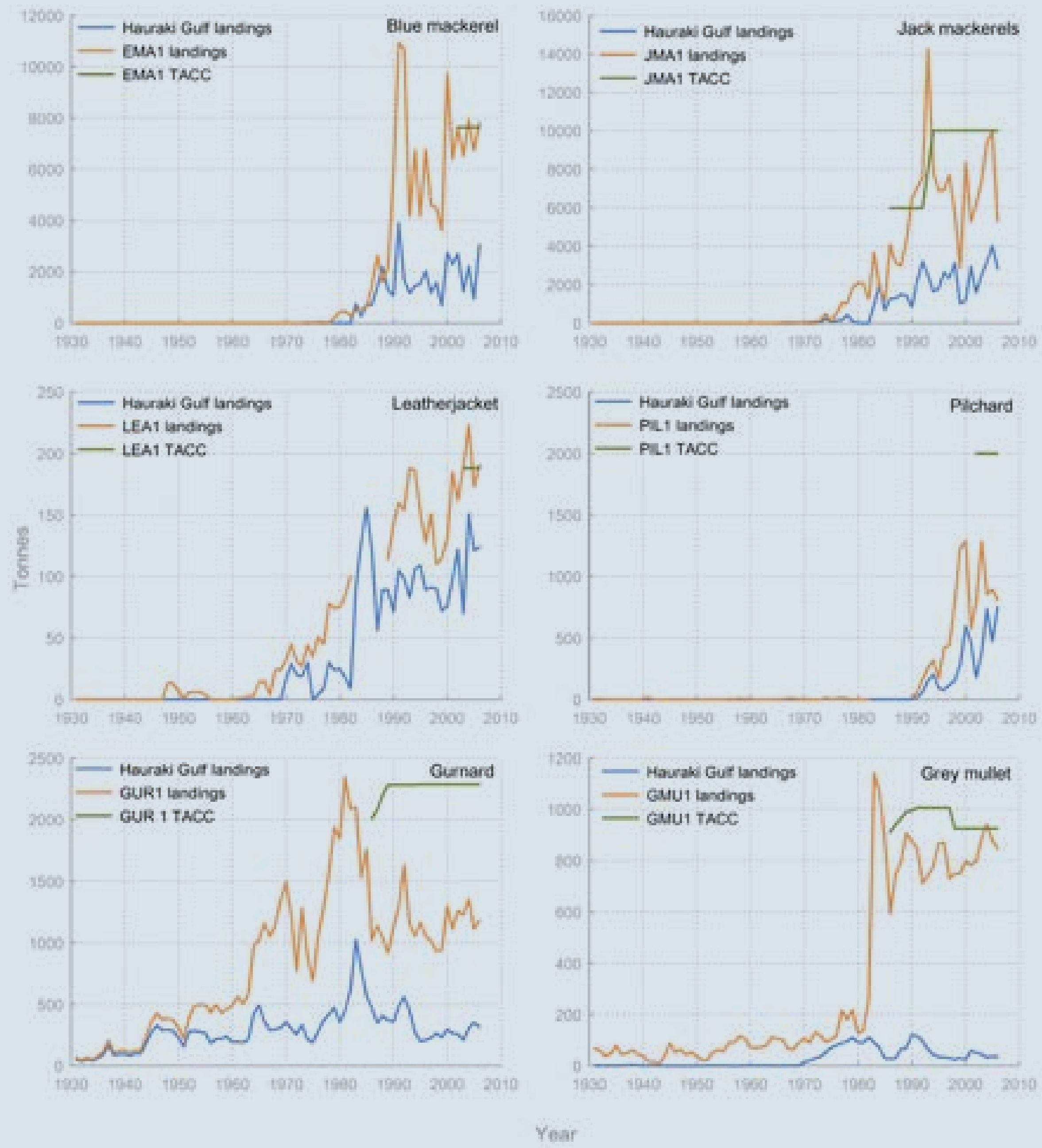


PŪMATŪ PAIHANA
6.2 TOXIC CHEMICALS

A relatively small proportion of the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is affected by sediment contamination. It includes older urban estuaries and tidal creeks in Auckland, and the southeastern Firth of Thames, where low (Threshold Effect Levels (TEL)) sediment quality guidelines are frequently exceeded for copper, lead and/or zinc. Mercury concentrations exceed the Probable Effects Level (PEL) guideline in Kuranui Bay (Thames). Localised contaminant hotspots are associated with landfills, reclamations, ports, marinas and industrial activity.

Contaminant trends have been determined for 51 sites in the Auckland region:

- lead has changed significantly at 16 sites with concentrations increasing at three and decreasing at 13 sites;
- copper has changed significantly at 23 sites with concentrations increasing at seven sites and decreasing at 16 sites;
- zinc has changed significantly at 11 sites with concentrations increasing at seven sites and decreasing at four sites.

Insufficient data is available from the Waikato Region to assess temporal trends.

From a Māori perspective, the mauri of areas with elevated contaminant concentrations could be regarded as diminished. Declining trends in copper and lead concentrations point toward improving mauri in some areas. Conversely, increasing concentrations 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. Māori are particularly concerned about the effects of contaminants on the mauri of the coastal areas, and on ecology, amenity and kaimoana (seafood).

Monitoring and investigations carried out by Auckland Council (and the former ARC), WRC 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;
- 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.

Maritime accidents can also be a major source of contaminants to the marine environment, such as the MV Rena oil spill. Of concern to the HGMP is the RMS Niagara that was shipwrecked approximately 15km east of the Hen and Chicken Islands. The quantity of oil still present on the shipwreck is not known, but the vessel had capacity for 4000 tonnes – an order of magnitude greater than the Rena oil spill. Maritime New Zealand have reportedly indicated that risks associated with the wreck are lessened by any remaining oil likely to be in a semisolid state. Although there are occasional reports of small amounts of oil coming from the wreck as it slowly degrades, past occurances are reported to have naturally dispersed without causing any significant environmental impact (Anon. 2016).

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).

The Tāmaki Estuary. Photo by Shaun Lee.

In the Auckland region, contaminant concentrations are most elevated in the sheltered estuaries and tidal creeks associated with old urban catchments (Mills et al. 2012). In these locations, lower TEL sediment quality guideline values are frequently exceeded for zinc, copper, lead and mercury (see Table 5 for a description of sediment quality guidelines). Of the 98 sites in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi that were monitored or assessed by Auckland Council between 2005 and 2016, 29 exceeded TEL guideline values for at least one of these contaminants (Research, Investigation and Montioring Unit (RIMU), Auckland Council, unpublished data). 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 PEL guideline values.

Copper, lead and zinc concentrations were sufficiently monitored[26] between 2004 and 2016 in the Auckland region to estimate trends for 51 sites. At these sites, statistically and environmentally significant[27] trends were detected at:

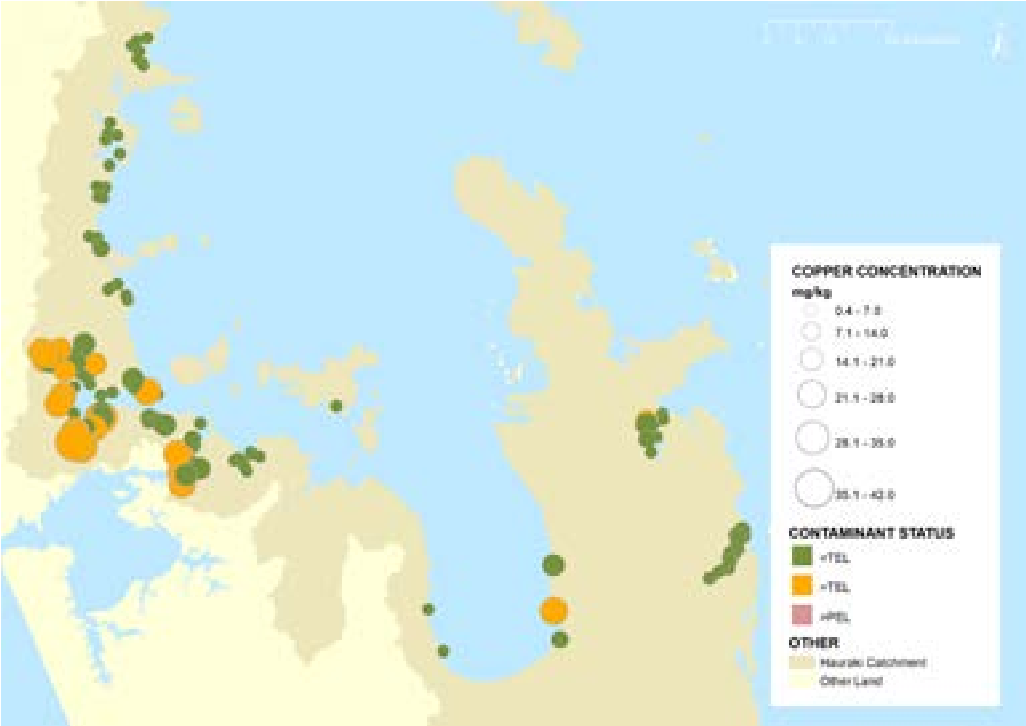
- 16 sites for lead concentrations with three displaying worsening (i.e. increasing concentrations) trends and 13 displaying improving trends;
- 23 sites for copper concentrations, with the majority (16) displaying improving trends;
- 11 sites for zinc concentrations with the majority of these (seven) displaying worsening trends (Geoff Mills, Diffuse Sources Ltd, unpublished data).

[26] For a sufficiently long period and at frequent enough intervals.

[27] Statistically and environmentally significant trends are those where there is a relatively high probably (95%) that the result is not simply due to random variation (noise) in the data, and rates of change are greater than 1% of site medians per year. Note that in 2014 environmental significance was determined using a slightly different method (i.e. rates of change greater than 1% of TEL guideline values were used in 2014). Changes were made in this report to provide a consistent method of reporting trends in sediment and water quality indicators.

***Figure 6.12**: 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 μm sediment fraction. Data provided by Auckland Council.*

a.



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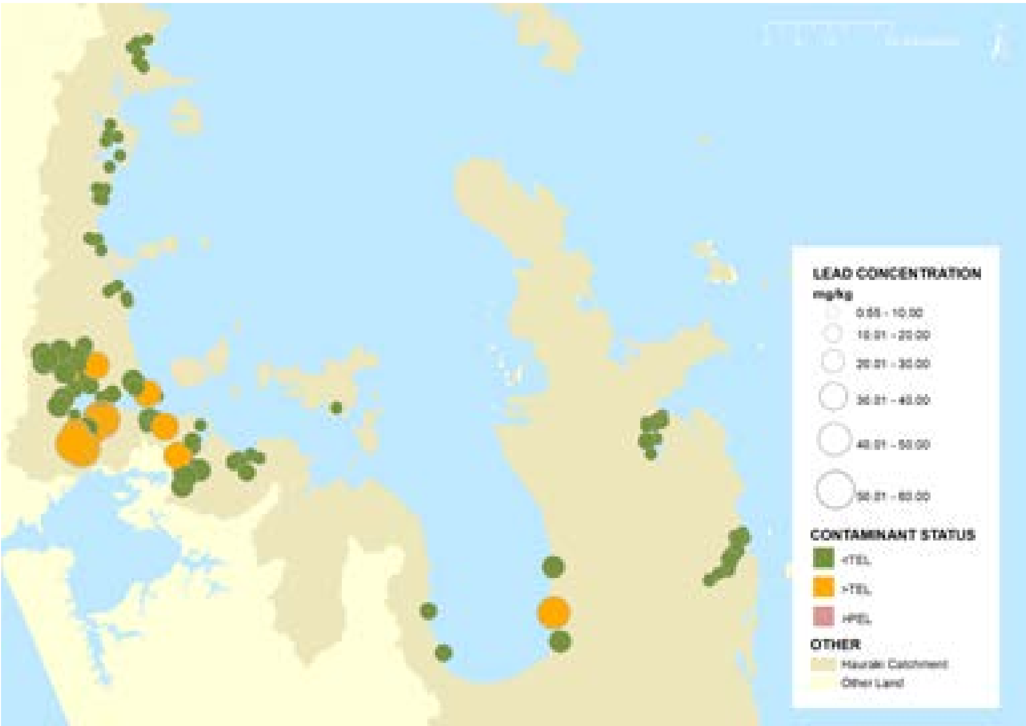

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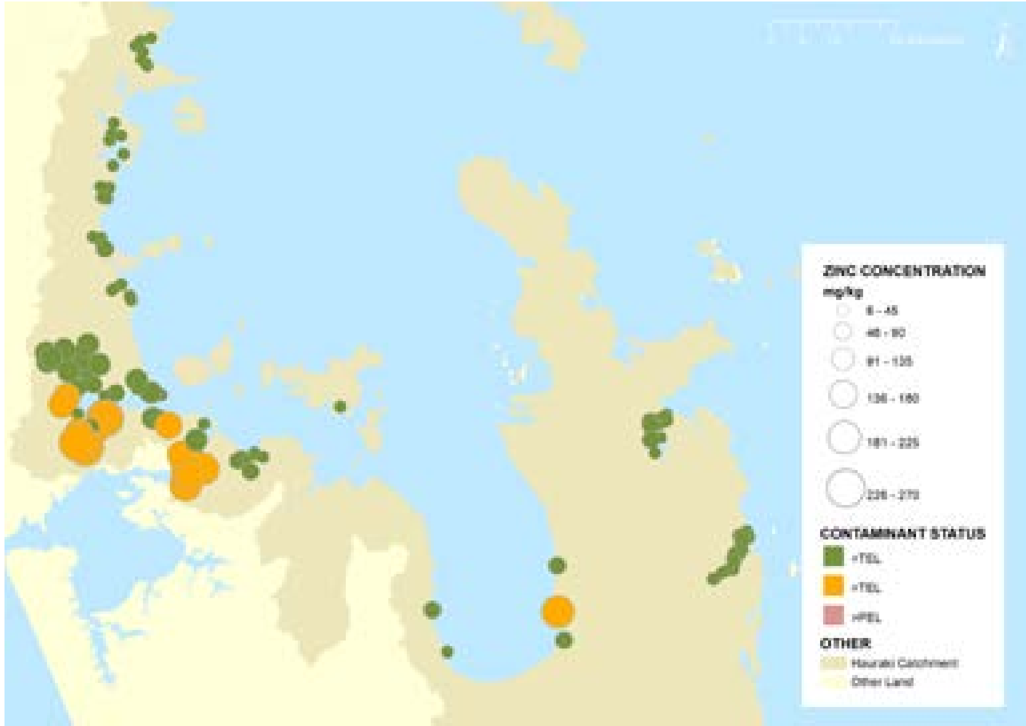

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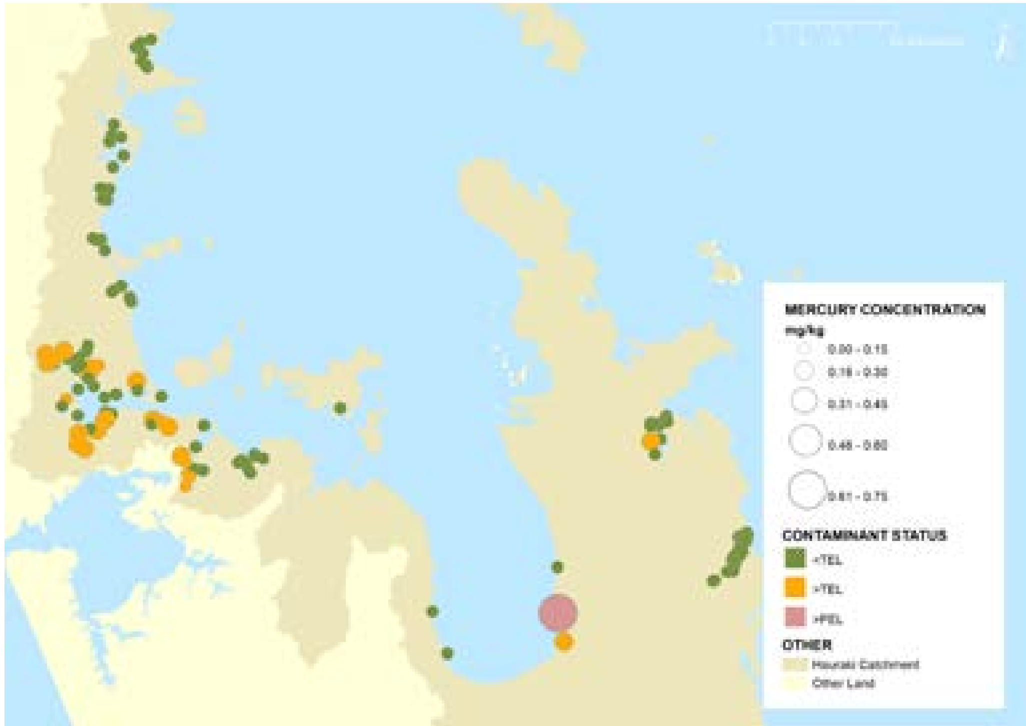


***Figure 6.13**: Trends in the concentrations of a) copper, b) lead, and c) zinc in coastal sediments around the Auckland urban isthmus. Arrow colour indicates whether the trends are statistically and environmentally significant (red) or non-significant (blue). Arrow size is proportional to the rate of change (mg/kg/yr). Concentrations were obtained using strong acid digestion of the < 500 µm sediment fraction. Data provided by Auckland Council.*

a.

b.

c.

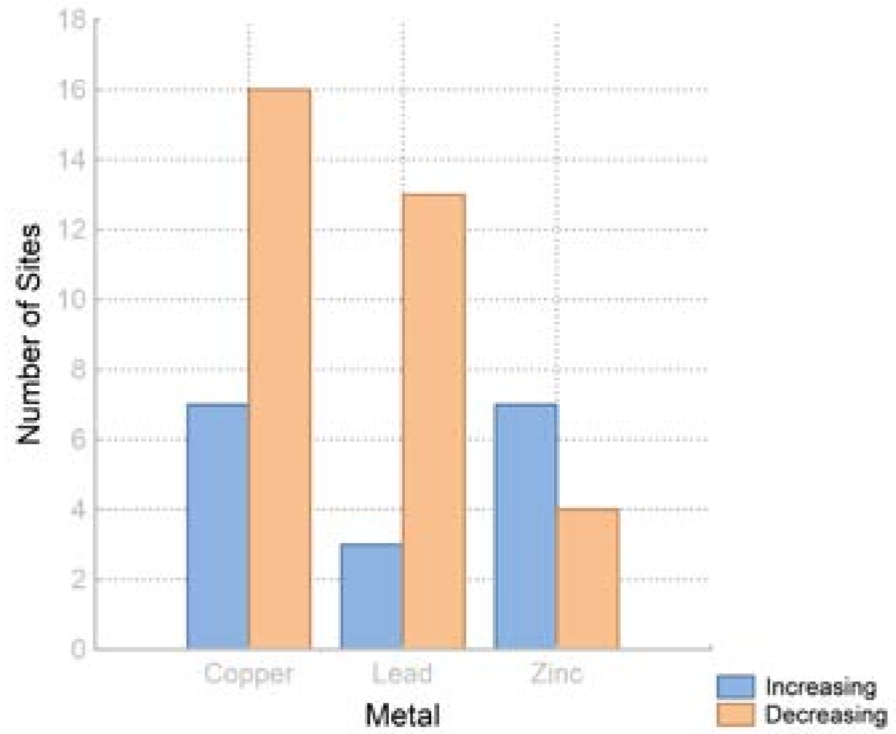


***Figure 6.14**: Number of sites (out of 51) in the Auckland region with statistically significant (p < 0.05) and environmentally significant trends in copper, lead and zinc concentrations. Data provided by Auckland Council. Statistically and environmentally significant trends are those where there 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 the site median.*

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). Sampling carried out by WRC between 2008 and 2014 indicates that copper, lead and zinc concentrations continue to exceed TEL guideline values in Kuranui Bay (Thames), while mercury concentrations exceed the higher level PEL guideline value at that site (***Figure 6.12***). Kuranui Bay adjoins a reclaimed area (Moanataiari), which was initially formed using mine tailings dumped upon intertidal flats (Kim 2007) .

Mercury concentrations also exceeded the TEL guideline at one of 12 Whitianga sites sampled, but concentrations of copper, lead and zinc were below guideline values. Guideline values were not exceeded in any of the 30 Tairua sites analysed for copper, lead and zinc, or the 21 Tairua sites analysed for mercury.

Investigations by WRC, TCDC and others have also shown that:

- cadmium concentrations are slightly elevated in the southern Firth, but they remain below guideline values;
- elevated concentrations of arsenic and mercury occur at sites within Coromandel Harbour, with some having sediment concentrations above guideline values.

Monitoring of the Waikato sites has not been carried out frequently enough to statistically examine trends in contaminant concentrations.

***Table 6.4**: 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. Threshold Effect Levels (TEL) guideline values (MacDonald et al. 1996) 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. Probable Effect Levels (PEL) guideline values (MacDonald et al. 1996) 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 (mg/kg)	TEL Guideline Value (mg/kg)	PEL Guideline Value (mg/kg)
Copper	c. 5*	18.7	108.2
Lead	c. 5*	30.2	112.2
Mercury	Undetermined	0.13	0.70
Zinc	c. 35*	124	271

* Diffuse-Sources Limited (2004)

PARA WHENUA ME TE HAUORA O TE PAPA MOANA
6.3 SEDIMENT AND BENTHIC HEALTH

Sediment is a serious environmental contaminant that degrades coastal habitats.

Several monitored estuaries have shown increases in the proportion of fine sediment, with the most significant changes seen in Ōkura, Mangamangaroa, Tūranga and Waikōpua Estuaries and Miranda. Many of these estuaries have also shown changes in the intertidal communities that are consistent with increased sedimentation, though not all changes can be explained by changes in sediment.

Seven of the 21 water quality sites monitored by Auckland Council, displayed statistically significant trends in total suspended solids (TSS) concentrations: three sites had worsening trends (increasing concentrations) and four sites had improving trends.

WRC does not monitor coastal TSS 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.

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 highest[28] of 65 identified threats to marine habitats in New Zealand respectively (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; Ellis et al. 2002; Nicholls et al. 2003; Morrison et al. 2009).

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). WRC 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).

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

[28] The threat posed by increasing sediment loads is ranked equal to the threat posed by bottom trawling. Ocean acidification and climate change were ranked greatest and second greatest threats.

(Swales et al. 2002; Jones 2008). For instance, sediment has radically altered characteristics of the Firth of Thames over the past century and a half. Historic forest clearance and mining during the late 1800s to early 1900s generated vast amounts of sediment. Surveys carried during that period during suggest that around 44,000,000m^3 of sediment was deposited within the lower Waihōu River and in the Southern Firth south of (Kaiaua) in the 40 years prior to 1918. This equates to around 300 years of today's suspended sediment loads from the Waihōu and Piako Rivers to the southern Firth (Ministry of Works files, 1919-1975, in Swales et al. 2008). The conversion of Hauraki wetlands to pastoral land also exacerbated sediment runoff, with flood protection works (stopbanks and drainage channels) likely to have increased toe sediment delivery to the Firth (Swales et al. 2008). As a result, over the past 90 years sediments in intertidal and shallow subtidal areas of the southern Firth have been increasing at rates up to 10 times higher than many other North Island estuaries, and when compared to rates before the mid-1800s (Swales et al. 2016).

This has had serious consequences for the coastal ecosystem. Dredging and sedimentation led to a 'step-change' in the ecological functions and values of the Firth. Extensive shellfish beds (mussels and oysters) that once blanketed the seabed were destroyed and replaced by muddy sediments containing a persistent community of species that can survive in the degraded conditions (Paul 2012, Green & Zeldis 2015). The Firth continues to be affected by legacy and ongoing sediment runoff, with catchment loads likely to increase further if the frequency and severity of storm events increases in accordance with climate predictions.

Changes in mud content and benthic ecology

Auckland Council and WRC both monitor sediment characteristics and seabed communities[29] in a number of harbours and estuaries in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (***Figure 5.16***). Key results from these programmes are summarised below.

Figure 6.15: *Sediment from an earthworks site and upper catchment adjoining Karepiro Bay, on the northern side of Ōkura Estuary. Photo by Geoff Reid.*

In 2000, ARC initiated an estuary monitoring programme that was specifically designed to detect sediment-related changes in the composition of intertidal communities in Ōkura Estuary. Between 2002 and 2004, this programme was expanded to include Pūhoi, Waiwera, Orewa, Mangemangeroa, Tūranga and Waikōpua 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 2004, there has been statistically significant increases in the proportion of very fine and muddy sediments (i.e. sediments < 125 μm). Sites in Ōkura, Mangamangaroa, Tūranga and Waikōpua have experienced the most widespread increase in fine sediment, with 70-100% of sites showing increases (Hewitt & McCartain 2017). Many of the ecological changes observed in the monitored estuaries are consistent with increased sedimentation (e.g. increases in mud-tolerant animals and declines in mud-sensitive animals), with Ōkura, Tūranga, Ōrewa and Managemangeroa exhibiting the most changes in benthic community composition. The effect of sedimentation at Ōkura is particularly concerning with almost half the sites showing changes in community composition consistent with increasing mud (Hewitt & McCartain 2017, Hewitt & Simpson 2012).

Figure 6.16: *Long-term monitoring sites in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi for sediment texture and benthic ecology.*

Sediment characteristics and macrofaunal community composition have been monitored annually in the Mahurangi Harbour since 1994. A marked increase in the proportion of fine sediments (< 125 μm) occurred at all sites between April 1995 and April 1997, which was followed by abrupt stepwise declines in the populations of five species that are sensitive to mud (wedge shells (*Macomona lilana*), cockles (*Austrovenus stutchburyi*), nut shells (*Linucula hartvigiana*), the limpet (Notoacmea scapha), and a polychaete worm (*Scoloplos cylindrifer*)), particularly at the muddiest site (Hamilton Landing). Since then, the proportion of fine sediments at all sites has been relatively stable, but populations of most mud-sensitive species have not recovered. Wedge shells, nut shells and the worm *S. cylindrifer* still show estuary-wide statistically significant decreasing trends in abundance, while cockles show fluctuating trends in abundance (Cummings et al. 2016).

[29] Only the abundance of certain indicator taxa are measured.

Mahurangi Harbour. Photo by Shaun Lee.

Similarly, sediment characteristics and macrofaunal community composition have been monitored in the central Waitematā Harbour since 2000 and the upper Waitematā Harbour since 2005. Few long-term trends in mud content were observed in the Waitematā Harbour between 2000 and 2014. Shoal Bay, in the central harbour, has showed an increase in mud content since 2003, and the mud content of sediments from Waiarohia Inlet, in the upper harbour has increased since 2007. Mud content at other central sites has been relatively stable, while mud content at upper harbour sites has been highly variable. Ecological changes at Shoal Bay and Waiarohia are consistent with the increasing mud content, while observed changes in species' abundances at the other sites do not appear to be related to sedimentation or contaminant effects. Rather, they appear to display natural long-term cycles in abundances (Parkes & Lundquist 2015; Townsend et al. 2015).

WRC has conducted a Regional Estuary Monitoring Programme in the Firth of Thames since 2001. Mud content has significantly increased at Miranda (***Figure 6.16***), and almost significantly increased at Kuranui Bay, while other sites shows no significant trends. Changes in species' abundance vary among sites, and some, but not all, changes in the benthic community are consistent with increasing muddiness. For example:

- At Miranda, which has become increasingly muddy, there have been decreasing trends in the abundance of the mud-sensitive anemone (*Anthopleura aureoradiata*) and the worm (*Aonides trifida*). The abundance of the mud-tolerant capitellid worm increased dramatically between 2001 and 2011, but then subsequently decreased to almost zero (***Figure 6.17***). It should be noted that Miranda has 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.
- At Te Puru, there have been decreasing trends in the abundance of the mud-sensitive nut shells and pipi. However, these changes were not associated with a significant increase in muddiness.
- At Kuranui Bay, mud content has (almost significantly) increased, but no significant trends in species' abundance have been observed at this site (Needham et al. 2014).

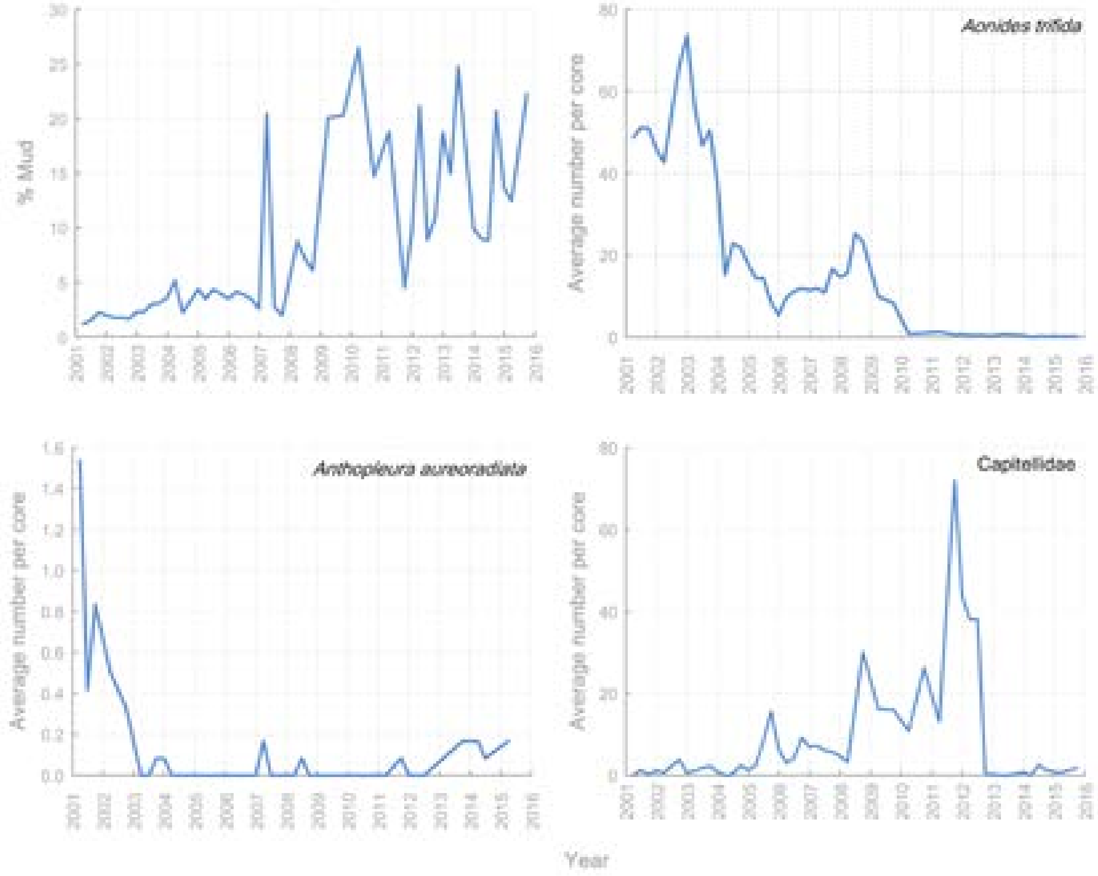


***Figure 6.17**: Long-term trends at the monitored estuary site in Miranda, in the Firth of Thames between 2001 and 2015: Changes to the percentage of the sediment that is mud; the abundance of the mud-sensitive worm, Aonides trifida; the abundance of the mud-sensitive anemone, Anthopleura aureoradiata; and, the abundance of the mud-tolerant capitellid worms. Note that some of the apparent increase in mud after 2007 was due to a change in methodology that allowed for a greater percentage of mud able to be detected post-2007. Data provided by Waikato Regional Council.*

Total suspended solids (TSS)

Auckland Council (and its predecessor ARC) collected monthly TSS data from sites in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi over a 7 to 29-year period (depending on the site). Highest concentrations of TSS occur in the upper reaches of the Waitematā Harbour and in Tāmaki River (***Figure 6.18***). In the ten-year period between 2007 and 2016, 7 of the 21 water quality sites monitored, displayed statistically significant trends in TSS concentrations. Of these, three sites had increasing (worsening) trends and four sites had declining (improving) trends. Improving trends occurred at three of Auckland Council's northern sites (Goat Island and Ti Point (both near Leigh), and Orewa) and in Tāmaki Inlet. Significant worsening trends were detected at two sites in the Upper Waitematā Harbour, and at the mouth of Tūranga Estuary in Whitford embayment (note that only seven years of data were available for the latter site). In contrast, the 2014 State of our Gulf Report only reported two sites with statistically significant trends between 2004 and 2013, both associated with declining TSS concentrations.

These results do not include data from a number of major storm events occurring in 2017, which are likely to have generated a substantial spike in sediment runoff to the Gulf. The effects of those events have not been quantified, but may be substantial. 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). Median TSS values from Auckland's 21 Hauraki Gulf / Tīkapa

Moana / Te Moana-nui-a-Toi sites indicate that between 2007 and 2016 most sites (19 out of 21) had TSS concentrations that exceeded 4 mg/l at least 50% of the time. This suggests that there are likely to be some adverse effects on snapper larvae.

a. b.

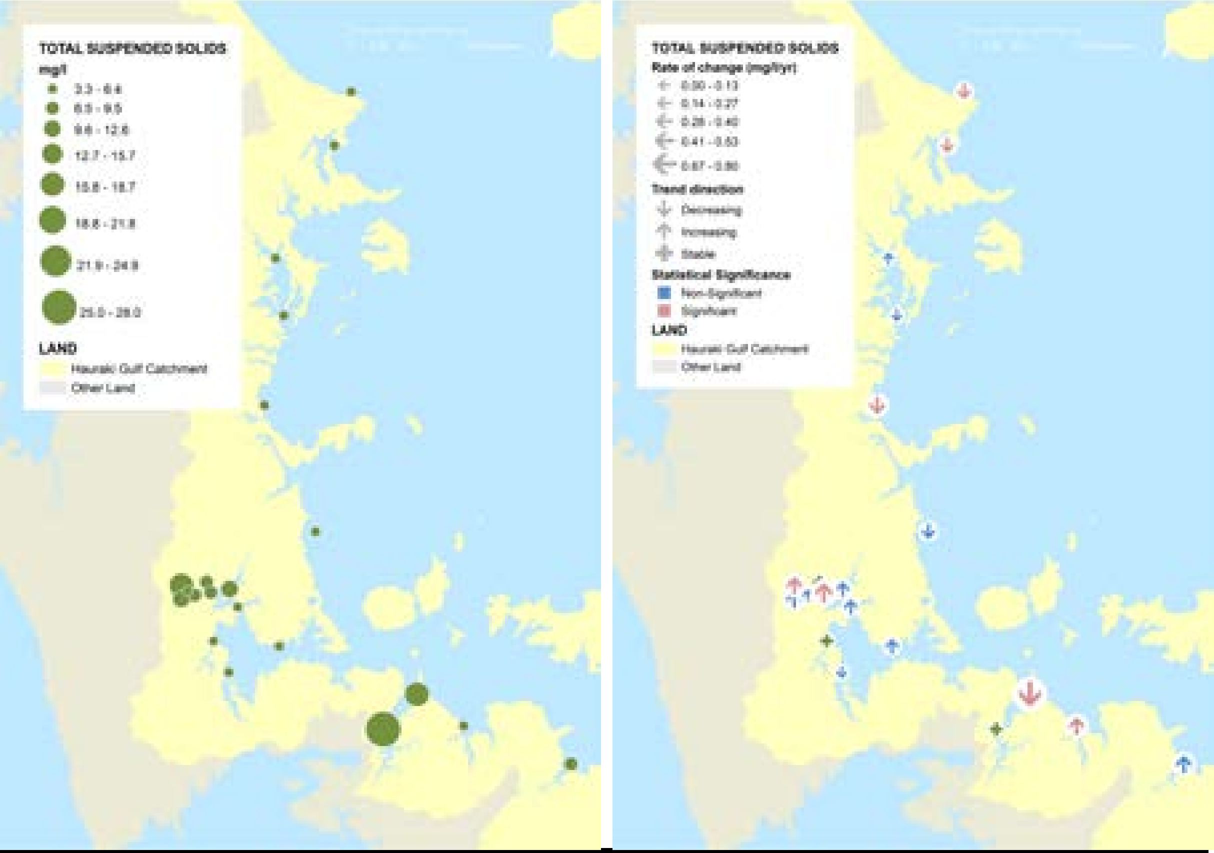


***Figure 6.18**: Auckland Council monitoring results showing a) median monthly concentrations of total suspended solids (TSS) (mg/l), and b) TSS trends (mg/l/yr) in coastal water samples obtained between January 2007 and December 2016 (except for Wairoa River and Tūranga Estuary mouths in Tāmaki Strait, where monitoring started in January 2009). 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.*

WRC does not collect comparible water quality data. However, modelling by NIWA suggests that sediment loads from rivers draining the Hauraki Plains dominate sediment inputs to the Gulf (***Figure 6.19***; 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.

Suspended sediment west of Waiheke Island. Photo by Shaun Lee.

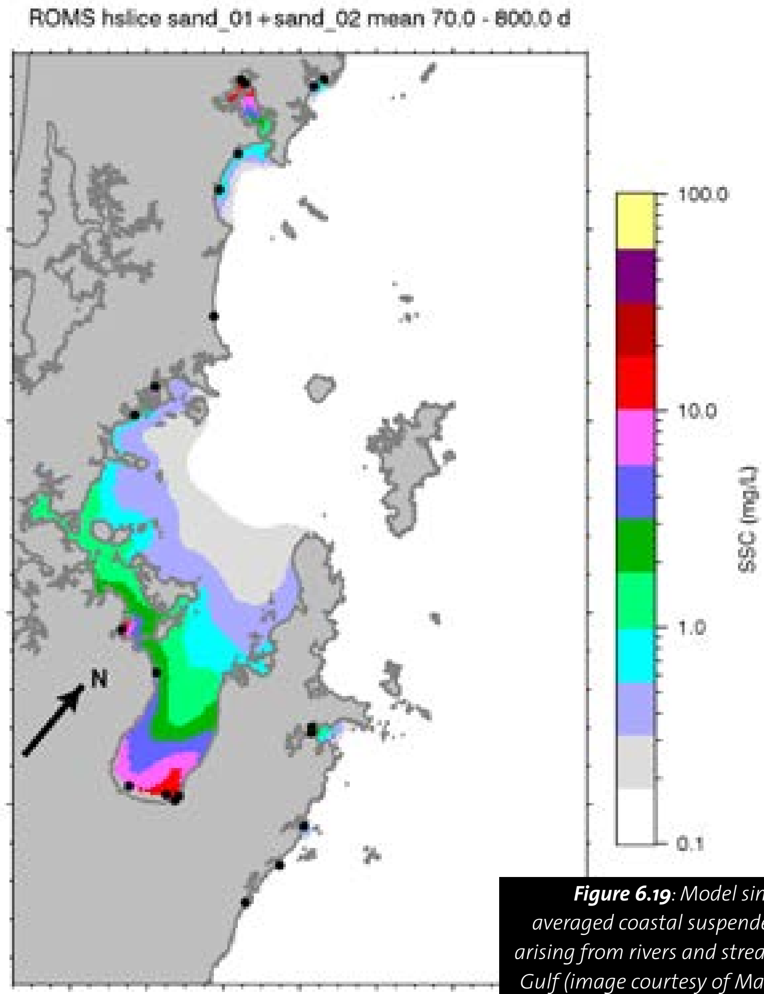


***Figure 6.19**: Model simulation showing two-year, averaged coastal suspended sediment concentrations arising from rivers and streams draining to the Hauraki Gulf (image courtesy of Mark Hadfield, NIWA; Hadfield et al. 2014).*

NGĀ MĀNAWA

6.4 MANGROVES

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.

Since the 2014 report, approximately 10.71ha of mangroves have been removed from Whangamatā, and approximately 17.81ha were removed from Tairua. Minor clearances have also occurred in several other areas.

A 'TCDC and HDC Mangrove Management Bill' is currently being considered by a Parliamentary Select Committee. The Bill aims to facilitate the removal of mangrove vegetation to *"achieve and maintain appropriate levels"* of mangroves; and to *"restore, protect, and enhance any amenity values or ecosystems of the coastal area from which mangrove vegetation is removed"*.

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; Morrisey 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 (Morrisey 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 (Morrisey et al. 2010). Mangroves also provide roosting, feeding, and/or breeding habitat for birds, terrestrial invertebrates and reptiles. Around 48 bird species have been observed using mangrove habitat, including At Risk or Threatened species such as the New Zealand fairy tern (*Sterna nereis davisae*), white heron (*Ardea modesta*), Australasian bittern (*Botaurus poiciloptilus*), caspian tern (Hydroprogne caspia), pied shag (*Phalacrocorax varius*), North Island fernbird (*Bowdleria punctata vealeae*), banded rail (*Gallirallus philippensis assimilis*), New Zealand pied oystercatcher (*Haematopus finschi*), pied stilt (*Himantopus leucocephalus*), and eastern bar-tailed godwit (*Limosa lapponica baueri*) (Bell & Blayney 2017b). The eriophyid mite, Aceria avicenniae, and the larvae of the moth, Planotortrix avicenniae only live on mangroves, while Pacific and forest geckos (*Hoplodactylus pacificus* and *H. granulatus*) are common in northern mangrove forests (Morrisey et al. 2007).

Negative impacts on Threatened and At Risk birds have been identified as a key issue for mangrove removals. The direct loss of foraging habitats has the potential to have severe detrimental impacts on the populations of some bird species. Reductions in the extent other habitats (e.g. saltmarsh) and introduced predators has resulted in banded rail becoming dependant on mangroves habitats for their continued survival in the North Island (Bell & Blayney 2017a). Mangroves also provide a corridor between the shore and open areas of sand and mud. Their removal is therefore likely to impede the movement of birds between foraging, roosting and/or resting areas (Bell & Blayney 2017b).

Mangroves at high tide in Whangateau Estuary. Photo by Darryl Torckler.

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).

Although the expansion of mangrove forests appears to be slowing, public views about mangroves remain divided. Some groups supporting protection and others advocate for clearance. A variety of reasons are used to support the clearance of mangroves (Lundquist et al. 2017). These include, maintaining or restoring:

- recreation and amenity values;
- sand flats, seagrass and shellfish beds;
- access and navigation channels;
- the use of structures such as jetties;
- the functioning of drainage and flood protection systems.

NGĀ PANONI O TE KAHU MĀNAWA
6.4.1 CHANGES IN MANGROVE COVER

Estimates of mangrove cover were provided in the 2014 State of our Gulf Report for nine estuaries with long-term records (***Figure 6.20***). Those estimates are summarised and updated below:

- Historic estimates of percent cover in Pūhoi were considerably higher than recent estimates. The reasons for this were uncertain, but could have been due to the misclassification of saltmarsh as mangroves in earlier aerial photographs, roading related changes to the estuary, or other analytical issues. Reference maps were generated to improve future comparisons.
- Estimates of mangrove cover in Lucas Creek, Ōkura, Mangamangaroa, Whangapoua and Whangamatā indicate:
  - In all five estuaries, the most recent estimates of mangrove cover were greater than estimates of cover prior to the 1970s (albeit very slightly for Lucas Creek).
  - Percentage of cover has only increased in one estuary (Mangamangaroa) since the 1990s.
  - Percentage of cover had been relatively stable or declined slightly since the 1990s in four of the estuaries (Lucas Creek, Ōkura, Whangapoua, and Whangamatā). Since the 2014 report, approximately 10.71 hectares of mangroves were also removed from Whangamatā, with plans to remove a further 4.64ha in the second half of 2017 and 2018.
  - Updated aerial photographs obtained in 2015-2016 were for two of the nine estuaries: Lucas Creek and Mangamangaroa. These indicated that there had been little change in mangrove cover within the two inlets since the 2014 State of our Gulf Report (***Figure 6.20*** and ***Figure 6.21***)
- In the remaining three estuaries (Whitianga, Tairua, and Wharekawa) percentage of mangrove cover had been relatively stable or declined slightly since the 1990s. A slight reduction in Wharekawa was consistent with consented clearance activities that had been ongoing for some years. Since the 2014 report, approximately 17.81 hectares were removed from Tairua, with further plans to remove a further 0.77 hectares in 2018.

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 show that the subsidence of the tidal flats will impede the ongoing expansion of mangrove forests in the 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 per year. Unless sediment deposition keeps pace with the subsidence, this is likely to limit the seaward expansion of mangrove forests in the southern Firth (Swales 2012).

Ē TAHI ATU MAHI O INĀKUA AKE NEI
6.4.2 OTHER RECENT ACTIONS

Between 2011 and 2014, consents were granted to:

- clear 0.21 hectares of mangroves in Millon Bay (Baddeleys Beach) in the Auckland region;
- clear mature mangroves from 22.91ha in Whangamatā Harbour and remove seedlings from both Whangamatā and Ōtahu harbours;
- clear mature mangroves from 21.81 hectares in Tairua Harbour, and remove seedlings from the whole harbour.

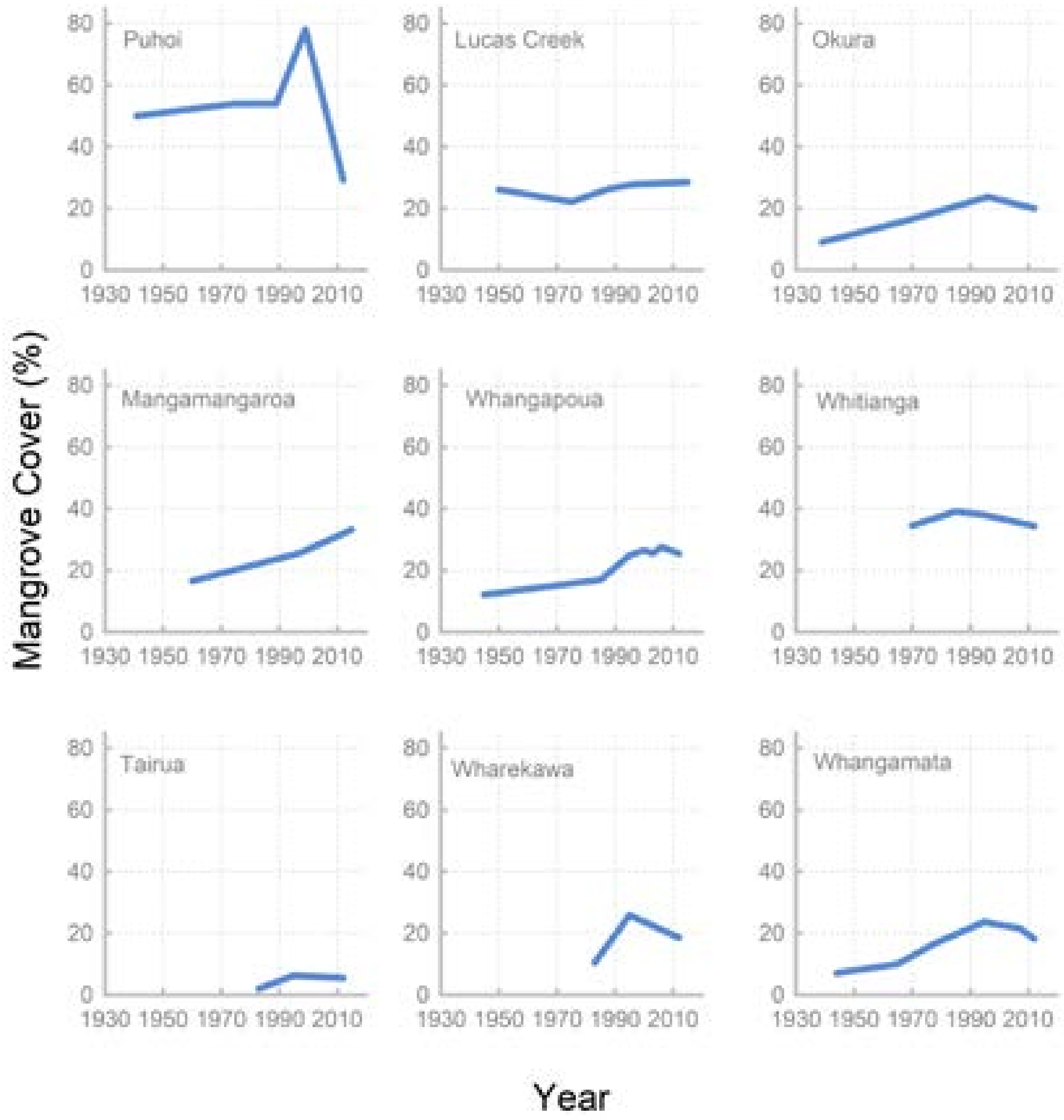


Figure 6.20: *Variation in mangrove cover (as a percent of estuary area) over time. Historic data was collated from Jones (2008) and Morrisey et al. (2007), while more recent data was obtained by mapping mangroves from aerial photographs obtained by Auckland Council and Waikato Regional Council between 2010 and 2016. Note that historic figures for Pūhoi appear to be inflated.*

Since then:

- An additional consent has been approved for the Miranda Naturalists Trust to clear seedling and juvenile mangroves from a defined area around the mouth of Miranda Stream.
- Four consents have been issued in the Auckland region for relatively minor mangrove clearances. The consents were associated with bridge and outfall construction, clearance around the outlet of a farm drain, and clearance from an area along Tāhuna Tōrea Reserve in Tāmaki River to protect historic fish dams.
- The Parliamentary Member for Coromandel, Scott Simpson MP, introduced a Local Bill into Parliament on behalf of the TCDC and HDC. The TCDC and HDC Mangrove Management Bill seeks to facilitate the removal of mangrove vegetation to *"achieve and maintain appropriate levels"* of mangroves; and to *"restore, protect, and enhance any amenity values or ecosystems of the coastal area from which mangrove vegetation is removed"*. The Bill passed its first reading in Parliament in August 2017, and has been sent to the Local Government and Environment Select Committee for further consideration.

Mangrove seedlings growing in tire tracks. Photo by Shaun Lee.

- WRC and the TCDC have formed a 'partnership' for mangrove management in Coromandel harbours by signing up to a joint Statement of Intent and Action List.
- Provisions of the Proposed Auckland Unitary Plan, which classified the removal of seedlings and mature mangroves back to the 1996 line as permitted activities, where not included in the operative version of the plan. The operative Unitary Plan provides for some mangrove removal where they have spread and removal is necessary to restore or enhance identified values (e.g. natural character, public access and access to the coast from a marae). Mangrove seedling removal is a permitted activity away from sensitive ecological areas, and other mangrove removal can be provided for as a discretionary activity that takes into account the site-specific circumstances of a mangrove removal proposal. However, the plan also recognises that mangroves should be retained where they perform important ecological functions, contribute to natural character or mitigate coastal hazards.

***Figure 6.21**: Mangrove cover in the indicator estuaries with updated aerial photos: a) Lucas Creek, and b) Mangamangaroa.*

NGĀ TAIORA
6.5 NUTRIENTS

Between 2006 and 2015, the four major rivers (Waihōu, Piako, Kauaeranga and Waitakaruru) draining to the southern Firth of Thames were estimated to have carried an average annual load of 3,666 tonnes of nitrogen and 198 tonnes of phosphorus.

Greatest nutrient inputs to the Firth of Thames come from landuses associated with farming on the Hauraki Plains. Stock numbers, estimated leaching rates of agricultural nitrate from the Hauraki Plains, modelled concentrations of total nitrogen, and total phosphorus in Hauraki rivers are estimated to be amongst the highest in the country. Historically, catchment nutrient loads to the Firth were likely to have been much lower, with a higher relative proportion coming from offshore (Hauraki Gulf).

Nitrogen and phosphorus loads from rivers on the Hauraki Plains are estimated to have decreased in the 24 years between 1991 and 2015 by 0.3% per year and 1.2% per year, respectively. This decrease is attributed to improvements in the treatment of sewage, industrial wastewater, and dairy shed effluent offsetting the effects of intensive farming.

Aquaculture reforms in 2011 allow an additional 1100 tonnes of nitrogen per year to be discharged into the Firth of Thames from finfish farms.

Overall nutrient loads from Auckland catchments have not been quantified, but total nitrogen loads from Auckland's largest river and largest wastewater treatment plant are modest compared to agricultural loads from the Hauraki Plains and prescribed limits for fish farming.

In the Auckland region, coastal nutrient concentrations are highest in the Upper Waitematā Harbour and Tāmaki Inlet. Trends in ammonium-N have recently changed from declining to increasing in western sites of the Waitematā Harbour, and environmentally significant phytoplankton blooms have occurred more often in the latest 10-year period.

Waikato Regional Council do not carry out routine long-term monitoring of coastal nutrients in the Firth of Thames, but a long-term investigation by NIWA has shown that nitrogen concentrations in the Firth increased substantially between 1998 and 2013. It is possible that this may be due to a decreased capacity of the Firth to process (denitrify) high, ongoing catchment loads. The same time series has shown seasonal depletion of dissolved oxygen and seasonally-elevated acidity levels (lowered pH) in the Firth.

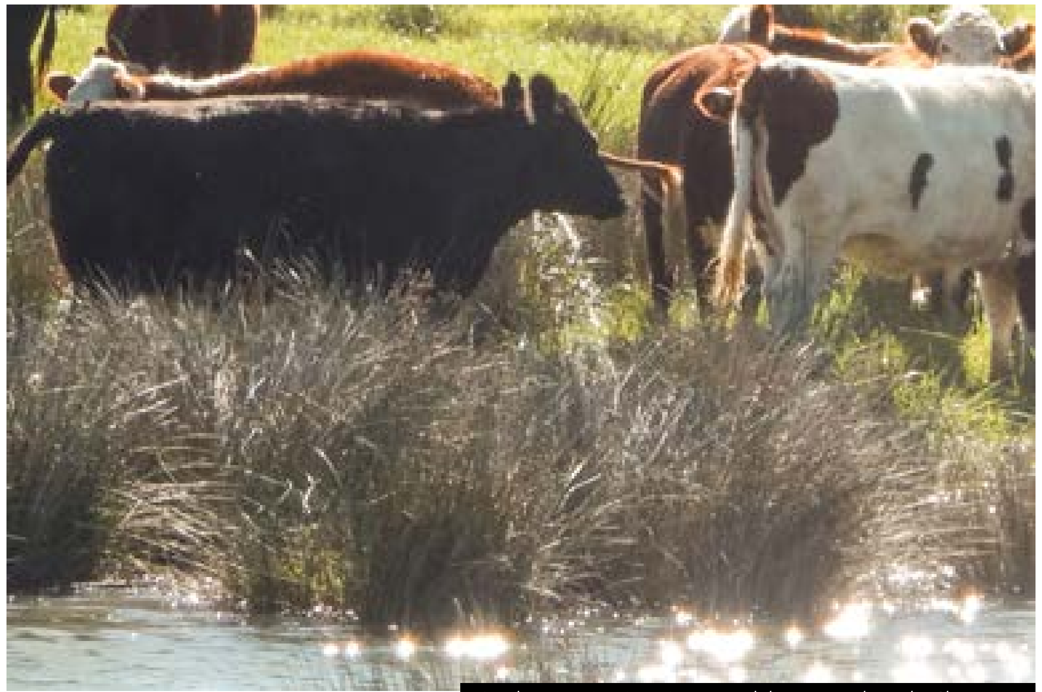
Nutrients are necessary to sustain the plant (algae) growth that forms the foundation of the food chain. Slight increases in nutrients can increase ecosystem productivity, but high nutrient levels are detrimental and potentially lead to nuisance phytoplankton and seaweed blooms, reduced water quality, and toxic effects. The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is naturally maintained by nutrients that: a) upwell from deep offshore waters; b) are recycled from the seabed; or, c) get washed off the land. Humans have increased nutrient inputs through wastewater discharges, fertiliser application and livestock effluent. Nitrogen is usually the nutrient that determines the rate of increase of phytoplankton in the coastal marine environment. Consequently, nitrogen has the greatest effect on water quality, making it the nutrient of primary concern for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Phosphorus is also a key nutrient of concern for the marine environment[30].

[30] In freshwater systems phosphorus is usually the primary nutrient of concern, and nitrogen the secondary nutrient of concern.

In the 24 years between 1991 and 2015, total nitrogen concentrations along the Waihōu River increased by 0.5% per annum at the Te Aroha monitoring site and declined by 0.5% in the Karangahake monitoring site of the Ōhinemuri tributary. Total nitrogen concentrations at the most-downstream sites monitored on the Piako and Waitoa Rivers declined by 1.2% and 0.8% per annum over the same period (Vant 2016). Total phosphorus concentrations have remained stable or have declined at all sites. The most notable improvement is in the lower Waitoa River, where total phosphorus concentrations declined by 14.8% per annum between 1991 and 2015. This is related to the extremely high concentrations in the 1990s, which were caused by the use of phosphoric acid as a cleaning agent in the Waitoa dairy factory .

Estimates of combined nitrogen loads from all Hauraki Rivers indicated that between 1991 and 2015, the overall nitrogen load declined by 0.3% per year, with an average decline between 2006 and 2015 of 1.2% per year. Average declines in phosphorus loads also occurred, with a decline of 2.3% per year between 1991 and 2015, and a decline 3.1% per year between 2006 and 2015[31] .

Despite this, leaching rates of agricultural nitrate from the Hauraki Plains, and modelled river concentrations of total nitrogen and total phosphorus are still estimated to be amongst the highest in the country (***Figure 6.22*** & ***Figure 6.23***; Ministry for the Environment & Statistics NZ 2015; Larned et al. 2017; Ministry for the Environment & Statistics NZ 2017a, b). This reflects the area having some of the highest densities of stock (see section 5.1, ***Figure 5.8*** & ***Figure 5.7***).



Cattle urinating in a Coromandel estuary. Photo by Shaun Lee.

Between 2006 and 2015, the four major rivers (Waihōu, Piako, Kauaeranga and Waitakaruru) draining to the southern Firth of Thames were estimated to have carried an average annual load of 3,666 tonnes of nitrogen and 198 tonnes of phosphorus (Vant 2016). Among the four rivers, the Waihōu and Piako Rivers contributed around 97% of these loads (54% and 43% of total nitrogen, and 62% and 35% of total phosphorus, respectively). These load estimates are based on nutrient concentrations and water flows at the most downstream monitoring sites in Waihōu and Piako Rivers (and include the Waitoa River site), but it should be noted that those sites are not at the bottom of the catchment (see ***Figure 5.24*** for the locations of monitoring sites used to generate estimates of total nutrient loads).

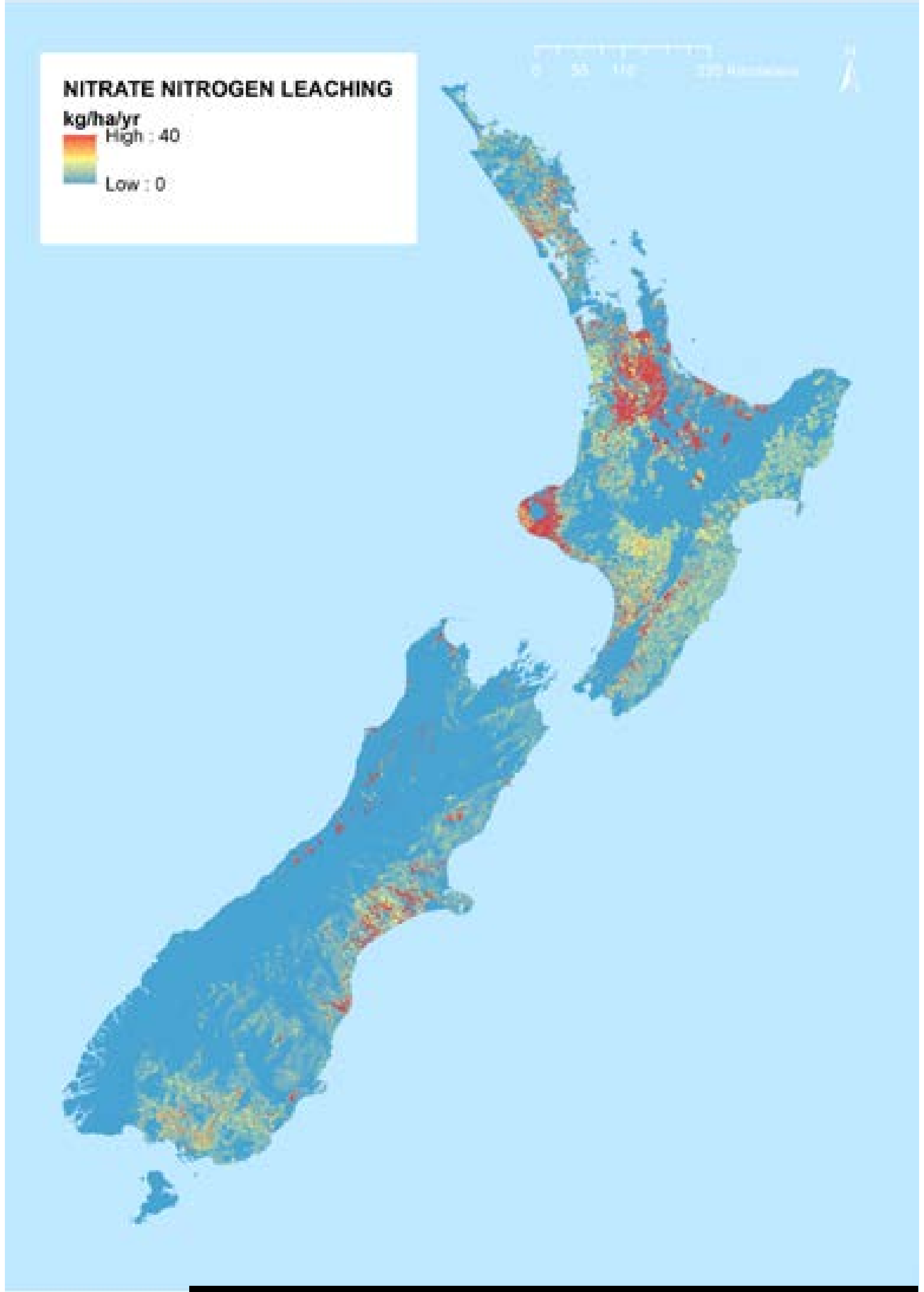


Figure 6.22*: National variation in estimated leaching rates of agricultural nitrate nitrogen (Ministry for the Environment & Statistics NZ 2015).*

Point source discharges are estimated to have contributed around 6% of the nitrogen and 22% of the phosphorus carried by the Hauraki rivers between 2006 and 2015, while natural background sources contributed around 21% of the total nitrogen and 38% of the total phosphorus loads[32]. The remaining 73% of the nitrogen load and 41% of the phosphorus load was estimated to have come from diffuse agricultural sources (Vant 2016).

[31] Changes in the way data were analysed means that the most recent estimates of loads and trends cannot be compared with those made in previous years (Vant 2016).

[32] Totals of phosphorus figures slightly exceed 100% because of rounding.

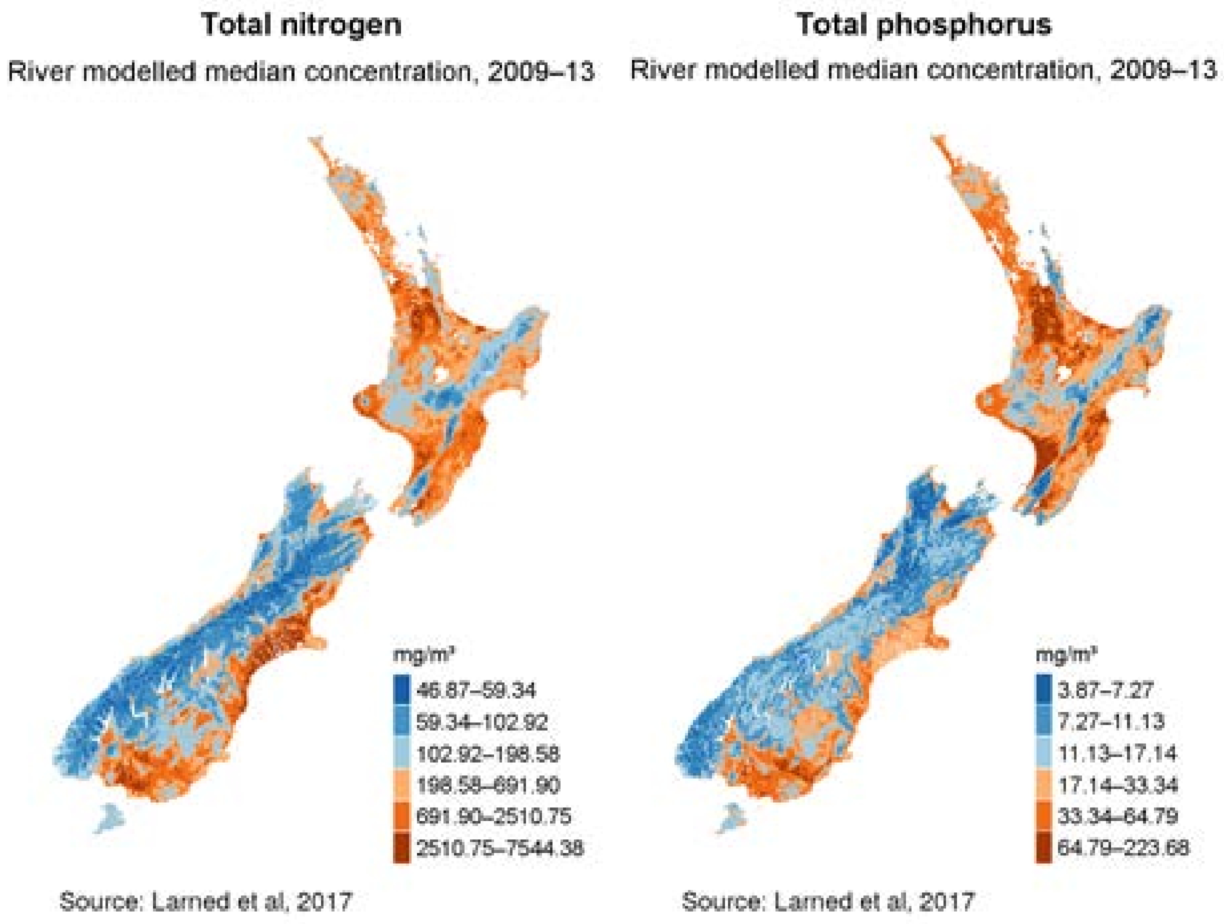


***Figure 6.23**: Modelled river concentrations of total nitrogen and total phosphorus throughout New Zealand (see Larned et al. 2017; Ministry for the Environment & Statistics NZ 2017a, b).*

Overall, Vant (2016) concluded that:

- over the past 20-25 years water quality in rivers of the southern Firth of Thames catchment has generally been stable or improved, with relatively few sites displaying deterioration;
- total combined loads on nitrogen and phosphorus in Hauraki rivers declined between 1991 and 2015;
- the effects of intensive farming appear to have been offset by improved treatment of sewage, industrial wastewater, and dairy shed effluent.

In comparison, Auckland rivers and streams are likely to contribute relatively low nutrient loads because of their small size and low stock densities. Overall nutrient loads from Auckland catchments have not been quantified, but an estimate prepared for the 2014 State of our Gulf report indicated that the average annual nitrogen load from Auckland's largest river in the Hauraki Gulf catchment (Wairoa River) was 120 tonnes per annum. The total nitrogen load from Auckland's largest wastewater treatment plant discharging into the Hauraki Gulf (Rosedale) is estimated to have varied from 179 to 226 tonnes between 2014 and 2016 (Watercare Services, unpublished data). This is slightly less than the total nitrogen load estimated to be coming from wastewater treatment plants and industrial discharges to the four main Hauraki Rivers (236 tonnes per year), and well below loads to those rivers attributed to diffuse agricultural sources (2,723 tonnes per year, see Vant (2016)). 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, the additional

***Figure 6.24**: Major streams and rivers in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment. Rivers referred to in this report are labelled, and the locations of the monitoring sites used to generate the nutrient loads for Hauraki Rivers are shown.*

loads are likely to be relatively small compared to agricultural loads from the Hauraki Plains (note that wastewater from urban areas in the southern Waitematā and Tāmaki areas is processed at the Māngere Wastewater Treatment Plant, which discharges to Manukau Harbour).

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 section 5.1.2).

6.5.1 NGĀ TAIORA TAKUTAI MOANA
COASTAL NUTRIENTS

Auckland Council's Research, Investigation and Monitoring Unit has consistently collected coastal water quality data at monthly intervals from 19 sites in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi since 1987-1993. Another two sites, at the entrances to Tūranga Creek (Whitford) and Wairoa River (Clevedon), were added to the programme in 2009.

Ammonium-N and nitrate-nitrite-N are forms of nitrogen that are immediately available for phytoplankton and macroalgae uptake and growth, and are used as key indicators for nitrogen. 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.

Mahurangi Harbour. Photo by Shaun Lee.

Median nutrient concentrations showed a general pattern of being relatively low in exposed coastal areas and Mahurangi Harbour between 2007 and 2016[33] , moderate in the Central Waitematā and Tāmaki Strait, and highest in the upper Waitematā Harbour and Tāmaki Inlet (***Figure 6.25***). Over this period, significant phytoplankton blooms[34] were detected on 11 occasions in the upper Waitematā Harbour (c.f. 7 occasions during the previous 10 year period), and one occasion in Tāmaki Inlet. Stable or declining trends prevailed for three of the four indicators of nitrogen and phosphorus (***Figure 6.26***). However, at sites in the upper and western side of the Waitematā Harbour, 10-year trends for ammonia-N concentrations have switched from declining to increasing trends. The cause(s) of this change has not been identified, but it coincides with a period of substantial urban development in the Upper Waitematā and an increasing frequency of spikes in Enterococci concentrations (and indicator of wastewater contamination) (RIMU, Auckland Council, unpublished data).

Waikato Regional Council periodically monitor coastal water quality in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. The data provides 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. However, results from a long-term research program being carried out by NIWA

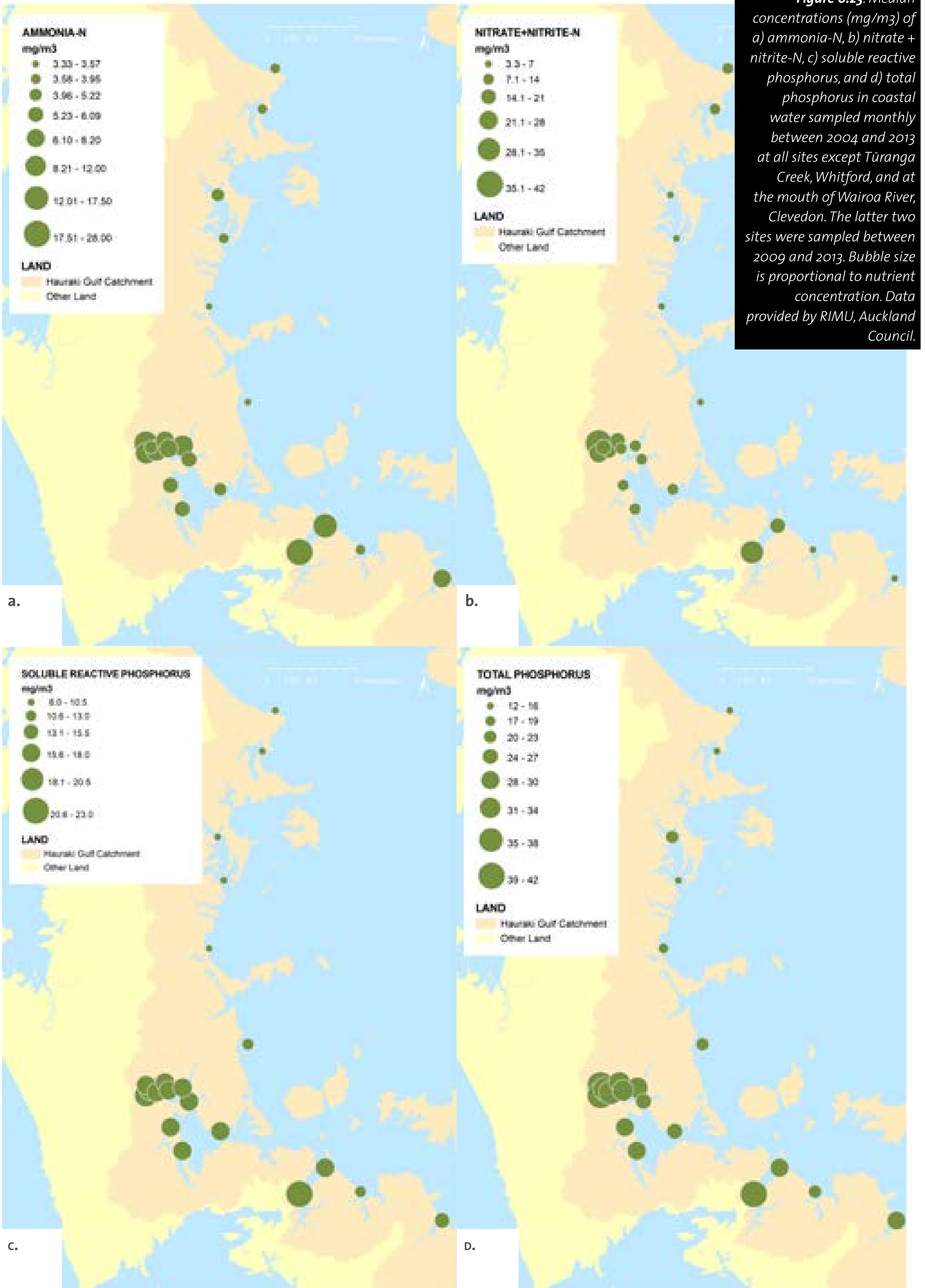


***Figure 6.25**: Median concentrations (mg/m3) of a) ammonia-N, b) nitrate + nitrite-N, c) soluble reactive phosphorus, and d) total phosphorus in coastal water sampled monthly between 2004 and 2013 at all sites except Tūranga Creek, Whitford, and at the mouth of Wairoa River, Clevedon. The latter two sites were sampled between 2009 and 2013. Bubble size is proportional to nutrient concentration. Data provided by RIMU, Auckland Council.*

[33] 2009 to 2013 for the Tūranga and Wairoa sites.

[34] Blooms producing chlorophyll a concentrations of > 0.03 mg/l.

indicates that dissolved inorganic nitrogen concentrations at a site in the outer Firth of Thames increased at a rate of 5.1% per year over a fifteen-year period between 1998 and 2013 (Zeldis et al. 2015). Concentrations of dissolved organic nitrogen (which is not immediately available for uptake by algae) also increased over this period, but at a slower rate. In contrast, dissolved inorganic phosphorus concentrations did not change significantly, while dissolved organic phosphorus decreased by 5.5% per year. Note that, in coastal ecosystems, primary productivity tends to be controlled by nitrogen, rather than phosphorus levels.

The increasing trends in nitrogen concentrations were reflected in increases in chlorophyll a and phytoplankton cell counts (Zeldis et al. 2015). Chlorophyll a showed an increasing trend in the Firth's bottom waters (but not in surface waters) of around 4.2% per year, and an increase in phytoplankton cell counts and bacterial biomass throughout the water column of about 7% per year. Dissolved oxygen levels also became depleted in bottom waters during summer and autumn periods when the water column was stratified. This is thought to be caused by a combination of the stratification preventing the upper and lower waters from mixing, and microbes consuming oxygen in the bottom waters as they decompose organic matter that has sunk down and accumulated over the preceding spring and early summer. Periods of oxygen deletion are matched by corresponding increases in dissolved carbon dioxide and acidity levels (the latter manifests as reduced pH) (Green & Zeldis 2015; Zeldis et al. 2015).

The causes of increasing nitrogen concentrations in the Firth of Thames are complex, but they do not appear to correspond to recent trends in nutrient inputs from rivers or to climatic conditions. However, model studies and observations of increasing gradients in phytoplankton, organic matter and turbidity from the outer to inner Firth indicate that current levels of dissolved inorganic nitrogen are dominated by catchment loads. Historically, catchment nutrient loads to the Firth were likely to have been much lower, with a higher proportion coming from the ocean offshore (Hauraki Gulf). Rivers are estimated to contribute 57% of the total nitrogen load and 87% of dissolved inorganic nitrogen load to the Firth of Thames, with the remainder coming from offshore (Zeldis et al. 2015).

Much of the nitrogen entering the Firth of Thames is eventually released into the atmosphere through the process of denitrification. It is possible that the increasing trends in nitrogen concentrations within the Firth may be due to a decreased capacity of the Firth to process (denitrify) high, ongoing catchment loads, leading to excess nitrogen building up within the system. This is a subject of ongoing research, along with continuing study of the pH and oxygen conditions in the Firth (J. Zeldis, NIWA, pers comm. August 2017).

***Figure 6.26**: 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 2007 and 2016. Arrow size is proportional to the rate of change and arrow colour indicates whether trends were statistically and environmentally significant (red) or non-significant (blue)[35]. Crosses indicate stable concentrations. Data provided by RIMU, Auckland Council.*

[35] Statistically and environmentally significant trends are those where there is a relatively high probably (95%) that the result is not simply due to random variation (noise) in the data, and rates of change are greater than 1% of site medians per year.

6.6 HE TĀ KINONGA KOIORA MOROITI (TUKUMATE) MICROBIOLOGICAL CONTAMINATION (PATHOGENS)

Microbiological contamination originates from a variety of sources.

Beach monitoring indicates that action guideline values for contact recreation are occasionally exceeded on many Auckland and Coromandel beaches. There have been large changes to the monitored beaches over the last decade, with monitoring ceasing at both the worst and the best beaches.

Microbiological contamination of natural shellfish beds is not routinely carried out. 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 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 they 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. Septic tank seepage can also be an issue in areas that are not serviced by a reticulated wastewater system.

The discharge of sewage from vessels is regulated by the Resource Management (Marine Pollution) Regulations 1998. Auckland Council proposed to implement more stringent vessel discharge regulations in their Proposed Auckland Unitary Plan, but the proposed regulations were not implemented because of strong community opposition and a lack of scientific evidence on the impacts of current discharge practices.

Agriculture, wild animals and other natural sources are also sources of microbiological contaminants to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

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 2002).

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 microbial testing that confirms that products are safe to eat (Aquaculture New Zealand no date).

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 mana whenua and other people.

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 and land into waterways, 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 section 5.1.1), and less frequently in other suburbs, towns and settlements. There are 34 municipal wastewater treatment plants in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment (***Figure 5.27***), but 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 6.27: *Wastewater treatment plants in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi catchment and their discharge receiving environments.*

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 increases. Localised microbial contamination of ground water is a problem in some coastal Coromandel areas that rely on septic tanks for sewage disposal (Waikato Regional Council no date).

Wastewater discharges from boats are another source of microbiological contamination. The discharge of wastewater from boats in New Zealand is currently regulated by the Resource Management (Marine Pollution) Regulations 1998. These regulations stipulate that untreated sewage cannot be discharged into the marine environment:

- within 500 m of land (mean high water spring);
- in water less than 5 m deep;
- within 500 m of a marine farm or mahinga mātaitai (traditional food collection) reserve;
- within 200 m of a marine reserve; or,
- within areas prohibited under rules in a Regional Coastal Plan.

Councils have the authority to extend the default restrictions in the Marine Pollution Regulations in their Regional Coastal Plan. Auckland Council sought to extend the default restrictions by prohibiting the discharge of wastewater from vessels within 2km from land in the Proposed Auckland Unitary Plan. However, the proposed restrictions were amended during the Unitary Plan Hearing process, and largely reverted to the default Marine Pollution Regulations in the operative Auckland Unitary Plan. The exceptions were that wastewater discharges from vessels are now prohibited within certain harbours and bays (Waitematā Harbour, Mahurangi Harbour, Bostaque Bay, Port Fitzroy, Nagle Cove and Tryphena Harbour) (***Figure 5.28***). In comparison, Northland Regional Council has prohibited the discharge of sewage from vessels in all Northland harbours, including the Bay of Islands.

Wastewater discharges from vessels in the Waikato Region also default to the Marine Pollution Regulations. WRC is also considering whether more stringent measures should be applied when its Coastal Plan is updated (Sim-Smith et al. 2016).

Animals can also be significant pathogen sources to coastal environments via streams and rivers (McBride et al. 2002; Wilson 2016). Microbial source tracking found that ruminant animals were one of the main sources of faecal bacteria in Coromandel stream mouths. Faecal material from gulls and possums were also identified at most locations (Wilson 2016).

Swimmers at Taurarua / Judges Bay. Photo by Shaun Lee.

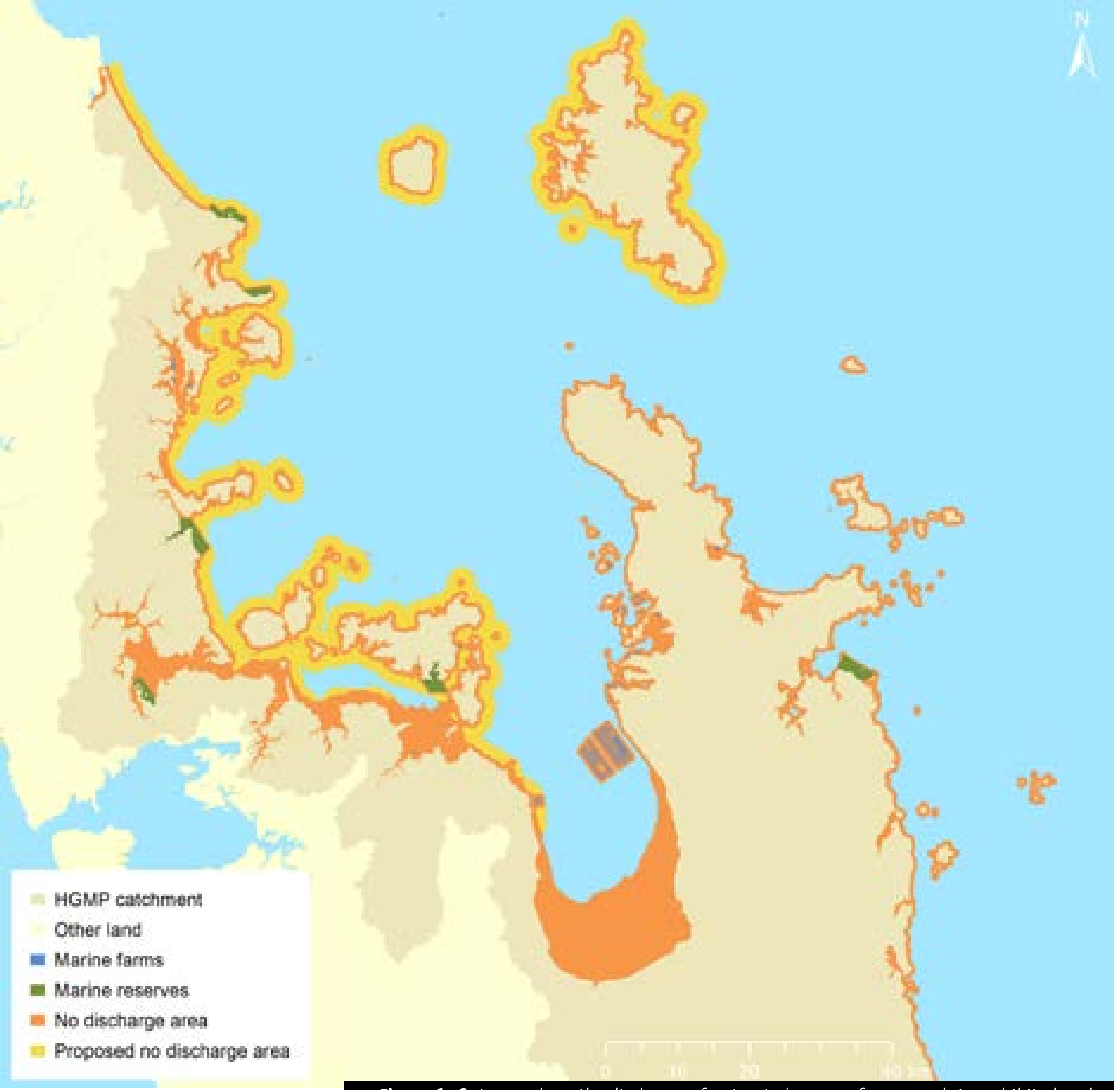


***Figure 6.28**: Areas where the discharge of untreated sewage from vessels is prohibited under operative sections of the Auckland Unitary Plan and Waikato Coastal Plan. For comparison, the area originally included in the Proposed Auckland Unitary Plan is also shown.*

6.6.1 HE TOHU Ā-KOIORA MOROITI
MICROBIOLOGICAL INDICATORS

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 popular swimming beaches are monitored by Auckland Council and WRC during summer, in accordance with the Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (Ministry for the Environment 2002). Monitoring in the Auckland region is generally carried out once per week at 40+ sites within the HGMP between December and March. Monitoring in the Waikato Region is now conducted once per week at seven sites between November and February, though no regular beach monitoring was conducted between March 2008 and November 2015. In both regions, more frequent monitoring is required if high Enterococci counts are detected (Table 5.5). Auckland Council is also developing a forecast model designed to provide three-day forecasts of bacteria concentrations.

***Table 6.5**: 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 were pooled and compared for the following three summer periods: 2007-2010, 2010-2013 and 2013-16[36]. In the Auckland region, around half of the monitored sites in each period exceeded the action guideline on at least one occasion, while in the Waikato Region, 13-29% of sites exceeded the action guideline at least once (Figure 5.29). Beaches in the North Shore (Wairau Outlet, Castor Bay, Milford Beach, Takapuna Beach, Rothesay Bay), Central Waitematā (Te Atatū Beach, St Mary's Bay), Howick (Mellons Bay) and Tairua Harbour had the most frequent exceedances, with an average percentage exceedance of 5-20% for the period between 2007 and 2016 (Figure 5.30).

***Figure 6.29**: Number of monitored beach sites in the HGMP that exceeded the 'action' guideline value for Enterococci concentrations between 0 and 25% of the time. Varying Auckland sites were monitored during summer (Dec–Mar) between 2007 and 2016 (left), while Waikato sites were only monitored during the summers (Nov–Feb) of 2007-2008 and 2015-2016 (right). Data provided by Auckland Council and Waikato Regional Council.*

[36] Each three year period encompasses three summers. Thus, the 2007-2010 period runs from December 2007 to March 2010.

Overall changes to water quality in monitoring swimming beaches within the HGMP are difficult to assess because of numerous changes to the monitored sites over the years. The number of monitored beach sites has decreased from 53 Auckland sites and 16 Waikato sites in 2007-2008, to 42 Auckland sites and 7 Waikato sites in 2015-2016. Furthermore, only 29 Auckland sites and 5 Waikato sites were monitored during both periods. Auckland Council have ceased monitoring and erected permanent warning signs at four sites (Cox's Bay, Meola Reef, Little Oneroa Lagoon and Wairau Outlet) due to ongoing water quality issues, and have ceased monitoring at nine other sites (Goat Island, Tāwharanui (two sites), Kendall Bay, Cheltenham Beach, Devonport, Ōmaha, Wenderholm and Umupuia Beach) because they have a history of excellent water quality (Auckland Council 2017c).

Of the 34 sites that were monitored in both the 2007-2010 period and the 2013-2016 period, nine sites had worse water quality in 2013-2016, eleven sites were unchanged, and 14 sites had better water quality in 2013-2016. The greatest improvements in microbial water quality occurred in Mellons Bay (a 9% reduction in exceedances), Herne Bay (a 7% reduction in exceedances) and Cockle Bay (a 5% reduction in exceedances), while the largest declines have occurred in Kohimaramara Beach and Tairua Harbour (both 5% increases in exceedances).

***Figure 6.30**: Percentage of beach monitoring samples exceeding the Ministry for the Environment and Ministry of Health's 'action' guideline for Enterococci concentrations between: a) the 2007-2008 to 2009-2010 summer seasons in the Auckland region, and the 2007-2008 summer seasons in the Waikato Region; b) the 2010-2011 to 2012-2013 summer seasons in the Auckland region; and c) the 2013-2014 to 2015-2016 summer seasons in the Auckland region, and the 2015-2016 summer season in the Waikato Region. Note that beach monitoring was not conducted in the Waikato Region between autumn 2008 and spring 2015. Data provided by Auckland Council and Waikato Regional Council.*

a.

b.

c.

HE MOMO KOIORA TAIMOANA URU NOA MAI (NŌ WHENUA KĒ)

6.7 INTRODUCED (NON-INDIGENOUS) MARINE SPECIES

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 non-indigenous species that exhibit pest characteristics have arrived in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi since 2000.

Two marine species have been detected that are new to the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi since the 2014 State of our Gulf Report, one of which is a potential pest species.

The large amount of boating, aquaculture and other marine-based activities in the Gulf increases the risk that introduced species will flourish and spread.

Little is known about the potential long-term impacts of high-risk non-indigenous species on the native plants and animals.

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

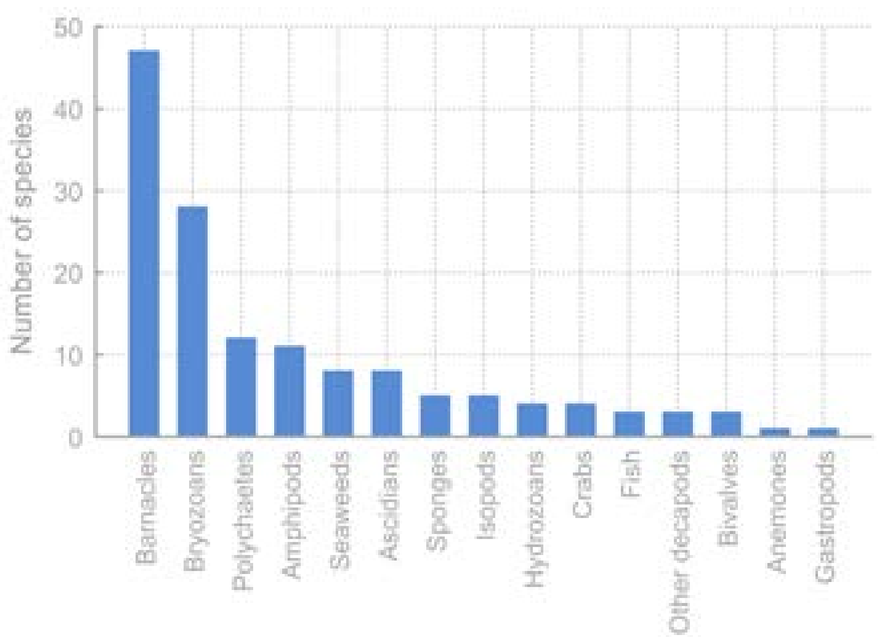
- competing with native species for food, space and other resources;
- consuming native and aquaculture species;
- fouling natural and artificial surfaces;
- spreading disease;
- releasing toxic compounds.

Most non-indigenous marine species arrive accidentally through ballast water, or attached to vessel hulls, and marine equipment (Hayden et al. 2009a). 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 non-indigenous species are capable of surviving in New Zealand, and many have relatively little impact on the marine environment (Ministry for Primary Industries 2013d).

About 351 non-indigenous marine species have been identified in New Zealand, of which, 187 are now established in the country (Inglis & Seaward 2016). 143 non-indigenous species have been recorded from the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (***Figure 5.31***). Many of these species appear to be well established in the Port of Auckland and have widespread distributions in other ports and marinas nationwide. It is possible that other non-indigenous species also occur in the Gulf but have not been detected or formally identified in the biosecurity surveillance surveys or through MPI's passive surveillance systems (T. Riding, MPI, pers. comm.).

Two non-indigenous species new to New Zealand, *Caprella scauroides* (a caprellid amphipod) and *Botrylloides giganteum* (a colonial ascidian), have been found in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi since the publication of the 2014 State of our Gulf Report, and both species are considered to be established in the Waitematā Harbour (Woods et al. 2017). *Botrylloides giganteum* is a potential pest species that may threaten shellfish farming by smothering shellfish or weighing down farm structures (Ministry for Primary Industries 2015).

***Figure 6.31**: Number of non-indigenous marine species recorded in the Hauraki Gulf through MPI's baseline and surveillance surveys, and specimens obtained through passive surveillance. Data provided by NIWA with permission from MPI.*



Once established, the eradication of non-indigenous marine species is extremely difficult or impossible, and very expensive (Bell et al. 2011). Management is therefore focused on preventing the introduction and spread of species to new locations. Standards for managing risks from ballast water and hull fouling were recently introduced to assist with preventing new arrivals (see section 5.3.4).

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 eleven of New Zealand's busiest ports and marinas (including Auckland) is now carried out at six monthly intervals under the Marine High Risk Site Surveillance programme, 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*).

The programme also has two secondary objectives:

1. To detect incursions of species that are new to New Zealand.
2. 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. Currently, there are four secondary target species:
   a. Mediterranean fan worm (*Sabella spallanzanii*)
   b. Clubbed sea squirt (*Styela clava*)
   c. Asian bag mussel (*Arcuatula senhousia*)[37]
   d. Droplet tunicate (*Eudistoma elongatum*) (Riding et al. 2016).

[37] This species was formally known as the Asian date mussel (*Musculista senhousia*)

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. MITS receives specimens from the Marine High Risk Surveillance Programme, miscellaneous MPI biosecurity activities, and passive surveillance from the general public.

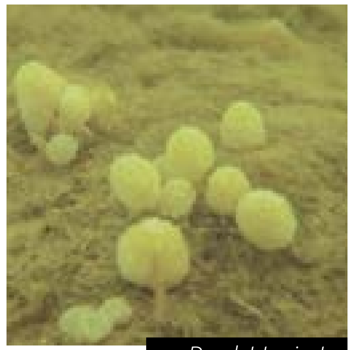
At least six non-indigenous species with the potential to cause serious harm to the marine environment have already become established in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, of which five have arrived in the Gulf since 2000. Control measures and the potential long-term impacts of these species are discussed below.

Mediterranean fan worm. Photo by Shaun Lee.

1. The Mediterranean fan worm (*S. spallanzanii*) was first discovered in Lyttelton Harbour in 2008, though it is thought that it arrived in the country on a heavily fouled barge from Australia to Auckland (Fletcher 2014). 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 has been found from Whangarei down to Lyttleton Harbour, and is well established in Auckland and Whangarei (Fletcher 2014). 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, Nelson, Tauranga (Fletcher 2014).

Clubbed sea squirt. Photo by Shaun Lee.

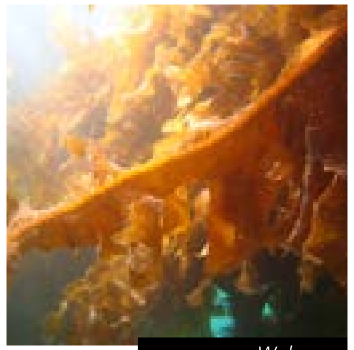
2. The clubbed sea squirt (*S. clava*) was first discovered in Auckland's Viaduct Basin in 2005, and was subsequently found to be present throughout the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi and Lyttelton Harbour. It is thought that the sea squirt entered New Zealand attached to the hulls of vessels, and has been present in the country since at least 2002 (Kluza et al. 2006; McFadden et al. 2007). Complete eradication of the sea squirt was determined by a group of marine experts to be technically unfeasible, and in 2008 the Ministry of Agriculture and Fisheries (MAF) and Biosecurity NZ made a decision to cease work on it. The sea squirt has now been recorded in New Zealand north of Dunedin. 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 Tutukaka, Picton, Nelson, Tarakohe and Tauranga Harbour (Forrest 2013; Bay of Plenty Regional Council 2015; K. Walls, MPI, pers. comm.). 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. 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).


Droplet tunicate. Photo by Shaun Lee.

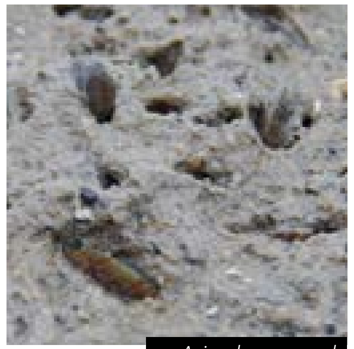
3. The droplet tunicate (*E. elongatum*) is a colonial ascidian that has white, cylindrical heads that are up to 1.5 m long. The ascidian typically grows on hard surfaces such as rocks and man-made structures. It was first discovered in New Zealand in 2005 but was not initially considered a pest species. However, in 2007-2008 it was found in high densities in several Northland locations associated with oyster farms, and in 2010 it was discovered at Sandspit Beach in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (Grace 2014). 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). 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 (C. Bunton, Northland Regional Council, in Dickey 2017). 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 (Morrisey 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 around the country (Page et al. 2011).


Asian paddle crab. Photo by Shaun Lee.

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 Wēiti and Tāmaki Estuaries. The Asian paddle crab is an aggressive species that could out-compete native crabs for food and space (Fowler et al. 2013). 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).


Wakame. Photo by Shane Kelly.

5. The Asian kelp (*Undaria pinnatifida*) was first discovered in Wellington Harbour in 1987 and was detected in the Firth of Thames in 2002 and the Port of Auckland in 2004 (Russell et al. 2008). 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 commonly found on mussel farms, is easily spread by human activities and has a hardy microscopic stage that is difficult to eradicate (James 2016; James & Shears 2016). 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 2017b).


Asian bag mussel. Photo by Shaun Lee.

6. The Asian bag mussel (*A. senhousia*) was accidently introduced into New Zealand in the 1970s and is now widespread throughout the upper North Island. 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). The bag mussel has a short life span (1-2 years) and beds are often ephemeral (Sim-Smith 1999). 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.

PŪKOHU WAI KAIKINO, TUKUMATE, PAREKURA NUI HOKI
6.8 HARMFUL ALGAE, PATHOGENS AND MASS MORTALITIES

Harmful algae and pathogens in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi occasionally cause the mass mortality of marine species, and pose poisoning risks for humans.

Monitoring for marine biotoxins and harmful algae species is conducted by the government and the aquaculture industry. Since 2000, there have been nine reported toxic algal blooms in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. No human illnesses associated with biotoxins have been caused by the consumption of commercially harvested shellfish, and the only illnesses caused by recreationally harvested shellfish have been the result of people ignoring warning signs.

MPI also investigates any reports they receive about unusual mortalities of marine species. Since 2014, there have been three reported mass mortality events in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, two for shellfish and one for fish. The shellfish mortalities were thought to be the result of stress, possibly caused by spawning or environmental conditions, that made the shellfish susceptible to opportunistic pathogens. The cause of the fish kill is unknown.

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 / Tīkapa Moana / Te Moana-nui-a-Toi region during extended periods of northwesterly 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 (Österblom et al. 2008; Hsieh et al. 2010).

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 no date). MPI monitors three sites (Whangaparāoa, Tairua and Great Barrier Island[38]) in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi for recreational shellfish gatherers (B. Roughan, MPI, pers. comm.). Either weekly phytoplankton samples or fortnightly shellfish samples are screened for toxic phytoplankton species or associated biotoxins in shellfish flesh. If toxic phytoplankton species are detected in water samples, then shellfish flesh samples are required. If biotoxin concentrations exceed the limits specified by MPI (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 toxic phytoplankton/marine biotoxins, bacteria and heavy metals. Phytoplankton sampling is required weekly, bacteria sampling is required monthly, and metal sampling is required once every three years. The commercial food safety programme is paid for by industry, but information is shared with MPI to support food safety associated with recreational shellfish gathering. 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 (NZFSA 2006).

[38] Monitoring at the Great Barrier site is shared between industry and MPI.

Nine toxic algae events have been detected by the monitoring programme between January 2000 and August 2017 (***Table 5.6***). Human illnesses caused by the consumption of contaminated shellfish are rare. No cases have been caused by commercially harvested shellfish, and the only cases in recreational shellfish gatherers have occurred due to people ignoring warning signs (B. Roughan, MPI, pers. comm.).

Table 6.6*: Toxic algae events recorded in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Data provided by the Coromandel Marine Farmers Association and MPI.*

Date	Location	Details
Sep 2005	West Coromandel	Diarrhetic shellfish poison events linked to *Dinophysis acuminata* algae blooms. Commercial industry harvest closures at Wilson Bay. Public warnings were also issued.
Jul–Aug 2006	West Coromandel	Diarrhetic shellfish poison events linked to *Dinophysis acuminata* algae blooms. Commercial industry harvest closures at Wilson Bay. Public warnings were also issued.
Nov 2007	Whangaparāoa Peninsula	Paralytic shellfish toxin potential linked to *Alexandrium catanella* algae bloom. Public warnings were issued.
May 2009	Great Barrier Island	Paralytic shellfish toxin at linked to *Alexandrium sp.* algae bloom. Public warnings issued.
Dec 2010	Whangamatā	Paralytic shellfish toxin linked to *Alexandrium sp.* algae bloom. Public warnings issued.
Dec 2011	Whangamatā	Paralytic shellfish toxin linked to *Alexandrium sp.* algae bloom. Public warnings issued.
Apr–Jul 2015	Whangamatā	Paralytic shellfish toxin linked to *Alexandrium sp.* algae bloom. Public warnings issued.
Aug–Oct 2015	West Coromandel	Diarrhetic shellfish poison events linked to *Dinophysis acuminata* algae blooms. Commercial industry harvest closures at Wilson Bay. Public warnings were also issued.
Jun 2016	Whangaparāoa Peninsula to Kawau Island.	Paralytic shellfish poison risk linked to *Alexandrium sp.* bloom. Public warning issued for the area including the Mahurangi Harbour, Kawau Island and other smaller offshore islands in the vicinity. Commercial oyster farms in the Mahurangi Harbour were placed under a precautionary harvest closure and monitored.

MPI 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' magazine. Events occurring since the 2014 State of our Gulf Report was published are listed below:

- Unusually high mortalities of cockles were observed in 2014 in Whangateau Estuary, Sandspit Estuary and Ōrewa Estuary. It is thought that post-spawning stress and environmental conditions may have increased the cockle's susceptibility to opportunistic pathogens as a mixture of pathogens were identified in dead shellfish (Bingham 2014).
- A mass mortality of pipis was observed in Ōkura Beach in 2016. Diagnostic testing found Rickettsia sp. and several opportunistic pathogens present in the pipis. It is thought that the shellfish may have been stressed or weakened by environmental conditions or Rickettsia sp., making them susceptible to the opportunistic pathogens (Bingham 2017).
- A mass mortality of fish in Te Mata Creek was reported in 2015 but the fish were too badly decomposed for diagnostic testing. It is unknown what killed the fish but no other mortality events have been reported, so it is thought that the mortality event was a one-off incident (Bingham 2016).

OTAOTA TAIMOANA

6.9 MARINE LITTER

Man-made litter is a widespread issue for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.

Marine litter 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 marine litter near Auckland mainly comes from land-based sources, while fishing related material dominates further afield.

Between 2014 and 2016, staff from the Watercare Clean-up Trust spent around 6000 hours on clean-up activities, and together with a host of volunteers, they removed around 882,000m3 of marine litter from the coast.

Litter at Ōkahu Bay. Photo by Shaun Lee.

Man-made marine litter is a ubiquitous and on-going issue for the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Marine 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 in aquatic environments;
- acts as a vector for the dispersal of invasive species;
- can degrade nursery habitats;
- 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).

'Nationally Critical' shore plover on Motukorea Island. Photo by Shaun Lee.

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.

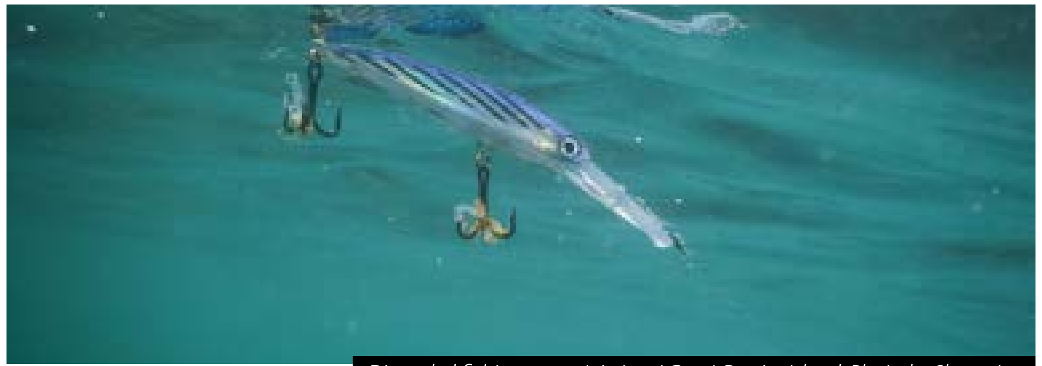
Plastics provide a direct and indirect pathway for the uptake of toxic organic contaminants by wildlife. In seawater, plastics absorb and concentrate contaminants such as polychlorinated biphenyls, dichlorodiphenyl, dichloroethylene, nonylphenol, and phenanthrene. These can become several orders of magnitude more concentrated on the surface of plastic debris than in the surrounding seawater (Barnes et al. 2009). 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 marine litter 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 marine litter. The bulk of the marine litter 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, marine litter collected from beaches that are further afield contains a high proportion of fishing related-material (Hauraki Gulf Forum 2011).

NGĀ AHUNGA WHAKAOTAOTA I TE TAIMOANA

6.9.1 TRENDS IN MARINE LITTER

Watercare Harbour Clean-Up Trust and its precursor, the Waitematā Clean-up Trust, have been operating since 2002 to remove marine litter from the Waitematā Harbour and surrounding areas. The Trust has a purpose-built boat, which it uses for collection. The vessels 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.



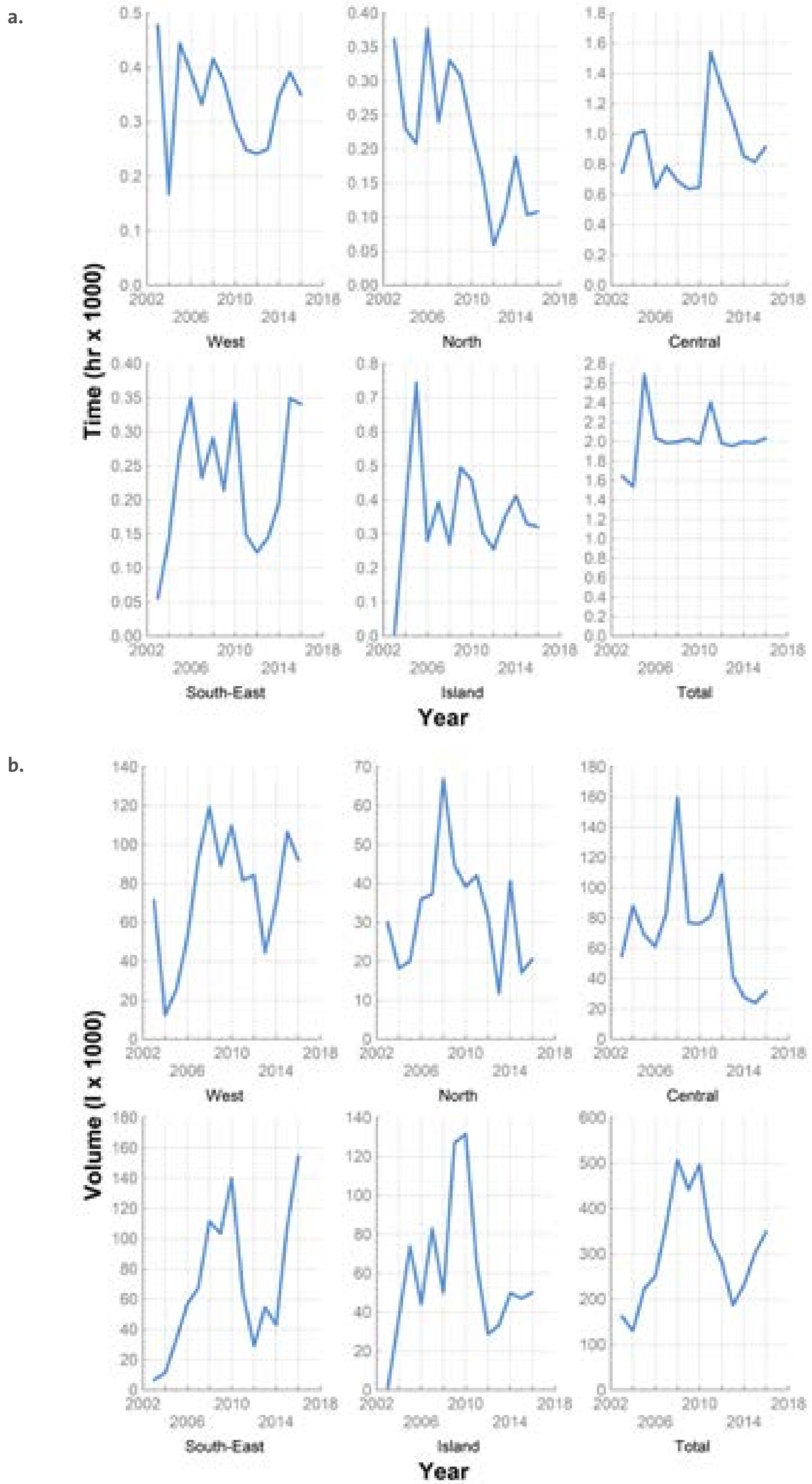
Discarded fishing gear at Aotea / Great Barrier Island. Photo by Shaun Lee.

The Trust divides their efforts amongst five general areas, and maintains daily records of the volume of marine litter collected from each area. Between 2014 and 2016, the Trust's staff spent around 6000 hours on clean-up activities, and together with a host of volunteers removed around 882,000m3 of marine litter. The amount of staff time put into marine litter collection has been fairly steady since 2006, although the time spent in any particular area has varied, and a spike in activity also occurred during the 2011 Rugby World Cup (***Figure 5.32***). Area-specific, and total annual volumes of marine litter collected has also varied from year to year due to prioritisation, accessibility, and marine litter volumes. Despite this, the total annual volumes of marine litter removed have never fallen below 130,000 litres since the Trust began its activities, and volumes have been as high as 507,000 litres.

Watercare Harbour Clean-Up Trust volunteers. Photo by Shaun Lee.

The success of the Trust's operating model and the results of its work are being nationally and internationally recognised. Similar programmes are being roll-out throughout the country, and efforts are being boosted through partnering and sponsorship. Recent achievements have included maintaining a strong volunteer base, which was recently boosted by the Royal New Zealand Navy who assisted with the clean-up of Tāmaki Inlet as part of their humanitarian aid training.

Figure 6.32*: Marine litter collected by the Watercare Harbour Clean-up Trust in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi between 2003 and 2016, showing (a) the time worked by the Trust's staff, and (b) estimated volumes of marine litter collected. Note that the y-axis varies among graphs. Data provided by H. Smith, Sea Cleaners.*



TE TIAKI ME TE WHAKAORA I TE KANORAU KOIORA
6.10 MAINTENANCE AND RECOVERY OF BIODIVERSITY

Gannets feeding off Aotea / Great Barrier Island. Photo by Darryl Torckler.

NGĀ MOTU O TĪKAPA MOANA
6.10.1 ISLANDS OF THE GULF

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 Island, Te-Hauturu-o-Toi / Little Barrier Island, Kawau, Rangitoto, Whakaū / Red Mercury and Kawhitu / Stanley Island.

Significant progress is being made in revegetating other large islands including Tiritiri Matangi, Motuora, Motutapu, Te Motu-o-Ihenga / Motuihe, and Rotoroa Islands. Much of this work has been community led.

Mammalian pests are absent from 47 islands in the Gulf, with Ahuahu / Great Mercury Island declared pest-free in 2016.

Argentine ants have been successfully eradicated from Tiritiri Matangi Island after a 15 year eradication programme. This is one of the largest ant eradications in the world. Progress is also being made towards eradicating Argentine ants on Kawau and Aotea Islands, and the eradication of Darwin's ants on Rangitito Island.

Plague 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. An eradication programme for plague skinks is currently underway on Aotea.

Kauri dieback disease is present on the mainland and Aotea, but not in other Hauraki Gulf Islands (Te Hauturu-o-Toi / Little Barrier Island, Motutapu, Waiheke, Pōnui and Kawau). Current management has largely been directed towards surveying and minimising the spread of the disease while treatment and management options are being developed.

Endemic birds, reptiles and insects are increasingly being translocated among the islands that are free of mammalian pests. Five species (takahē, weka, brown kiwi, kōkako and hihi) translocated to pest-free islands in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi have improved in conservation status since 2008.

Island biodiversity

The islands of the Gulf provide vital sanctuaries for New Zealand's terrestrial biodiversity. Restoration of island vegetation and the eradication of mammalian pests have been instrumental to the recovering of numerous native bird species. The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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.

Te Hauturu-o-Toi / Hauturu / Little Barrier Island is probably the least modified island, containing the largest remaining area of relatively unmodified northern New Zealand forest that is protected from alien mammals. The island has sufficient size and altitude 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 Te Hauturu-o-Toi / Little Barrier Island is now covered in native forest. Te Hauturu-o-Toi / Little Barrier Island is one of New Zealand's first offshore sanctuaries and has and 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 was 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, Te Hauturu-o-Toi / Little Barrier Island 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). Te Hauturu-o-Toi / Little Barrier Island and other predator-free islands have been instrumental to the population recoveries of the North Island saddleback (*Philesturnus rufusater*) and kōkako (*Callaeas wilsoni*). Saddlebacks were transferred to Te Hauturu-o-Toi / Little Barrier Island from Taranga Island / Hen Island via Repanga / Cuvier Island between 1984 and 1988. Saddlebacks have thrived on predator-free islands and the estimated national population has increased from 500 in 1964 to more than 7000, currently (Parker 2013). Similarly, 32 kōkako were transferred to the island between 1980 and 1988, and the island is now home to one of the largest kōkako populations in the country (Innes 2017). Te Hauturu-o-Toi / Little Barrier Island is the only known breeding location for the 'Nationally Endangered' New Zealand storm petrel (*Fregetta māoriana*); it is one of only two

Tāiko on Aotea / Great Barrier Island. Photo by Shaun Lee.

breeding grounds for black petrel (tāiko) (*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 Te Hauturu-o-Toi / Little Barrier Island and Aotea (Towns

Wētāpunga on Te Hauturu-o-Toi / Little Barrier Island. Photo by Shaun Lee.

et al. 2012), and Te Hauturu-o-Toi / Little Barrier Island is an important sanctuary for tuatara (*Sphenodon punctatus*) and wētāpunga (*Deinacrida heteracantha*).

Other large islands with more than 80% native forest cover include Aotea / Great Barrier Island, Kawau, Rangitoto, Whakaū / Red Mercury, Tiritiri Matangi and Kawhitu / Stanley Island (***Figure 6.34***). In 2015, the Aotea Conservation Park was opened on Aotea that covers around 55% of the island. The park increases the legal protection of the area, which has significant conservation value (Department of Conservation no date-a).

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 / Tīkapa Moana / Te Moana-nui-a-Toi, 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 more than 200 species of native trees and flowering plants, including many species of orchid and more than 40 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-rātā hybrid) forest in New Zealand. Its unique indigenous ecosystem and vegetation have been recognised by its status as a separate and entire ecological district (Department of Conservation no date-b).

Restoration of a number of islands in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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[39] 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 1984[0]. 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 albicilla*) 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 82% forested, having increased by 8% since 2008. The remaining 18% is being left as open grassland for species that prefer an open habitat.

Restoration of Motuora by volunteers began in 1990, and the island was jointly managed by the Motuora Restoration Society and DOC until 2016, when DOC resumed full management of the island. 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. Planting of pioneer species is now complete 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 wētāpunga onto Motuora have occurred since 2006. Motorua has also been used as a crèche site for kiwi since 1999 (Motuora Restoration Society (Inc) 2017).

Kiwi on Motutapu Island. Photo by Shaun Lee.

Motutapu and Te Motu-o-Ihenga / Motuihe have also been partially revegetated. The Motutapu Restoration Trust has planted around 75ha of native forest on the island since 1994, however, this only accounts for around 5% of the total area. The vast majority of the island is currently open pasture that supports 3,500 sheep and 1,000 cattle. The island was declared predator-free in 2011 and is now inhabited by bellbirds (*Anthornis melanura*) and kākāriki (who returned naturally), and translocated populations of brown kiwi, takahē (*Porphyrio mantelli*), saddleback, whiteheads, shore plover (*Thinornis novaeseelandiae*) and pāteke (*Anas chlorotis*) (Motutapu Restoration Trust no date). Restoration of Motuihe commenced in 2000 with the establishment of the Motuihe Trust. The trust has currently planted around 50% of the island and aims to reach 75%. Motuihe became predator-free in 2005 and saddleback, kākāriki, little spotted kiwi (*Apteryx owenii*), Duvacel's gecko and tuatara have been translocated to the island (Kiwis for Kiwi no date).

Rotoroa Island was used as a rehabilitation facility for alcoholics between 1911 and 2005. The 92ha 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 400,000 native seedlings, including sand dune plants. The island became predator-free in 2014 and the trust is currently working with Auckland Zoo to create a wildlife conservation sanctuary on the island. To date, this has involved the translocations of takahē, whitehead, shore skinks, moko skinks (*Oligosoma moco*), pāteke and brown kiwi and saddleback onto the island, and the creation of a decoy gannet colony to attract gannets. One of the main aims of the restoration project is to provide an opportunity for people to get actively involved in wildlife management. *"It's about trying to reforge the relationship between people and the natural environment – finding new ways to*

[39] Mammalian predators never established on Motuora Island, though DOC have eradicated recent isolated rodent incursions (A. Warren, DOC, pers. comm.).

[40] Kākāriki (Cyanoramphus novaezelandiae) was transferred to Tiritiri Matangi before restoration began in 1974.

Duvaucel's gecko translocation. Photo by Shaun Lee.

make people feel part of, and responsible for, maintaining a natural environment that is diverse and healthy" (J. Wilcken, Auckland Zoo, in Rotoroa Island Trust no date).

Many other islands in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi remain highly modified by urban development or farming activity, including Pakatoa, Browns Island, Kawhitu / Stanley Island, Rākino Island and Ahuahu / Great Mercury Island (***Figure 6.34***). There has been very little change in the percent cover of native forest between 2008 and 2012[41]. The most notable increases were Rotoroa Island and Tiritiri Matangi Island, which both increased by 8% cover, while no islands decreased in percentage cover.

Harmful terrestrial pests and diseases

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 HGMP are managed by Auckland Council, WRC and DOC. Forty seven islands in the Gulf greater than 1ha in area are currently free of mammalian pests (***Figure 6.35***). Systematic pest eradication began in New Zealand in the mid-1980s, and since then, the number of islands in the Haruaki Gulf free of mammalian pests has increased dramatically (***Figure 6.36***; Towns et al. 2013). Since the 2014 State of our Gulf report, Ahuahu / Great Mercury Island has been declared mammalian pest-free, but Motu Kaikōura / Selwyn Island has lost its pest-free status due to a re-invasion of rodents (Motu Kaikōura Trust 2016).

Maintenance of the pest-free status of these islands is critical as pest populations can rapidly increase from a single pair (Nathan et al. 2015), and even the incursion of a single pest can decimate threatened species' populations (Dowding & O'Connor 2013). Prevention of re-invasions is managed by active surveillance (traps, bait, tracking tunnels 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 (Bassett et al. 2016). For example, between 2014 and 2016, nine incursions of mammalian pests were detected and eradicated on pest free islands in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (A. Warren, DOC, pers. comm.).

Introduced non-mammalian species can also threaten native species through competition for resources and predation. Plague skink[42], Argentine ants and Darwin's ants are emerging pest issues for the Hauraki Gulf. Recently, eradication of Argentine ants has been successfully completed on Tiritiri Matangi after an intensive 15 year eradication programme. This is one of the largest ant eradications in the world and involved placing bait stations less than 3 m apart over an 11ha area. The most challenging part of the eradication was finding the few surviving ant nests once the bulk of the ant nests had been controlled (A. Warren, DOC & J. Russell, University of Auckland, pers. comm.). Eradication programmes on other islands are also underway, including the eradication of Argentine ants on Kawau and Aotea / Great Barrier Island, eradication of plague skinks on Aotea, and eradication of Darwin's on Rangitoto (A. Warren, DOC, pers. comm.). Argentine ants and plague

Plague skink. Photo by Shaun Lee.

skinks are well established on Waiheke Island, and plague skinks are well established on Rangitoto, Motutapu, Waiheke, Kawau and Rotoroa Islands (Chapple et al. 2016). Eradication of these established populations is deemed unfeasible by Councils and DOC.

Pest management on Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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 / Tīkapa Moana / Te Moana-nui-a-Toi. The disease, which is caused by the water mould *Phytophthora agathidicida*, was only identified in 2007, but it has been present on Aotea since at least the 1970s. The disease was first reported on the mainland in 2006 and surveillance has found that the disease is present in Auckland and the Coromandel Peninsula, but not in other Gulf Islands (Te Hauturu-o-Toi / Little Barrier Island, Motutapu, Waiheke, Pōnui and Kawau) (Jamieson et al. 2014; Auckland Council no date). Current management has largely been directed towards surveying and minimising the spread of the disease while treatment and management options are being developed. Public awareness signage and shoe cleaning stations have been deployed at key sites to minimise the spread of the disease by visitors (Keep Kauri Standing no date).

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, maintain genetic diversity of island populations, populate distant islands that would not be naturally re-colonised[43] and restore ecosystems. Tiritiri Matangi Island has received the highest number of translocated species (16), followed by Tāwharanui Open Sanctuary on the mainland (11 species), and Motuihe Island (10 species). Among the translocated species in the Gulf there has been one 'Nationally Critical' bird species (shore plover), three 'Nationally Vulnerable' bird species (takahē, black petrel and hihi), and one 'Nationally Endangered' reptile (Whitaker's skink) (***Table 6.7*** to ***Table 6.9***). Of the 20 bird species that have been translocated to Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands, five species (takahē, weka, brown kiwi, kōkako and hihi) have improved in conservation status since 2008.

[41] The most recent Land Cover Database available is for vegetation cover in 2012 (LCDB4.1).

[42] Also called rainbow skinks.

[43] Islands more than 25km away from the nearest seabird colony are unlikely to be naturally recolonised following pest eradication (Buxton et al. 2014).

Key: *New Zealand threat codes used in* ***Table 5.7*** *to* ***Table 5.9***

Threatened:
- Nationally Critical (NC)
- Nationally Endangered (NE)
- Nationally Vulnerable (NV)

At Risk:
- Declining (D)
- Relict (R)
- Recovering (Rec)
- Naturally Uncommon (UC)

Not threatened: (NT)

Table 6.7 *Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands and adjoining mainland sanctuaries (MS) where native bird species have been translocated. Data from DOC. The conservation status of birds is from Robertson et al. (2017).*

	NC	NV			D					R		Rec						UC	NT	
	Tūturuatu – shore plover	Takahē	Tāiko – black petrel	Hihi – stitchbird	North Island brown kiwi	Tītitipounamu – rifleman	Mātātā – North Island fernbird	Pītoitoi – North Island robin	Pōpokotea – whitehead	Red-crowned kākāriki	Common diving petrel	North Island weka	Kōkako	Little spotted kiwi	Tieke – North Is. saddleback	Pāteke – brown teal	Pycroft's petrel	Koekoeā – long-tailed cuckoo	Kōmiromiro – North Island tomtit	Korimako – bellbird
Hauturu / Little Barrier Island			●		●								●		●					
Aotea /Great Barrier Island								●												
Tāwharanui Open Sanctuary (MS)		●						●	●	●					●	●		●		
Kawau Island					●							●								
Motuora Island					●				●		●						●			
Wenderholm Regional Park (MS)								●												
Tiritiri Matangi Island		●		●		●	●	●	●	●			●	●	●	●			●	
Rangitoto Island									●											
Motutapu Island	●	●			●				●							●				
Motuihe Island									●	●				●	●					●
Waiheke Island																				●
Shakespear Regional Park (MS)								●												
Rotoroa Island		●			●				●						●	●	●			
Whanganui Island												●								
Cuvier Island										●					●		●			
Whakaū / Red Mercury Island														●	●					
Kawhitu / Stanley Island									●						●					

Table 6.8*: Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands where native invertebrate species have been translocated. Data from DOC. The conservation status of invertebrates is from Trewick et al. (2012) and Leschen et al. (2012).*

	Relict	Recovering		Naturally Uncommon	
	Wētāpunga	Mercury Island tusked wētā	Māhoenui giant wētā	Auckland tree wētā	Large darkling beetle
Tiritiri Matangi Island	●				
Cuvier Island		●			
Motuora Island	●				
Whakaū / Red Mercury Island (Mercury Group)		●			
Kawhitu / Stanley Island (Mercury Group)		●			
Double Island (Mercury Group)		●			
Korapuki Island (Mercury Group)		●		●	●
Ōhinau Island		●			
Mahurangi Island			●		
Noises	●				

Table 6.9*: Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands and adjoining mainland sanctuaries (MS) where native reptile species have been translocated. Data from DOC. The conservation status of reptiles is from Hitchmough et al. (2016).*

	NE	D		Relict						Rec	UC	NT
	Whitaker's skink	Auckland green gecko	Forest gecko	Duvaucel's gecko	Egg-laying gecko	Marbled skink	Tuatara	Pacific gecko	Moko skink	Robust skink	Shore skink	Common gecko
Hauturu / Little Barrier Island							●					
Tāwharanui Open Sanctuary (MS)		●	●	●								
Motuora Island				●				●			●	
Tiritiri Matangi Island		●		●							●	
Motuihe Island				●			●	●			●	●
Crusoe Island								●			●	
Whakaū / Red Mercury Island, Mercury Group	●									●		
Kawhitu / Stanley Island, Mercury Group										●		
Korapuki Island / Mercury Group	●				●	●				●		
Rotoroa Island									●		●	

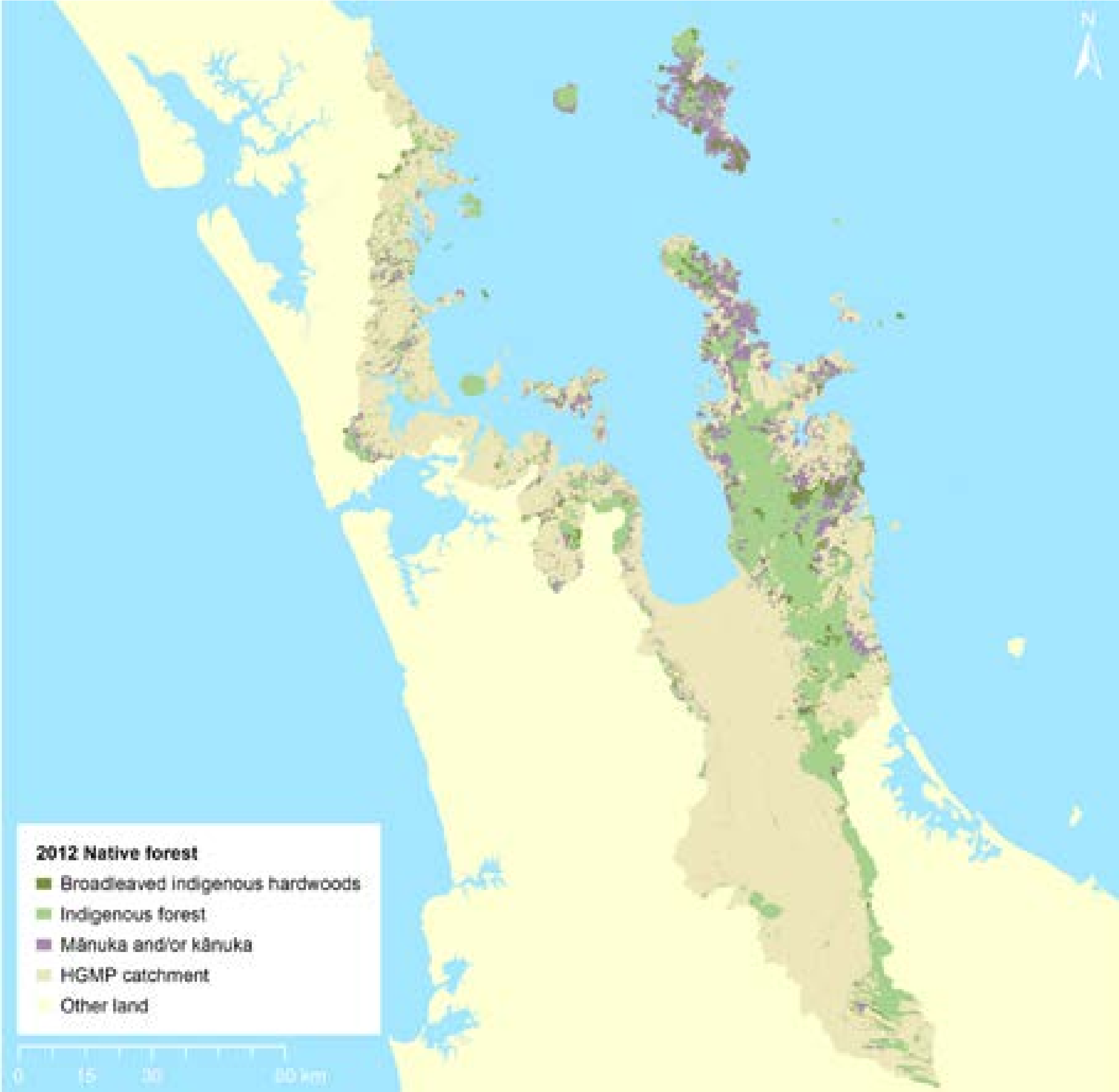
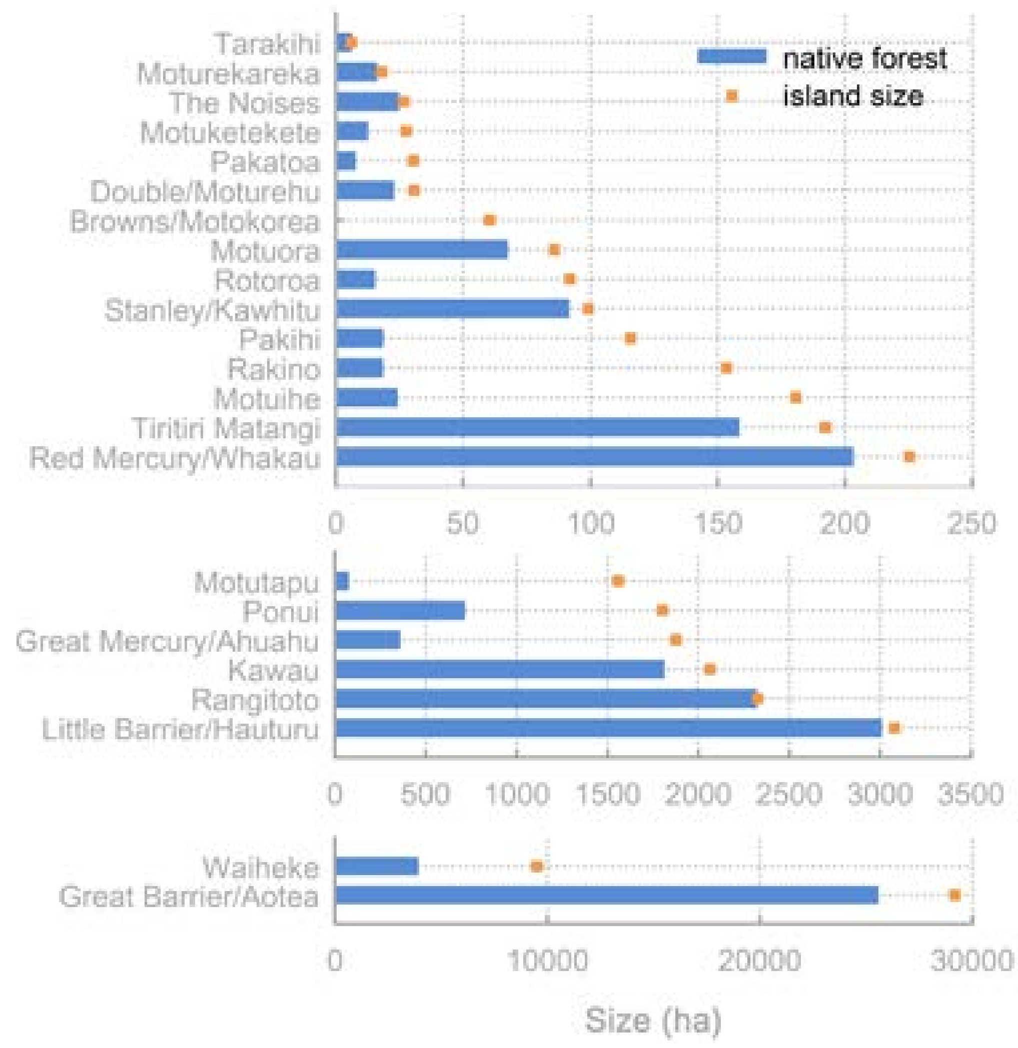


***Figure 6.33**: Extent of native forest cover on Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands in 2012 (data source: LCDB4.1).*

***Figure 6.34** Area of Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi islands covered in native forest in 2012 and island size. Native forests are defined as indigenous forest, broadleaved indigenous hardwoods, matagouri or grey scrub, and mānuka/kānuka vegetation classes (data from LCDB4.1).*



Fire damaged moko skink on Motukorea / Browns Island. Photo by Shaun Lee.

Tieke (saddleback) on Te Hauturu-o-Toi / Little Barrier Island. Photo by Shaun Lee.

Figure 6.35*: Mammalian pest-free islands in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi. Ahuahu / Great Mercury Island has become pest-free since the 2014 State of the Gulf report.*

Pāteke (brown teal). Photo by Shaun Lee.

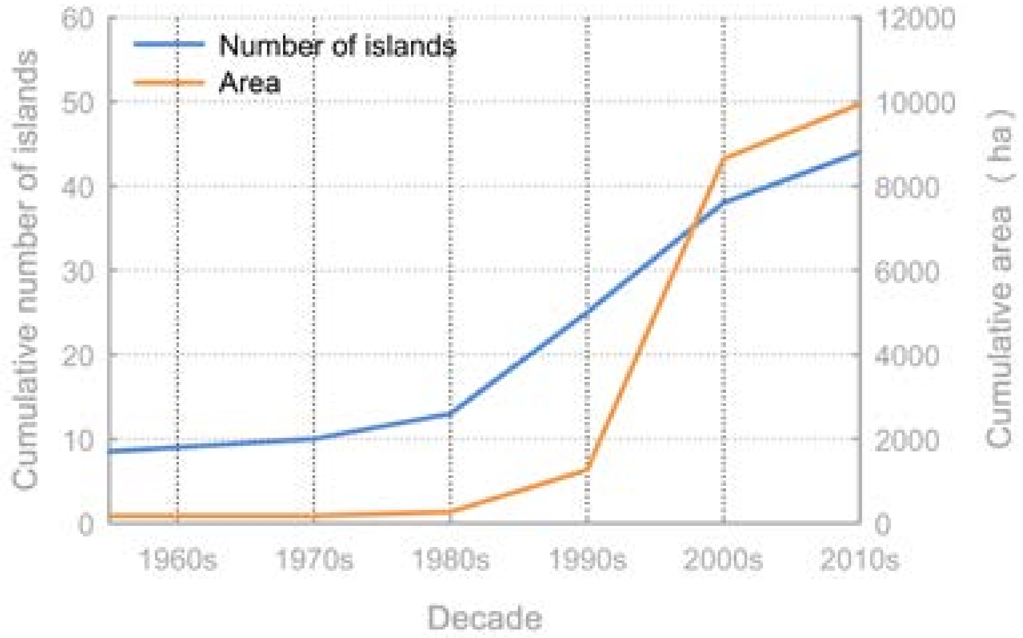


Figure 6.36*: Increase in the number of islands and total area that is mammalian pest-free in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi between 1960 and 2017. Data updated from Towns et al. (2013) and Bassett et al. (2016). Three pest-free islands with an unknown eradication date have been excluded from the graph.*

Sunset at Te Hauturu-o-Toi / Little Barrier Island. Photo by Shaun Lee.

6.10.2 PAKAKĒ BRYDE'S WHALES

Bryde's whales are listed as a 'Nationally Critical' species.
The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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.
Since 1989, there were 44 recorded fatalities of Bryde's whales in the greater Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi.
17 out of 20 (85%) whales whose cause of death was known were killed by ships, while the other three whales died from entanglement in fishing or aquaculture equipment.
The implementation of a voluntary speed reduction in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi to 10 knots for large vessels appears to be reducing the number of ship strikes, with only one whale killed since the protocol was implemented in 2013.

Bryde's whales (*Balaenoptera edeni brydei*) 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. 2016). 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 / Tīkapa Moana / Te Moana-nui-a-Toi 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). Bryde's whales utilise a larger area of the Hauraki Gulf. They are most frequently observed in central and northern regions of the inner gulf from north of Waiheke Island to Great Barrier Island, but 'hot spot' locations vary each year (***Figure 5.37***; Constantine et al. 2015; Dwyer et al. 2016).

Bryde's whale in Hauraki Gulf Forum poster. Illustration by Dave Gunson.

Figure 6.37: *Recorded sightings of Bryde's whales in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi between August 2000 and September 2016 (Data from Ebdon 2017).*

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is one of the busiest waterways in New Zealand with Ports of Auckland handling around 1,500 commercial ship calls and 100 cruise ship calls per year (Ports of Auckland 2016). Bryde's whales spend more than 90% of their time in surface waters that are less than 12 m deep (Constantine et al. 2015). 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. Consequently, there is a high risk of collision between whales and ships, particularly at night when they are on the surface and may be slower to react. Ship strike is a serious concern for the sustainability of the Bryde's whale population in New Zealand, with whales likely to be killed or suffer severe injury if they are struck by ships travelling more than 13-15 knots (Laist et al. 2001).

From 1989 to 2016, there were 44 recorded fatalities of Bryde's whales in the greater Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi region, of which 24 (55%) died of undetermined or unknown causes. Of the 20 whales that died of known causes, 17 (85%) were most likely killed by ship strike, and three died from entanglement in fishing (two whales) or aquaculture (one whale) equipment (***Figure 6.38***).

Scientists, regulators and stakeholders have been working together since 2011 to reduce the probability of ship strike in the Gulf. The most feasible solution was found to be lowering the average speed of commercial ships in the inner Gulf to 10 knots. A reduction from 13 knots to 10 knots was estimated to reduce the probability of a lethal ship strike from 51% to 16% (Riekkola 2013). In 2013, the shipping industry and Ports of Auckland agreed upon a voluntary protocol to minimise ship-whale collisions. The main points of the protocol are:

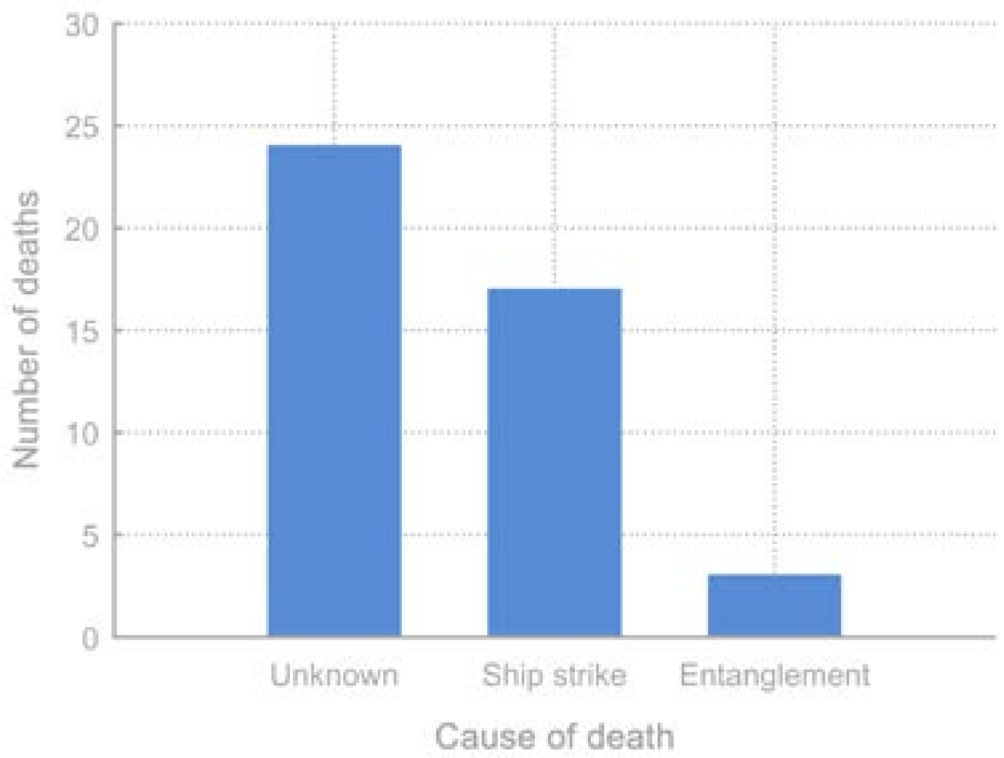


***Figure 6.38**: Causes of Bryde's whale fatalities in the great Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi between 1989 and 2016.*

- where possible, reduce speed in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi to 10 knots;
- stick to the recommended shipping routes to minimise the area covered by ships;
- keep a watch out for whales during the day when in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi;
- report all whale sightings to harbour control;
- slow down if a whale is spotted and do not pass within 1km from a whale (Ports of Auckland 2015).

Uptake of the voluntary protocol by large vessels (>70 m) has been good, with average vessel speed reduced from 14.2 knots to 10.6 knots following the introduction of the transit protocol (Collis 2015). The voluntary transit protocol appears to be successful in reducing ship strike with only one whale killed by ship strike since 2013. The average fatality rate of Bryde's whales from ship strike in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi has reduced from 0.9 whales per year (1989-2013), to 0.3 whales per year (2014-2016), but a longer duration is needed to confirm whether the voluntary transit protocol is having a significant positive impact.

Consideration also needs to be given to other human activities that pose a risk to whales though decreased habitat availability or disturbance. For instance, a new 300ha zone for fish farming has been established in an area that is known to be used by the whales (see ***Figure 6.5***).

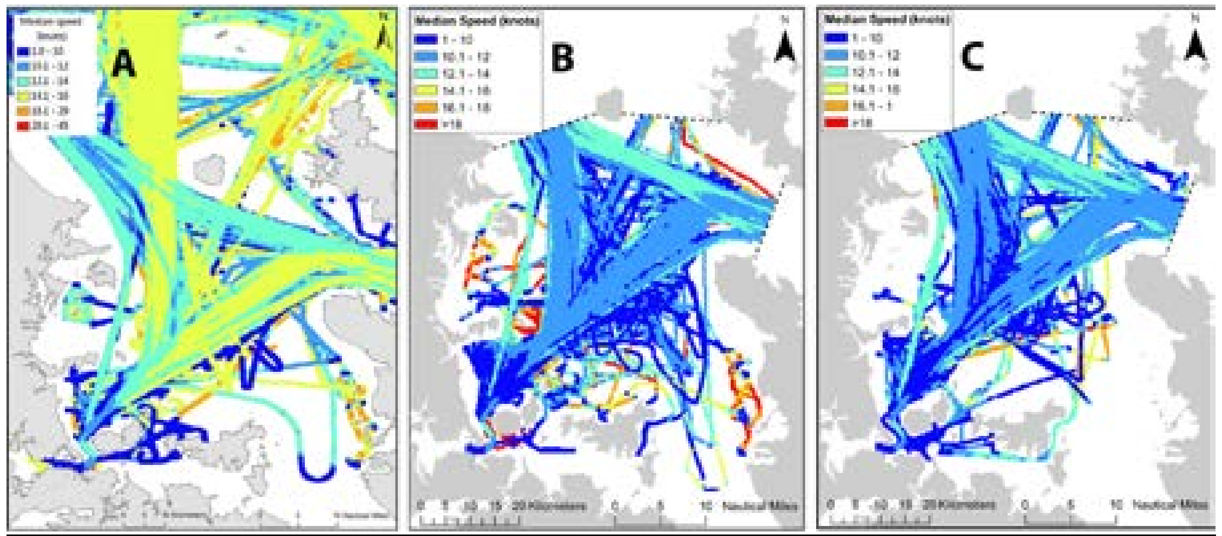


***Figure 6.39**: Median speeds of vessels larger than 70 m transiting through the Hauraki Gulf in a) July 2012-June 2013 (from Riekkola, 2013), b) October 2014-September 2015, and c) October 2015 -September 2016. Median speeds were calculated within 250 x 250 m grid cells. Note the difference in colour associations for higher speeds among the three graphs (Figure provided by P. Ebdon, University of Auckland, reproduced from Ebdon 2017).*

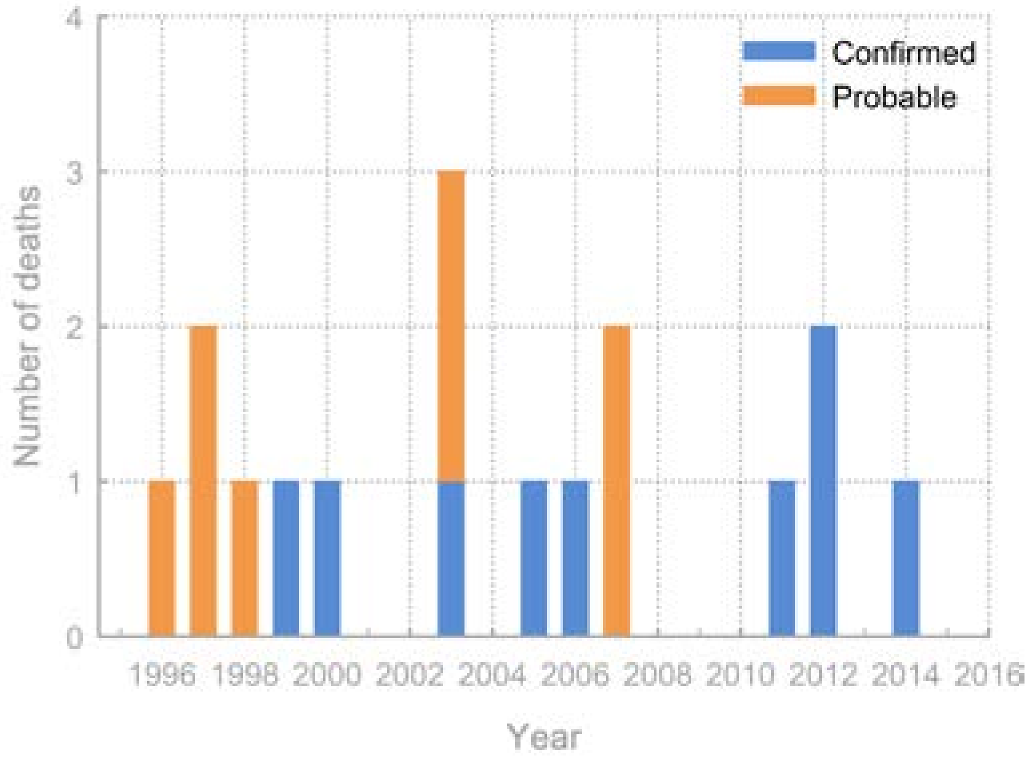


***Figure 6.40**: Number of confirmed and probable ship strike fatalities of Bryde's whales between 1996 and 2016 (Data from R. Constantine, University of Auckland).*

6.10.3 NGĀ MANU Ā-TAIMOANA ME NGĀ MANU Ā-UTA
SEA AND SHORE BIRDS

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi is an internationally important biodiversity hotspot for seabirds and the Firth of Thames is an internationally important site for waders, which is recognised through its designation as a Ramsar wetland.

The conservation status of four seabirds that reside in the Hauraki Gulf / Tīkapa Moana / Te Moana-

There are serious concerns about the long-term survival of four seabird species that breed in the Gulf:

- The New Zealand fairy tern is New Zealand's most endangered species, with only around 40 individuals and nine breeding pairs estimated to remain.
- The 'Nationally Vulnerable' New Zealand storm petrel was thought to be extinct for 108 years, until it was rediscovered in 2003. The petrel breeds on Te Hauturu-o-Toi / Little Barrier Island and the population is thought to be in the 100s to 1000s.
- The 'Nationally Vulnerable' black petrel is the seabird most at risk from commercial fishing activity, with an estimated 392 birds captured in 2013-2014. Of them over 100 were captured by the north-eastern snapper longline fishery.
- 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.

Wader counts in the Firth of Thames have been made by the New Zealand Ornithological Society since 1960. Trends of eight wader species counted between 1960 and 2016 show patterns in abundance, with:

- three endemic species (variable oystercatcher, New Zealand dotterel and banded dotterel) and one native species (spur-winged plover) increasing in number
- one endemic species (South Island pied oystercatcher) and two migratory species (ruddy turnstone and red knot) displaying cyclic patterns
- the migratory eastern curlew showing a decreasing trend.

Other wader species counted show no obvious patterns in abundance.

Major threats to marine bird populations include predation, commercial fishing activity, loss of habitat, disturbance and marine pollution.

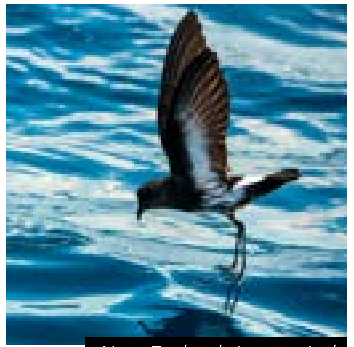
International migratory species are likely to be affected by both local and overseas pressures and changes in habitat quality.

Seabirds

The Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi 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 species (Buller's shearwater (*Puffinus bulleri*), New Zealand fairy tern (*Sternula nereis*), Pycroft's petrel (*Pterodroma pycrofti*), black petrel (*Procellaria parkinsoni*), and New Zealand storm petrel (*Fregetta maoriana*)), breed exclusively in the wider Hauraki Gulf region (Gaskin & Rayner 2013).

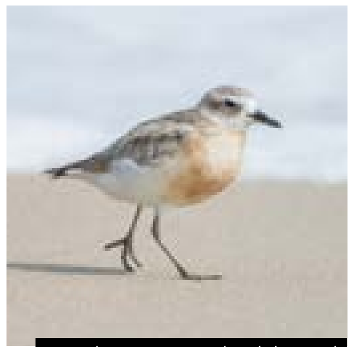
Seabirds extend island ecosystems by feeding exclusively within the marine environment and in a range of different marine habitats from coastal waters to hundreds, and in some cases thousands of kilometres offshore. Bird droppings add nutrients, particularly nitrogen and phosphorus, to the terrestrial environment, and lower the pH of the soil. Burrowing seabirds are frequently referred to as 'ecosystem engineers' because they mix the soil and significantly increase soil and litter invertebrate abundance and diversity (Orwin et al. 2016; Thoresen et al. 2017). There is also evidence that seabirds affect plant and seaweed diversity and growth (Bellingham et al. 2010; D. Towns, AUT, pers. comm.).

Seabirds are sensitive to changes in prey availability, making them good indicators of ecosystem health (Piatt et al. 2007). They are generally also long-lived and have low fecundity, making them vulnerable to commercial fishing, predation, marine pollution, and loss of prey and habitats. These threats have a cumulative impact on seabirds and a combination of at-sea threats is predicted to cause most New Zealand seabird populations to decline (S. Borrelle, Auckland University of Technology, pers. comm.). There have been several changes in the threat status of a number of seabirds and shorebirds since the 2014 State of our Gulf Report was published (Robertson et al. 2017). Changes in the status of seabirds that reside in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi include:



New Zealand storm petrel. Photo by Darryl Torckler.

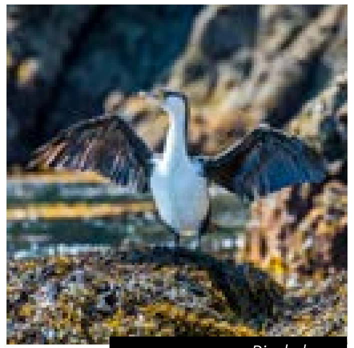
The New Zealand storm petrel, which was thought to be extinct for over 100 years, has improved from 'Nationally Endangered' to 'Nationally Vulnerable' with the discovery of a breeding colony in Te Hauturu-o-Toi / Little Barrier Island in 2013 (Rayner et al. 2015). Despite the lack of sightings for over 100 years, the current population is considered to be larger than initially thought, comprising hundreds, if not thousands of birds[44] (Gaskin 2017b).



Northern New Zealand dotterel. Photo by Shaun Lee.

The northern New Zealand dotterel (*Charadrius obscurus aquilonius*) has improved from National Vulnerable to At Risk (recovering). With the assistance of the protection programmes, the national population has increased from about 1350 birds in the early 1990s to 2075 birds in 2011 (Dowding 1993; Dowding 2017a).

[44] Based on the low rate of resightings of banded birds.



Pied shag.
Photo by Darryl Torckler.

The pied shag (*Phalacrocorax varius varius*) has improved from 'Nationally Vulnerable' to At Risk (recovering). However, this appears to be due to increases in central North Island populations, while populations in northern New Zealand appear to be declining (Powlesland 2017).

Red-billed gull adult and chick.
Photo by Shaun Lee.

Red-billed gulls (*Larus novaehollandiae scopulinus*) have improved from National Vulnerable to At Risk (declining). In 2014-2016, the national population was estimated to be around 28,000 breeding pairs (Frost & Taylor 2016).

The threatened status of other important seabirds in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi have not changed, including New Zealand's most endangered species, the 'Nationally Critical' New Zealand fairy tern that has only 40 remaining individuals (Department of Conservation no date-c), the 'Nationally Critical' black-billed gull), the 'Nationally Vulnerable' black petrel and the 'Nationally Vulnerable' flesh-footed shearwater (*Puffinus carneipes*).

Incidental capture of seabirds by both commercial and recreational fishers is a major conservation concern. Around 60,000 seabirds were estimated to have been caught by the New Zealand fishing industry between 2002-2003 and 2013-14, with numbers decreasing over this period from around 9,200 in 2002-2003 to around 5,000 in 2013-2014 (***Figure 6.41***). This decrease is due to both a decrease in fishing effort and a decrease in seabird capture rates, though capture numbers have been stable since 2008-2009 (Abraham et al. 2016; Abraham & Richard 2017). The vast majority of seabirds captured by commercial fisheries were not from the Hauraki Gulf because the majority of New Zealand'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 / Tīkapa Moana / Te Moana-nui-a-Toi is for snapper. An estimated 716 seabirds were caught by the northeastern (SNA1) snapper bottom longline fishery in 2013-2014, decreasing from around 1,500 birds in 2000-2001 (Abraham & Thompson 2011; Abraham & Richard 2017). However, the accuracy of the seabird bycatch estimates from the snapper bottom longline fishery is uncertain because of poor observer coverage of this fishery[45] (Abraham & Richard 2017). Better observer coverage of the snapper longline fishery is essential to understanding and improving bycatch rates in the Gulf.

Of great concern, are the species of seabirds captured by the snapper fishery in northeastern New Zealand, with flesh-footed shearwaters, black petrels and grey petrels (*Procellaria cinerea*) the most common species caught (Abraham & Richard 2017).

Pied shag in fishing line. Photo by Shaun Lee.

- Black petrels were assessed at the species most at risk from fishing impacts, with an estimated 392 birds captured in 2013-2014, of which, over 100 were captured by the northeastern snapper longline fishery (Richard & Abraham 2015; Abraham & Richard 2017). The species is only known to breed only on Aotea / Great Barrier Island and Te Hauturu-o-Toi / Little Barrier Island. The largest breeding colony occurs on Aotea and there were an estimated 2,072 birds and 880 breeding pairs on Aotea in 2015-2016 (Bell et al. 2016). This population has been monitored since 1995-1996, but trends in black petrol population are unclear, with different studies producing different trends from declines of 2.3% per year to an increase of 2.5% per year (Bell et al. 2013; Bell et al. 2015; Bell et al. 2016). Current capture rates are of grave concern for the sustainability of this species, although improvements have been made with capture rates in the small vessel bottom longline fishery halved over the past 10 years (***Figure 6.42***).
- Flesh-footed shearwaters are the fourth most at-risk species from commercial fishing, with 637 estimated captures in 2013-2014 (Abraham & Richard 2017). They are the most common species incidentally captured by the northeastern snapper longline fishery with over 250 birds estimated to be captured in 2013-2014, though numbers captured by the small vessel bottom longline fishery have nearly halved since 2002-2003 (***Figure 6.42***). The New Zealand population is classified as 'Nationally Vulnerable' because numbers in New Zealand have declined from 50,000-100,000 pairs in 1984 (Robertson & Bell 1984) to less than 15,000 pairs in 2012 (Waugh et al. 2013).

Significant numbers of seabirds are also captured by recreational fishers. It is estimated that recreational fishers catch 11,500 birds per year from the northeastern coast of the North Island, alone, mainly comprising petrels (45%) and seagulls (29%). Fishers report that 77% of birds captured were released unharmed, but the accuracy of this estimate is uncertain (Abraham et al. 2010). Autopsies of dead birds washed ashore indicate that a significant number of birds may be dying as a result of interactions with recreational fishers (Miskelly et al. 2012).

[45] Only 1.2% of snapper bottom longline fishing effort was covered by observers between 2006-2012. A lack of observer data means that the estimates are more reliant on model assumptions. This can lead to significantly different bycatch estimates depending on the type of model used to estimate bycatch (Richard & Abraham 2015).

Recent mitigation methods used to reduce seabird bycatch include:

- The appointment of a seabird liaison officer in 2010 to work with the longline fishery in northeastern New Zealand to reduce seabird bycatch. The liaison officer visits all skippers and works with them to implement mitigation methods such as development of seabird management plans, use of the correct gear, adjusting weights and setting speed, and offal and bait management (Goad 2017).
- The development of a National Plan of Action for Seabirds (Ministry for Primary Industries 2013e).
- Research on the diving and foraging behaviour of seabirds, and development of appropriate mitigation methods for commercial fisheries (e.g. Pierre & Goad 2016; Friesen et al. 2017; Parker 2017).
- Seabird SMART training workshops to educate commercial skippers about seabirds and mitigation methods (Southern Seabird Solutions no date).
- The establishment of a black petrel working group in 2014 comprising representatives of the fishing industry, environmental groups, iwi and government, who pledge to decrease black petrel bycatch rates in FMA1 (Southern Seabird Solutions 2017).
- Arranging opportunities for fishers to visit seabird colonies to help fishers recognise the value of their efforts to mitigate seabird bycatch (T. Searle, Lee Fish, pers. comm.).

Tom Searle, operations manager, Lee Fisheries with Tāiko (black petrel). Photo by Shaun Lee.

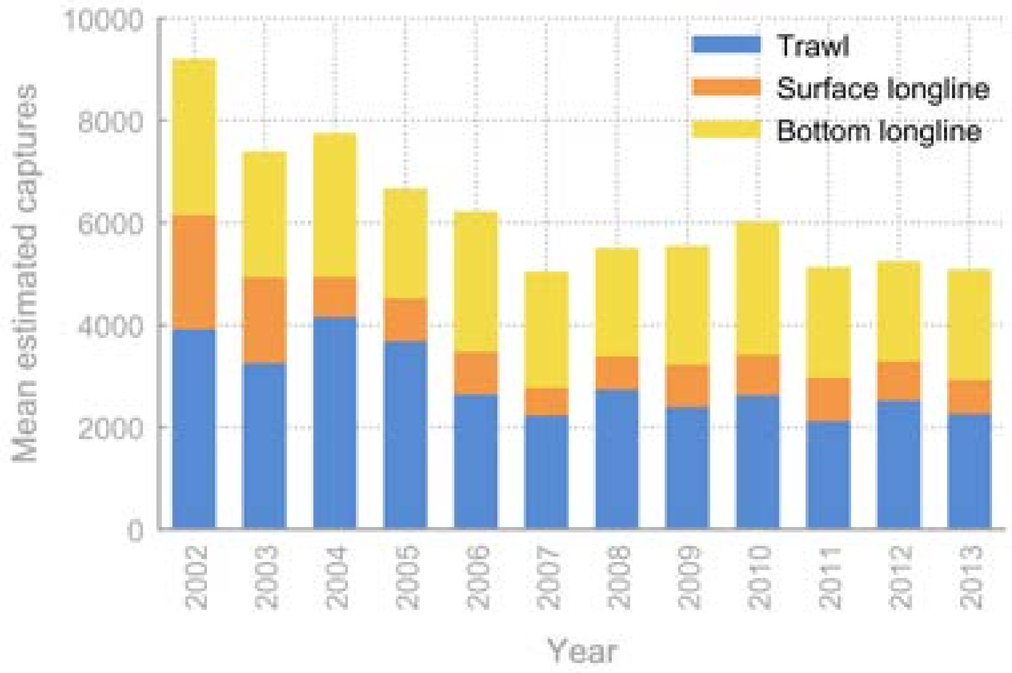


***Figure 6.41**: Mean estimates of the national number of seabirds caught by New Zealand's trawl and longline fisheries between 2002-2003 and 2013-2014 (Abraham & Richard 2017).*

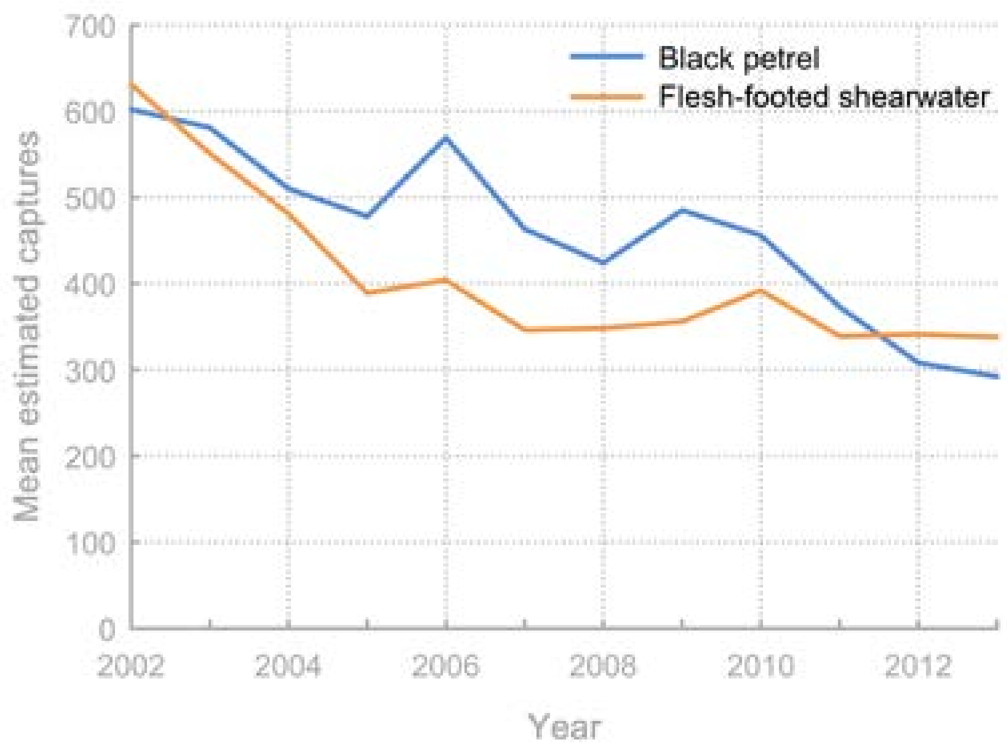


***Figure 6.42.** Estimated national mean capture rates for black petrels and flesh-footed shearwaters in the small vessel bottom longline fishery between 2002-2003 and 2013-2014 (data from Abraham & Richard 2017).*

Shorebirds

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). Around 11,000 birds migrate via the East Asian-Australasian Flyway from Siberia and Alaska to spend the summer in the southern hemisphere, before returning to their northern breeding grounds in March and June (Battley & Brownell 2007). The Firth of Thames is a terminal point for the East Asian-Australasian Flyway, and approximately 35,000 waders utilise the area each year. A total of 132 bird species have been recorded in the Firth of Thames including 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 (Battley & Brownell 2007).

The New Zealand Ornithological Society (Birds New Zealand) has been routinely counting birds at a number of sites in the Firth of Thames since 1960. The following long-term trends in the Firth of Thames are apparent:

Variable oystercatcher nesting at Pākiri. Photo by Shaun Lee.

- **Variable oystercatcher** (*Haematopus unicolor*) counts have increased consistently from zero prior to 1990 to nearly 300 per year in recent years. This increase is a reflection of a national increase from around 2,000 birds in the early 1970s to around 7,000 birds in 2006 (Bell 2010). No specific conservation measures are undertaken for variable oystercatchers, but some birds benefit from protection programmes for New Zealand dotterels (Dowding 2017b).
- **Northern New Zealand dotterel** (*Charadrius obscurus aquilonius*) counts have slowly increased from annual counts of generally less than 30 birds between 1960 and 1990, to 50-90 birds per year since 2011. Northern New Zealand dotterels usually have poor breeding success at unmanaged sites, due to the loss of eggs and chicks to 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 public education (Dowding 1993; Dowding 2017a; Robertson et al. 2017).
- Banded dotterel (*Charadrius bicinctus*) counts have generally increased in the Firth of Thames over the last 30 years. 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 thought be due to predation, but habitat loss and human disturbance has also contributed to the displacement of birds at some sites (Pierce 2013).

South Island pied oystercatcher roosting at Point England. Photo by Shaun Lee.

- **South Island pied oystercatcher** (*Haematopus finschi*) counts increased from very low numbers in 1960 to peak at around 32,500 birds in 1998. However, counts have been declining since 1998, with the 2016 surveys recording a combined total of around 13,500 birds. The reasons for the population decline have not been determined, but habitat modification, water extraction and dairy conversions in their breeding areas are commonly highlighted as potential causes (Sagar 2013).
- **Spur-winged plover** (*Vanellus miles*) are a relatively recent native species, which has flourished since it was first recorded breeding in Invercargill in 1932. Counts have increased rapidly in the Firth of Thames since they were first recorded there in the mid-1980s. Spur-winged plover are now widespread throughout New Zealand and their protected status was removed in 2010 (Woodley 2013).
- **The migratory eastern curlew** (*Numenius madagascariensis*) is a regular but rare, visitor to the Firth of Thames. Counts have dropped from 30 birds in 1962 to less than three birds per year since 1998. The species is classified as Endangered by IUCN and the global population is rapidly declining, primarily due to habitat loss around the Yellow Sea (Birdlife International 2016).
- **Ruddy turnstone** (*Arenaria interpres*) have an IUCN classification of Least Concern, with a global population of around 460,000-730,000 birds. Around 1,000-3,000 birds reach New Zealand each summer, with between 70 and 500 birds (probably juveniles) overwintering. Counts in the Firth of Thames peaked in 1982 at 388 birds, but have subsequently declined to less than 25 birds per year since 2001 (Szabo 2017).
- **Red knot** (*Calidris canutus rogersi)* is a migratory bird that breeds near the Arctic, visiting New Zealand during summer. However, it is also considered a New Zealand resident because more than 25% of the population spends at least 50% of their time in the country (Robertson et al. 2017). The 'Nationally Vulnerable' New Zealand population has declined from almost 60,000 birds in the early 1990s to around 30,000 in the 2010s (Battley 2017). Likewise, counts in the Firth of Thames have decreased from over 10,000 birds per year in the 1970s to less than 5,000 birds per year since 2010. The species is threatened by extensive land reclamation overseas, reduced prey availability, pollution and human disturbance (BirdLife International 2017).

Other shorebirds counted in the Firth of Thames surveys do not show any obvious trends in abundance.

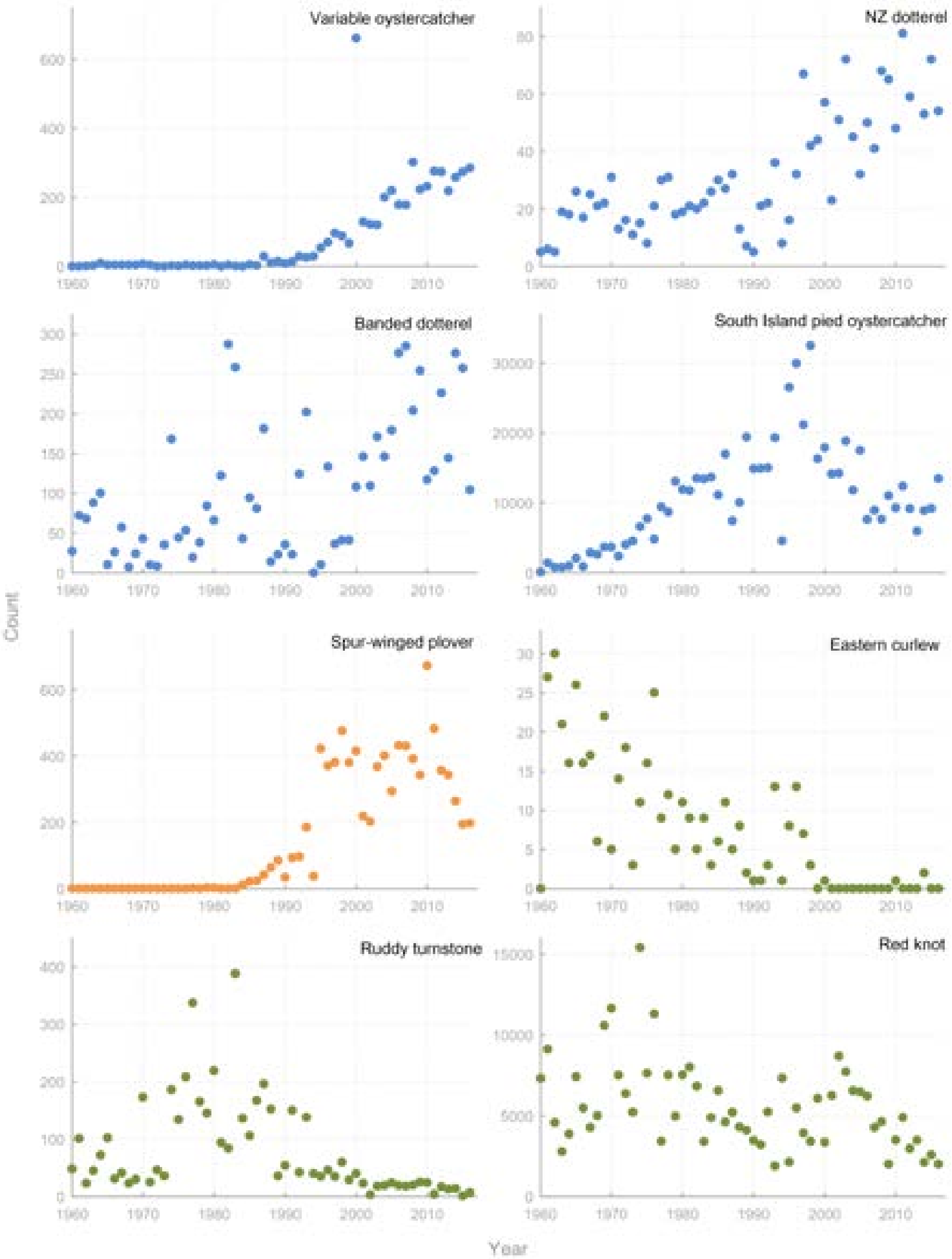


***Figure 6.43**: Trends in the combined number of shorebirds counted during summer and winter surveys undertaken by volunteers of Birds New Zealand in the Firth of Thames (data provided by Birds New Zealand). Endemic species having blue circles, native species have orange circles, and migrants have green circles. Note the different scales for the y-axis.*

NGĀ WHAKAWHANAKETANGA TAKUTAI MOANA
6.11 COASTAL DEVELOPMENT

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 Kaiaua coasts, Pākiri, Mahurangi South, Tāwharanui Peninsula, the Clevedon coast and around Ōrere Point.

Popular holiday areas such as Matheson Bay, Ōmaha, Pāuanui, Te Rerenga (northern Coromandel) and Whangamatā 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.

Aotea / Great Barrier Island. Photo by Shaun Lee.

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

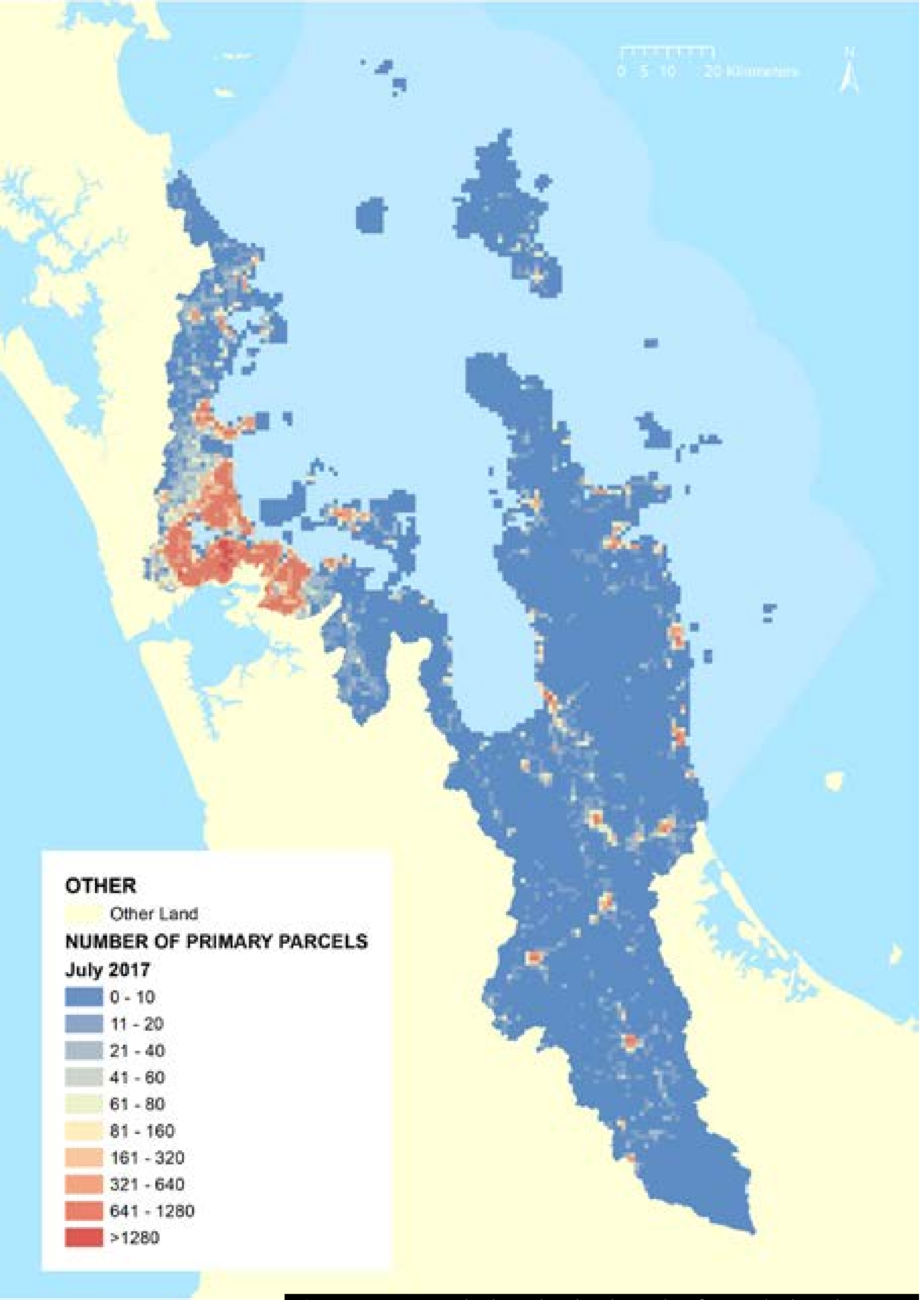


***Figure 6.44**: Variation in lot density based on the number of primary land parcel per square kilometre (LINZ Data Service, NZ Primary Land Parcels, 17 July 2017). The number of parcels was determined by counting parcel centroids (i.e. the central position of each parcel).*

Western end of Waiheke Island. Photo by Shaun Lee.

- 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.

Most of the islands of the Gulf only have less than 10 lots per square kilometre (***Figure 6.44***). The exceptions are the western side of Kawau Island, the southern end of Aotea, and the western end of Waiheke Island. On the Coromandel Peninsula, highest lot densities occur along the Thames coast, around Coromandel, between Whangapoua and Ōpito, between Whitianga and Hāhei, around Tairua and Pāuanui, and around Onemana, Whangamatā 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 Kaiaua coasts, but slightly greater densities are found north of Kaiaua. In contrast, very little of the mainland coast has low lot densities in the Auckland region. Those areas that do are Pākiri, Mahurangi South, Tāwharanui Peninsula, the Clevedon coast and the coast on either side of Ōrere Point.

Significant areas of greenfield coastal development between 2014 and 2017 were centred on the Beachlands, Riverhead, Whangaparāoa/Silverdale, and Snells Beach areas of the Auckland region. Substantial development/redevelopment also occurred in areas in and around the urban isthmus, within additional pockets of development in the Warkworth, Matakana and Point Wells areas north of Auckland. Recent development along the Coromandel Peninsula, and on the Hauraki Plains and Gulf Islands appeared to be relatively minor in nature, with low numbers of small subdivisions mostly occurring within existing towns and settlements (***Figure 6.45***).

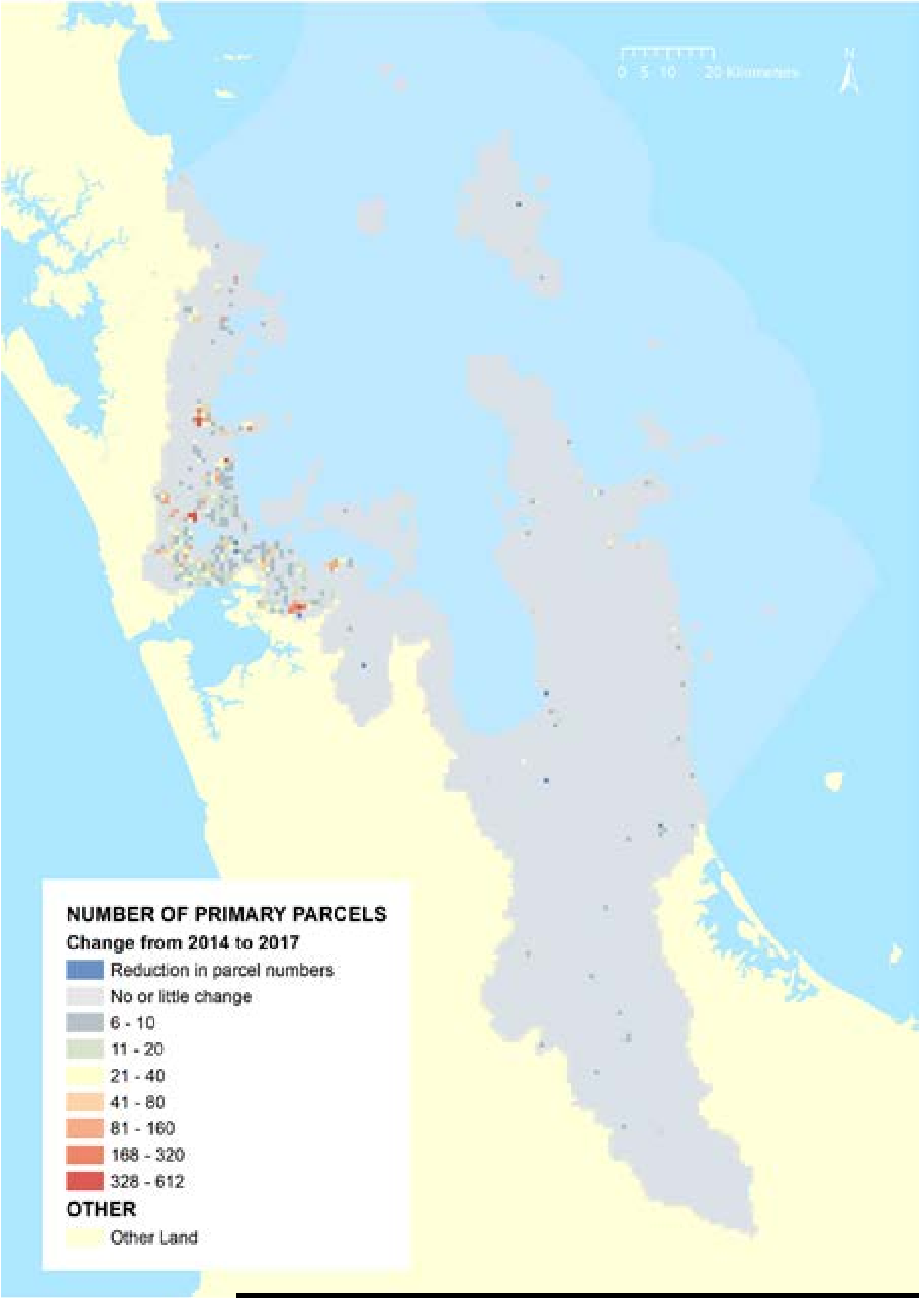


***Figure 6.45**: Changes in the number of primary land parcels between March 2014 and July 2017 (LINZ Data Service, NZ Primary Land Parcels, 18 March 2014 and 17 July 2017). The number of parcels was determined by comparing counts of parcel centroids between the two time periods.*

Golf course at Te Arai. Photo by Shaun Lee.

The 2014 State of Our Gulf Report highlighted that occupation patterns in Auckland's urban area differed markedly from those in holiday spots on Coromandel Peninsula and beaches north of Auckland. 2013 census data showed that urban Auckland dwellings had a high occupancy rate compared to five of the six coastal settlements assessed, and that this pattern was reasonable consistent over time. In the 2013 census:

- Matheson's Bay had 69 more dwellings than usual residents;
- Ōmaha had 540 more dwellings than usual residents;
- Pāuanui had 1,398 more dwellings than usual residents;
- Whangamatā had 1,026 more dwellings than usual residents;
- Te Rerenga (northern Coromandel) had 1,815 more dwellings than usual residents.

In Auckland, usual residents were increasing faster than the number of dwellings. In contrast, the number of dwellings had been increasing faster than the number of usual residents at five of the other six locations. This was largely attributed to demand for holiday homes in coastal settlements. An update of this information will be available following the 2018 census.

TE TŌTIKA O TE WHAKAUTU
7. ADEQUACY OF THE RESPONSE

Achieving our goals

Whāia te pae tawhiti kia tata, whāia te pae tata kia mau

Pursue the distant pathways of your dreams, so they may become your reality

Photo: Boy snorkels over urchin (kina) barrens off Aotea / Great Barrier Island by Darryl Torckler.

The HGMP 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). As noted earlier, those issues are provided under the Forum's strategic framework for action and include aspirations for:

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

Tangible progress has been made over the past three years on addressing the issues identified by Forum. The settlement of treaty claims has led to a step-change for Māori. Mana whenua have reclaimed their right to be involved in decisions affecting them and their rohe (regions). They have received compensation, in some cases, for resources that had been appropriated, and now have greater say in planning for the future. Mana whenua will invariably be a driving force in the management of the Gulf, with their kaitiaki obligations likely to put greater emphasis on intergenerational outcomes. The integration of knowledge gained through a combination of mātauranga Māori and western science is also expected to provide a more holistic picture of the natural environment and its connection to people.

Nutrient loads from the Hauraki Plains and heavy metal concentrations in Auckland's urban estuaries remain elevated, but some trends point toward slow improvements. The implementation of voluntary speed restrictions has brightened the outlook for Bryde's whales, and biodiversity gains are progressively being made on the islands of the Gulf.

However, pressures are rapidly mounting as the human population increases; demand for facilities, infrastructure and resources is pushing development towards the sea; and outcomes in Gulf's fisheries point to significant stress. In some areas, such as the Firth of Thames the gradual improvements might not be enough to reverse legacy effects, counter already-triggered trophic shifts, and prevent further degradation. Gains could be easily undone by new activities like fish farming or from the emerging effects of climate change.

A key issue for the Gulf appears to be that the pace of change is outstripping the ability of current management frameworks to respond effectively. There appear to be several reasons for this:

- **Technical constraints**: Some of the issues facing the Gulf are incredibly difficult to resolve because scientific or engineering solutions aren't available right now, and/or legacy actions and emerging global issues are likely to constrain what can practicably be achieved. Examples include resolving the effects of around 150 years of high sediment loads and decades of high nutrient loads to the Firth of Thames, managing invasive species, and addressing issues associated with climate change. However, existing tools are available for managing other significant issues, and are being used (e.g. ship speed reductions, island restoration, predator control, marine protected areas, stormwater controls, earthworks sediment controls). Ongoing advances could improve the performance of those tools or produce alternatives. In some cases, the roll-out of these tools needs to be broadened.
- **The commercialisation of natural resources**: The coast is the new frontier for development. The margins of the HGMP are exposed to increasing 'ocean sprawl' from activities such as new coastal subdivisions, roads, coastal protection works and outfalls. The Gulf is also increasingly being commercialised by activities such as aquaculture, marina development, port infrastructure and amenity structures. If commercial opportunity exists, there are incentives to explore them through national and regional development policies. The drive to secure space and natural resources for commercial activities, and public and private facilities has been building for the past 20 plus years. This was clearly illustrated during the rush to secure aquaculture space towards the end of the 1990s, which eventually led to a temporary moratorium on new aquaculture applications in 2001. Consent applications for new farming space have started flowing in again since the moratorium was removed, while the existing applications for spat catching space are still to be processed.
- **Financial implications:** The costs of resolving environmental issues can be high, both for management agencies (and by implication the community), and the private sectors involved. For example, the cost of the central interceptor project to alleviate wastewater overflows in Auckland is estimated to be around one billion dollars. Excessive cost (along with technical constraints) also impedes the control of established marine pests, and constrains options for dealing with a host of other issues – often with intergenerational implications. Government funding for Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi initiatives comes from limited budgets, which must be spread across the multiple responsibilities of councils and central government departments. Contraints on funding means that the private sector is playing an increasingly important role in supporting environmental initiatives.
- **Legislative and regulatory frameworks:** The complexity, interconnected and intergenerational nature of issues facing the Gulf makes them particularly difficult to manage. Dealing with this is a challenge for regulatory agencies, who have struggled to develop effective controls for some issues. Examples include, managing demand for aquaculture development; providing for population growth and associated demand for urban development; adapting to climate change; and, controlling sources of sediment, nutrients, and urban contaminants.

  There are also unresolved tensions and contradictions within the provisions of Fisheries Act (1996) and RMA (1991). This was the subject of a recent[46] High Court judgement that determined:

  – the Fisheries Act controls the use of fisheries catch limits (and associated tools such as quota allocation and quota management areas), and the impacts of fishing on those elements of the aquatic environment that affect fishing;

  – the RMA controls (with a few specific exclusions) the incidental effects of fishing on other resources and values.

  The Court provided a useful example to highlight that the RMA has a function in managing the indirect effects of fishing. The judgement indicated that if urchin barrens were caused by the removal of snapper and crayfish, then the associated effects (including effects on intrinsic values and the character of a place) would be subject to RMA controls.

  The example used by the Court is notable, because to date, no effective response to this issue has been provided through the RMA or Fisheries Act. The full implications of the Court's decision are yet to be determined, but they are likely to be significant.

[46] Judgement of Whata, J. (29 May 2017) Attorney General vs The Trustees of the Motiti Rohe Moana Trust, CIV-2017-470-3.

- **Institutional delays:** The development and implementation of regulation can be exceedingly slow. For instance, an application to discharge stormwater from Auckland Council's (and its legacy councils) stormwater networks was kept 'on hold' for around 16 years – only recently being lodged in October 2017. Applications for spat catching space have also been 'on hold' for a similar period. The Marine Reserve Act (1971) is now 46 years old, and is widely considered to be out-of-date and unduly restrictive. Various work on amending the Act can be traced back to the release of a discussion document by DOC in 2000 (Department of Conservation 2000), but no tangible changes have been made after 17 years of effort. Nor has the marine protected areas policy and implementation plan developed by the DOC and MFish resulted in any new protected areas in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi (Department of Conservation & Ministry of Fisheries 2005).
- **The lack of an accepted, holistic, and integrated plan for the Gulf:** Despite the purpose of the HGMP Act including, integrating the management of the natural, historic and physical resources of the Gulf, an integrated vision and implementable plan has remained elusive, despite the efforts of the Hauraki Gulf Forum over 17 years. For example, the SNA1 strategy group, made up of representatives from the customary, recreational and commercial fishing sectors, was tasked by the Minister with developing management options for the Snapper 1 fishery. The groups did not include representation from councils, yet several actions in the Snapper (SNA1) Management Plan would require councils to take responsibility for implementation (SNA1 Strategy Group 2016). This process was carried out in parallel to the Sea Change process, which considered a much broader range of issues and developed a different set of recommendations.

The delivery of Sea Change – Tai Timu, Tai Pari Plan was a significant step towards integration. The process was supported by mana whenua, DOC, MPI, the Hauraki Gulf Forum, Auckland Council and WRC, and delivered a mana whenua and stakeholder-driven plan, which draws on the knowledge, capability and willingness of a broad range of sectors to address accepted problems.

The plan is non-statutory and is still under consideration by agencies a year on from its release. Auckland Council and WRC consider that many of the recommendations align with business as usual. They are also looking for alignment with the Spatial Plan in long-term planning and with council controlled organisations and district councils. The provision of coordinated advice to Ministers by central government departments (DOC, MPI, and MfE) was delayed by the general election.

The Plan is the first of its kind for New Zealand and has significant political, financial, environmental, cultural and social implications. If agencies decide not to implement the plan, or to only implement parts of it, the Hauraki Gulf Forum will need to consider alternative approaches for addressing the challenges identified in its strategic framework for action. This is likely to involve more delays when the need for urgent action has been clearly signaled.

Photo: Famous Tāmure (snapper) 'Monkeyface' with kingfish at the Leigh Marine Reserve by Darryl Torckler

NGĀ WHAKAOTINGA
8. CONCLUSIONS

Almost 18 years have passed since the HGMP Act came into effect at the start of the new millennium on 27 February 2000. The Act established the Hauraki Gulf Forum and, among other things, tasked it with preparing and publishing a three-yearly report on the state of the environment in the Hauraki Gulf / Tīkapa Moana / Te Moana-nui-a-Toi, including information on progress towards integrated management and responses to the strategic issues identified by the Forum. Those reports have provided a holistic view of the Gulf, and described the incredible transformation that it has undergone since humans first arrived. They have tracked recent changes in pressures, management, environmental condition and outcomes for tāngata whenua.

This report updates most of the indicators in previous reports, with some showing improving trends. Stable or slowly decreasing trends in heavy metals in Auckland's estuaries, and nutrient loads from the Hauraki Plains are encouraging, but there is still a way to go. Other indicators contine to point towards the suppression of environmental values at low levels or progressive environmental decline. Most of the fisheries indicators fall into this category.

This report also builds upon previous reports, by providing more detail about rapidly mounting pressures. It highlights that the pace of change appears to be outstripping the ability of current management frameworks to respond. It also signals what seems to be the next phase in the Gulf's history, where commercial development is increasingly pushing out into the sea. This follows on from a plethora of other activities that have had a lasting environmental effect on the Gulf, including gold mining, kauri logging, the conversion of Hauraki wetlands to farmland, the depletion of fish stocks, dredging of mussel beds, and urban development.

There are a number of reasons why management is falling behind the demand for resources, but the lack of a holistic plan for the Gulf has hampered the implemention of a cohesive set of controls. For the first time, an integrated plan for managing the Gulf has been developed that provides new options for moving beyond business as usual.

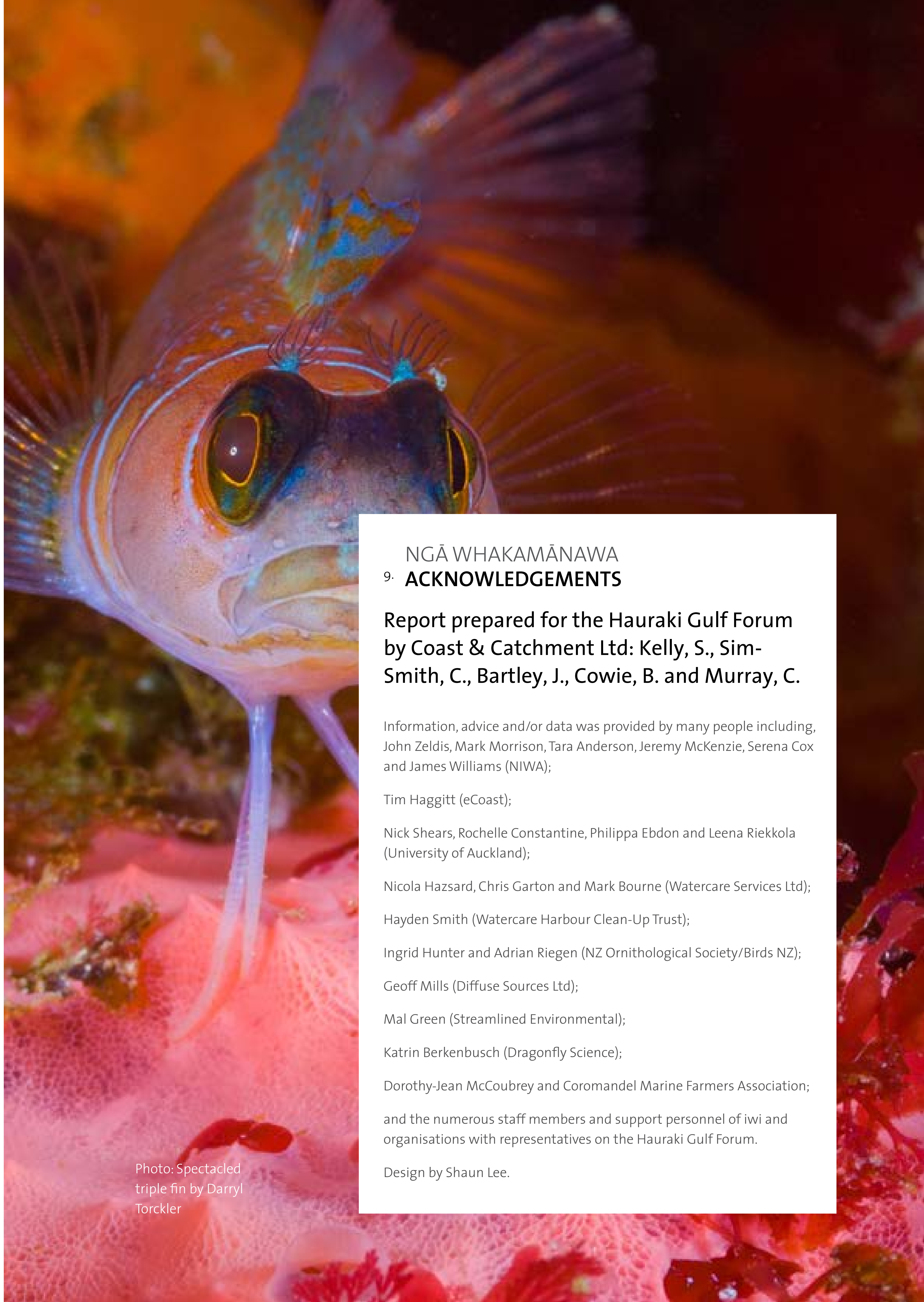


Photo: Spectacled triple fin by Darryl Torckler

NGĀ WHAKAMĀNAWA
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10. PAPAKUPU ME NGĀ WHAKAPOTOTANGA
GLOSSARY AND ABBREVIATIONS

ACE: Annual catch entitlements for commercial fishers.

Ahuahu: Great Mercury Island.

AMA: Aquaculture Management Areas.

Aotea: Great Barrier Island.

ARC: Auckland Regional Council.

Awa: Stream, river or creek.

B_0: 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. B_0 is often estimated from stock modelling and various percentages of it (e.g. 40% B_0) are used as biological reference points to assess the relative status of a stock.

B_{REF}: Biological Reference Point – 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.

B_{MSY}: 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.

Bycatch: Marine species that are caught unintentionally while catching certain target species. Bycatch can be a different species, the wrong sex, or undersized individuals of the target species.

CPUE: Catch per unit effort.

CROP: Cape Rodney to Okakari Point Marine Reserve. Commonly known as the Leigh Marine Reserve.

Deemed value: Deemed values are set for each fish stock in the QMS. They are set at a level to discourage fishers from targeting fish in excess of ACE and at the same time encourage them to land and report unintended bycatch. When the amount of a fisher's reported catch is more than the amount of ACE owned, the fisher is issued with a deemed value invoice. MPI sets both interim and annual deemed value rates for each quota management stock. The annual deemed value rate for a stock will always be higher than the interim deemed value rate.

DIN: Dissolved inorganic nitrogen.

DOC: Department of Conservation.

DRP: Dissolved reactive phosphorous.

Forum: Hauraki Gulf Forum.

Gulf: Hauraki Gulf.

Hapū: Tribe, sub-tribe, kinship group.

Hard Limit: A biomass limit below which fisheries should be considered for closure.

HDC: Hauraki District Council.

HGMP: Hauraki Gulf Marine Park.

HSS: Harvest Strategy Standard.

IAO: Iwi Aquaculture Organisation.

ITQ: Individual transferable quota.

IUCN: International Union for Conservation of Nature.

Iwi: Tribe.

Kaimoana: Seafood.

Kāinga: Village.

Kaitiaki: Guardian; ancestral, intergenerational responsibility to care for the environment.

Kawhitu: Stanley Island.

LAWF: Land and Water Forum.

MAF: Ministry of Agriculture and Forestry.

Mahinga kai: Food gathering place.

Mahinga mātaitai: Customary seafood gathering site.

Mana whenua: Power associated with the possession and occupation of tribal land.

Mātauranga: knowledge, wisdom, understanding, skill.

Maunga: Mountain.

Mauri: Life principle, life force, vital essence, special nature, a material symbol of a life principle, source of emotions – the essential quality and vitality of a being or entity.

MCY: Maximum Constant Yield – the maximum sustainable yield that can be produced over the long-term by taking the same catch year after year, with little risk of stock collapse.

MSY: Maximum Sustainable Yield – 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.

MBIE: Ministry of Business, Innovation and Employment.

MfE: Ministry for the Environment.

MFish: Ministry of Fisheries.

MPI: Ministry for Primary Industries.

NIWA: National Institute of Water and Atmospheric Research Ltd.

NPOA: National Plans of Action.

NPS-FM: National Policy Statement for Freshwater Management.

Ocean sprawl: The construction of artificial structures such as marine farms, wharves, moorings, oil rigs, bridges in the marine environment. Also includes land reclamation and dredging activities.

Pā: Fort.

Pātaka kai: Pantry, food storage.

Pers. comm.: Personal communication.

Poitō: Net floats.

PEL: Probable Effect Levels – sediment contaminant guideline where adverse biological or environmental impacts are expected to occur frequently.

QMA: Quota Management Areas – QMAs are geographic areas within which fish stocks are managed in the NZ Exclusive Economic Zone.

QMS: Quota Management System – 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.

Repanga: Cuvier Island.

RIMU: Research, Investigation and Montioring Unit, Auckland Council.

RMA: Resource Management Act 1991.

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.

SSB_0: Unfished spawning stock biomass – the total weight of sexually mature fish in the that would be present in an unfished stock.

TAC: Total allowable catch – 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.

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

Tāngata whenua: People of the land.

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

Taranga: Hen Island.

TCDC: Thames-Coromandel District Council.

Te Ao Māori: The Māori world.

Te Hauturu-o-Toi / Hauturu: Little Barrier Island.

Te Motu-o-Ihenga : Motuihe Island.

TEL: Threshold Effect Levels – sediment contaminant guideline associated with the onset of ecological effects.

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).

Whakaū: Red Mercury Island.

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 tāngata whenua of the Hauraki Gulf and its islands.

www.haurakigulfforum.org.nz

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Hauraki Gulf Forum
Tikapa Moana
Te Moananui a Toi