State of our Gulf 2023

Hauraki Gulf / Tīkapa Moana / Te Moananui-ā-Toi
State of the Environment Report 2023

Hauraki Gulf Marine Park
Ko te Pātaka kai o Tīkapa Moana
Te Moananui-ā-Toi

Hauraki Gulf Forum
Tīkapa Moana
Te Moananui-ā-Toi

HE WHAKATAUKI

Te kai a te tangata kē, he kai tūtongi kakī
Te kai a tōna ringa he tino kai, he tino mākona

Food from another hand merely tickles the throat
That gathered by one's own hand is real and satisfying

MIHI

Kei ngā toka tū moana
Kei te whānuitanga ake o te mana tangata
Te iti me te rahi
Hoatu, piki ake ki te tihi
Kimihia te pātaka
Aue, e whātoro ana
Taihoa ka kitea
Waihotia hei tohu maharatanga mo te ao
Tīhei mauriora

From the sentinels scattered throughout the oceans
To the farthest reaches of human endeavour
Both small and large
Seek sustenance
And as we keep searching
Eventually we will succeed
Let this be our heritage to the world
For long life shall be ours

First published August 2023

Published by:
Hauraki Gulf Forum
c/o Auckland Council
Private Bag 42300
Auckland, 1142

www.haurakigulfforum.org.nz
ISBN 978-0-473-68671-0

Cover: Dead tipa / scallop shell 📷 Shaun Lee

TE WHĀRANGI IHIRANGI
Contents

Sunrise at Te Whanganui A Hei / Cathedral Cove Marine Reserve © Shaun Lee

HE KUPU TAKAMUA
Foreword

The Hauraki Gulf is a taonga. It is our ancestor, playground, and pātaka kai. And it's in trouble.

The Hauraki Gulf Marine Park, Tīkapa Moana, Te Moananui-ō-Toi, spans some 14000 km^2 from Te Arai to Waihi. It is the seabird capital of the world, home to resident tohorā, and around 2 million people live by its shores. The State of the Gulf 2023 is, ultimately, a story about us. About our impact on the Gulf. About our slow but steady destruction of one of the great ecosystems on earth.

However, we may be finally starting to turn a corner. Thanks to mana whenua and local communities, the Gulf is, for the first time in over 100 years, scallop-dredge free. Other forms of seafloor-impact fishing are reducing. Riparian planting of waterways leading into the Gulf is proceeding at pace. Billions are being invested in stopping sewage and stormwater outflows. And we are on the cusp of seeing long overdue new marine and seafloor protection areas.

At the same time, the Gulf is never static. Climate change has well and truly arrived. Marine heat waves, invasive seaweeds, more frequent storms, and acidifying waters all pose serious new threats to the health of the Gulf. This underscores the vital importance of rebuilding a resilient Gulf, a biodiverse Gulf, an abundant Gulf.

The Hauraki Gulf Forum is committed to that better future.

Ngā mihi, nā

Nicola MacDonald
Co-Chair Tangata Whenua,
Hauraki Gulf Forum
August 2023

Toby Adams
Co-Chair,
Hauraki Gulf Forum
August 2023

Te whakarā-popoto a te kaiwhaka-haere

'Kia mau ki te kōura nui'

Whāia ngā hua whaitake, tēnā i te whai i ngā hua iti noa. [1]

He motuhake Te Pātaka Kai o Tīkapa Moana. Ko tāna he whakahaumako i te ao o te tangata. Ko tā mātou he tākaro, he kaukau, he hī ika, he whakataetae ki ōna wai. E hihiko nei mātou i te tirohanga ki ōna whenua me te kaha kōrure o tōna hanga.

Nā ōna aihe, nā ōna tohorā, nā ōna mangō, nā ōna whai me ērā atu momo ika. Nā ngā kōura me ngā wheke i tōia mai i ōna wai. Nā ngā manu o te moana, ngā manu o uta me ngā manu o te wao mōrea i hoki ake i te taparere o korehāhā.

E koa ana mātou ki te mahi tahi ki te whakahaumanu i te kanorau koiora o te whenua me te moana. E pōuri tahi ana hoki mātou i te wā ka tāmate, ka mate rānei ōna taonga motuhake.

Kei ōna takutai ko te whaitua o te tāone nui rawa i Aotearoa me ngā ara whānui o ngā pāmu haumako. He hirahira ōna wai matāwhanga mō te tauhokohoko ki tēnei whenua, arā, ko Tāmaki Herenga Waka tēnā, ko ētahi atu tauranga, herenga waka iti hoki ēnā.

He wāhi e nōhia ana, e mahingia ana, ā, e tautoko nei i ngā hinonga ā-arumoni, ā-tūnuku anō hoki. Me mārama, me whakahaere hoki ngā hononga tuatini pīroiroi o Te Pātaka Kai, o ōna motu me ōna hopuwai hei pupuri, hei tiaki, hei whakapai ake rānei i ōna wāriu mō ake tonu atu.

Ka whakawhiti Te Pātaka Kai i ngā whaitua, i ngā mana ā-rāngai, i ngā rohe whenua, i ngā rohe wai, me ngā ahurea. Nā konā, me pāhekoheko ngā whāinga me ngā rautaki a ngā rōpū whakahaere.

Koinei te whakaputanga tuawhitu o te pūrongo, o Te Āhua o Tīkapa Moana. He mea whai i ngā pūrongo putuputu o mua e whaiere nei ki te mate haere, ki te tāmate haere o te taiao me ngā kupu paremata koretake ki ngā raru maha e pā nei ki Tīkapa Moana.

Hāunga te kaha o te taumaha ki Tīkapa Moana, ko tā te pūrongo nei, kei te kainamu tātou ki te tīmatanga o tētahi wāhanga hou i te pūrākau mō Tīkapa Moana / Te Moananui-ā-Toi / Tīkapa Moana.

Ko te āhua nei kua tata rite tātou ki te tuku i ngā panonitanga hirahira hei whakapai ake i ngā putanga ā-kanorau koiora, ā-taiao hoki.

I te 2021, ka tukuna e te Kāwanatanga ā-Motu ***"Te Whakamāuitanga o Tīkapa Moana: Tā te Kāwanatanga i te Rautaki Huri Moana"***, ā, mai i taua wā, e āta kōkiri whakamua nei te whanaketanga mai o tētahi

Executive summary

Kia mau ki te koura roa.

'Hold on to the big crayfish'

Aim for worthwhile results rather than settling for small gains. [1]

Mussel deployment in Ōkahu Bay © Shaun Lee

The Hauraki Gulf Marine Park is special. It enriches people's lives. We play, swim, fish, and compete in its waters. We are invigorated by its vistas and constantly changing nature. By its dolphins, whales, sharks, rays and other fish life. By the kōura and octopus pulled from its waters. By seabirds, shorebirds and endangered forest birds brought back from the brink. We happily work together to restore island and marine biodiversity. And we are mutually saddened when its special values are degraded or lost.

Its shores contain Aotearoa'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 supports commercial enterprises and transport.

The Marine Park, 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 Marine Park 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.

This is the seventh State of Our Gulf report. It follows a succession of previous reports expressing concerns about environmental loss, degradation and inadequate responses to many of the issues impacting the Gulf.

While pressure on the Gulf remains high, this report suggests we may be close to starting a new chapter in the story of the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. We appear to be on the cusp of delivering important changes to improve biodiversity and environmental outcomes. In 2021, Central Government released ***"Revitalising the Hauraki Gulf: Government action on the Sea Change Plan"***, and since then, has been inching towards the development of a management plan that is tailored to the Gulf's fisheries, and implementing a rautaki whakahaere e hāngai pū ana ki ngā ika o Tīkapa Moana, me te uruhi i tētahi kaupapa e rangiwhāwhā ake ai te hora o Ngā Taiāpure Whakahaumaru i Tīkapa Moana.

Ka whai tēnei i ngā mahi kua aua atu i te ngahuru tau e mahia nei e te Rūnanga, e ngā iwi, e ngā rōpū hapori huhua, me te hunga takitahi.

Ā, kua ono tau ināianei mai i te tukuhanga o Tai Timu Tai Pari – Sea Change Hauraki Gulf Marine Spatial Plan, i tau ai he aratohu e nanaiore nei ki te whakaranea i ngā whakamaru me te whakaheke i ngā pānga hī ika i te Moana.

Heoi, kāore tonu ngā hua i te tino mōhiotia.

Ā, e kore hoki e mōhiotia kia kāhiti rā anōtia ngā MPA kua marohi, kia tūtohia, kia uruhia he mahere ika hei tautiaki, hei whakaora hoki i te pūnaha hauropi o te Moana.

Ko ētahi atu panonitanga nui he pitomata ō roto hei whakapiki i ngā putanga ki te Moana he mea karawhiu nā:

te Mana whenua me ngā rōpū hau kāinga — te whakahaumanutanga o ngā papa kūtai, ko te tono kia whakataiāpuretia te Hākaimangō-Matiatia (Waiheke ki te uru mā raki), ko te rāhui, me te rārangi porotutuki roa mō ngā motu o te Moana e whakatauira nei i ngā mahi tōtika e pahawa ana i ngā mana whenua me ngā hapori.

Te pūnaha whakawā — e hia pīra ā-kōti kua hura mai i ngā hapa tūāpapa o te whakaū i ngā ture rawa me ngā ture ika.

Nā ngā whakatau ā-kōti o nāia tata nei i whakakorea ai ngā taupā nui hei whakahaere i te whānuitanga o ngā pānga ā-taiao i te hī ika, kua tau hoki ngā take e pā ana ki te tika o ngā pārongo e whakamahingia ana ki ngā tatūnga mō te ika, ā, kua whai māramatanga mō ngā whakahauanga whakaaro me ngā pairuri hononga-kore ki ngā tatūnga ika.

Ko ngā pae whakawā motuhake — he nui ngā hua o ngā whakawākanga whakaaetanga rawa taiao.

Hei tauira, o ngā tono e toru kia unua ngā one i Pākiri, e rua i whakakāhoretia e ngā kaikōmihana, ā, ko tētahi whakaaetanga i whāiti.

Kua pīrahia ēnei tatūnga nā reira kāore te whakatau whakamutunga e mohiotia mō tētahi wā.

Ngā kaupapa tūāhanga nui — e koke nei a Te Puna (Taumata Arowai) i āna mahi hanga i te Ara Koti Wai Para, me te whai kia 80% te heke o te rōrahi rerenga wai o ia tau i te hopuwai ara koti wai para rā, hei hāpai i te ngaruru o te taupori o Tāmaki Makaurau, e manawaroa ai hoki ngā wāhanga mōrea o te pūnaha parakaingaki.

proposal to significantly grow the coverage of Marine Protected Areas in the Gulf.

This comes after more than a decade's effort by the Forum, iwi and numerous community organisations and individuals. And it is now six years since the release of Tai Timu Tai Pari – Sea Change Hauraki Gulf Marine Spatial Plan, which provided an ambitious roadmap for increasing protection and reducing fishing effects in the Gulf. Yet, outcomes are still far from certain. And they won't be until the proposed MPAs are gazetted, and a fisheries plan that protects and enhances the Gulf ecosystem is adopted and implemented.

Other notable changes with the potential to improve outcomes in the Gulf have been driven through direct action by:

Mana whenua and local communities — the restoration of mussel beds, an application for the Hākaimangō-Matiatia (Northwest Waiheke) Marine Reserve, rāhui, and the long list of achievements on the islands of the Gulf are great examples of where direct actions by mana whenua and communities are producing change.

The judicial system — multiple court appeals have identified fundamental flaws in the application of resource and fisheries regulation. Recent court decisions have eliminated key barriers to the management of the broader environmental effects of fishing, ruled on the matters related to the adequacy of information being used in fisheries decisions, and provided clarity about mandatory and irrelevant considerations in fisheries decision making.

Independent hearing panels — major resource consent hearings have had consequential outcomes. For example, commissioners declined two of three Pakiri sand extraction consent applications, and gave the other limited approval. These decisions have since been appealed so the final decision will not be known for some time.

Major infrastructure projects — Watercare Services is well into its construction of its Central Interceptor, which is expected to reduce average annual overflow volumes in the central interceptor catchment by 80%, help cater for Auckland's ongoing population growth, and provide resilience to at-risk sections of the sewer system.

Save Our Sands © Andy Bruce / Elevated Media

Te whakarērere waka ki Whitianga e rua rā i muri i te Huripari Gabriele. Avon Hansford

Sailing in Whitianga two days after Cyclone Gabriele Avon Hansford

Heoi, nā ngā take o inā tata nei i kitea ai ngā mōreareatanga me ngā tohu kino ā-hauropi e whakamātautia nei e tātou.

Ko te katinga ohorere te mahinga tipa tērā, ko te putu taunakitanga e pā ana ki te hekenga o ngā kai a ngā kaikonihi matua tērā, ko te taenga mai o te Caulerpa rāwaho tērā, arā, he riha moana kino rawa atu, ā, ko te pānga kikino o te hauota ki Tikapa Moana-o-Hauraki hoki tērā. He tohu nui ēnei whanaketanga kino kua eke te wā, me panoni.

Kei reira hoki te māramatanga ehara te āhuarangi hurihuri i te raru tūrehurehu nō anamata. He tūturu. Kua tae mai. Ka mutu, he nui ngā whakaputanga o āna pāpātanga, me te aha, kātahi anō ērā ka tīmata.

He take ā-ao te āhuarangi hurihuri, ā, he parekura te hua ki tēnā rohe, ki tēnā whenua. Nā ngā tūāhua i te tīmatanga o te 2023, e kitea ana, e tōkeke ai ngā rongoā, me nui ake te haumi i te pūtea, i ngā rawa, i ngā kaimahi me te ārahitanga ā-tōrangapū. He mōrearea rawa te nohopuku, ka mutu, ko tātou ka noho hei utu ki te tawhitawhi te urupare.

Ko te mea whakarapa kē, tē taea te tiaki te Moana mai i te pikinga pāmahana me te oreore mārire o te ao nei.

I tōna tikanga ka mahana ake, ka renga ake, ka waikawa ake, ā, ka hē kē atu ngā wai o te Moana.

Ka mōrearea ake ngā hīrangi, ka kaha ake te karawhiu o ngā āwhā, ka waipuketia te whenua, ā, ka kino kē atu te ngāhorohoro o ngā ākau.

Ka whakaekea mai ko ngā momo pārūrū hou tae ana ki ngā riha me ngā tahumaero, ā, ka neke whakatetonga ētahi momo māori. Ka taea e tātou te mahi e mārohirohi ake ai a Tīkapa Moana ki te āwhā te haere mai nei, mā te whakapai ake i te hauora o te pūnaha hauropi o te Moana.

Heoi anō, me whāwhai te mahi, me whakanui ake hoki.

Ko ngā kaupapa Kāwanatanga ā-Rohe hei panoni i te āhua whakahaere hī ika ki te Moana me te whakarite Taiāpure Whakahaumaru hou ētahi tino rongoā whai tikanga, ka mutu, he iti noa te utu.

Ko te pātai nui, mēnā rānei ka pahawa i ngā whakapōreareatanga tōrangapū.

E tika ana te kōrero, he tino uaua te whakahaere i ngā matū tāoke ki uta, ina koa te whakaputa mai o te parakiwai i ngā tūāhua huarere taikaha.

Ko tā tātau i kite ai i ngā āwha o te tīmatanga o 2023 ko ngā whenua i whenuku, i haruwai hoki i te wai, ka tanuku noa.

Ka ikia ngā kāinga, kōreparepatia ana ngā rori, ā, he awa paruparu i katoa atu ki te moana. Ka haukerekerea ngā kōtuinga waipara, me te aha, katoa ērā atu matū tāoke ka kawea atu ki te moana.

Nā konā tirohia anō ai e tēnei pūrongo ngā paetohu taiao matua, ā, ka tirotiro hoki ki ngā panonitanga o ngā tau e toru kua pahure. Kei raro iho nei te whakarāpopototanga o ngā kitenga matua mō ia paetohu.

However, recent events have underscored the precarious nature of the situation and the ecological tipping points we seem intent on testing. These include the recent emergency closure of the tipa (scallop) fishery, growing evidence about reduced food availability for top predators, the arrival of exotic *Caulerpa*, another serious marine pest, and adverse effects of nitrogen on the Firth of Thames. These negative developments underscore that change cannot come soon enough.

There is also the realisation that climate change isn't some abstract future problem. It is real. It has arrived. Its impacts are highly consequential — and they are just getting started.

Climate change is a global issue with catastrophic, local consequences. Events since the beginning of 2023 demonstrate that resilient solutions are going to require a huge investment in cash, resources, labour, and political leadership. The risks of inaction are now too great to delay our response.

Unfortunately, the Gulf cannot be shielded from the effects of a warming, more energetic planet. The waters of the Gulf are expected to get warmer, more turbid, more acidic, and more contaminated. We can expect lethal heatwaves, stronger storms, land inundation, and increased coastal erosion. We can also expect an insurgence of new subtropical species, including pests and diseases, and the southward shift in some native species.

We can increase the resilience of the Gulf to the coming storm, by improving the health of the Gulf ecosystem. But we must act quickly and at scale. Central Government proposals for changing how fishing is managed in the Gulf, and to create new Marine Protected Areas are an important part of the solution and will cost comparatively little. The big question is whether politics will get in the way of their implementation.

Dealing with land-based contaminants is arguably much harder, particularly for the sediment generated during extreme weather events. As the storms of early 2023 demonstrated, ground that was weakened and saturated by water simply collapsed. Homes were devoured, roads ripped apart, and a river of mud was carried into the sea. Wastewater networks were quickly overwhelmed and all manner of other contaminants were washed into the sea.

It is against that background, that this report relooks at key environmental indicators and examines changes over the past three years. A summary of key findings for each indicator is provided below.

He whakarā-popototanga i ngā panonitanga mai i te tau 2020

Tiakina te pātaka kai

Te mahi hī ika

E ōrite ana te maha o ngā ika e hīa ana mō te tauhokohoko te take. Ko te tapeke o ngā haonga ika ā-arumoni i te takiwā toru tau o nāia tata nei ko te 21,000 t. Ko te tawatawa me te tāmure ngā momo matua e hīa ana i Te Pātaka Kai. He ōrite ngā whiwhinga tāmure, engari e 22% te hekenga o te whiwhinga tawatawa i ngā tau e toru kua pahure.

He mea nui (te 69%) te ngaringari o ngā whiwhinga ā-arumoni i te whai repo i te takiwā toru tau kua pahure.

Kua heke haere te whakamahia o ngā tikanga arumoni e oia nei te papamoana, e 27% te harahara o ngā puhoro papamoana, ā, e 21% te harahara o ngā haonga Teina i te takiwā toru tau o nāia tata nei.

Whai repo / He pākaurua nō Aotearoa ki Te Kohuroa
@Benthics / Frances Dickinson

Te takunetanga o Whakangākautia a Hauraki Echo Valley / Greenpeace

Ngā taiāpure whakahaumaru

Kua tohua mai e te Kāwanatanga ā-Rohe tāna e whai nei kia nui noa atu āna mahi ki te whakapiki i ngā whakamarumarutanga ki Te Pātaki Kai. I marohitia e Te Papa Ātawhai kia 12 Ngā Rohe Matua Hei Tiaki, kia rima Ngā Rohe Papamoana Hei Tiaki, ā, kia whānui kē atu ngā taiāpure e rua o Te Pātaka Kai. Kua marohitia e Tini a Tangaroa te herenga o te puhoro papamoana, te hao ā-Teina me te hirou ā-rēhia hoki i te tipa ki ngā wāhi kua tautuhia, te aukatinga o te hirou ā-rehia i te tipa, ā, te whakahekenga hoki o ngā pānga o te hī kaimoana iti rawa me ngā momo ika tē whāia, me te whakatau rohe hauropi hirahira.

E taea ana e ngā mahere kaunihera ā-rohe te whakatau ngā pānga a ētahi mahi hī ika. Inājia tata nei kitea ai e Te Kōti Pīra tā te Ture Whakahaere Rawa (RMA) taupā kore i te āheinga a ngā kaunihera ā-rohe ki te whakahaere i ngā mahi hī ika, ā, kāore i te hī ika mō ngā take e herea nei e te Fisheries Act (1996) (Fisheries Act). Inakuanei waihangatia ai e Te Kaunihera ā-Rohe o Te Moana a Toi me Te Kauhinera ā-Rohe o Te Tai Tokerau he āpure hī ika-kore nā ā rātou Mahere hei whakamarumaru i ngā wāriu kanorau koiora e hirahira ana. Kāore anō kia whakataungia ērā ritenga ā-ture ki Tīkapa Moana.

Te toitūtanga rāngai ika

Kua pai haere ngā mōhiotanga mō te tūāhua o ngā kōputu ika, engari kei reira tonu ngā āputa. Kua aromatawaihia te tūāhua o ngā kōputu ika pakihau 10 o te 20[a] (e rua atu anō i ērā i te pūrongo o mua).

Ko ngā kōputu o ētahi momo ika me whakahou. I matapaetia, kei raro iho ngā kōputu o te tāmure, o te tarakihi hoki i ngā paetae whakahaere i ngā mahinga ika. I uruhia ētahi whakahekenga hauhake arumoni anō mō te tarakihi i te tau 2022, ā, e whai ana kia haumanu anō te kōputu ki ngā taumata paetae.

E mānenei ana ērā atu kōputu (te tuna, te kahawai, te araara, te tīkati, te kumukumu, te kuparu, te tope me te haku) i ngā taumata paetae.

He iti rawa ngā pārongo e taea ai te tūāhua o ngā rōpū e whitu (te tawatawa, te kanae raukura, te hauture, te hokarari, te makō, te parore me te pātiki) te whakatau.

E toru o ngā momo 20 (ā-taumaha) e hauhake arumoni nei kāore i te momo rahinga-kore (te pukeru, te whai repo, me te nohu) nō reira, kāore anō kia whakatauria te toitū o ngā tepe hao.

[a] Mā te rōrahi hauhake ā-arumoni

Summary of what's changed since 2020

Preserving the food basket

Fishing

We are taking a similar quantity of fish commercially. The total reported commercial catch of fish in the most recent three-year period was around 21,000 t.

Tawatawa (blue mackerel) and tāmure (snapper) continue to be the two main species caught in the Marine Park. Tāmure landings are similar, but tawatawa landings have decreased by 22% over the past 3 years.

A notable (69%) increase in the commercial landings of whai repo (eagle ray) in the past three-year period.

The use of commercial methods that disturb the seabed have declined, with 27% fewer bottom trawls and 21% fewer Danish seines conducted in the most recent three-year period.

Whai repo / New Zealand eagle ray in Mathersons Bay
@Benthics / Frances Dickinson

Show Your Heart for the Hauraki event
Echo Valley / Greenpeace

Marine Protected Areas

Central Government has signalled its intent to take significant actions towards increasing marine protection in the Marine Park. The Department of Conservation has proposed 12 High Protection Areas, five Seafloor Protection Areas, and the extensions of two marine reserves in the Marine Park. Fisheries New Zealand has proposed to restrict bottom trawling and Danish seining to defined areas, exclude commercial scallop dredging from the Hauraki Gulf (except within defined commercial dredging access areas), ban recreational tipa dredging, reduce effects of fishing on undersized and non-target species, and important ecological areas.

Some fishing effects can be addressed through regional council plans. The Court of Appeal recently found that the Resource Management Act (RMA) does not prevent regional councils from controlling fishing activities through their RMA functions, provided they are not doing so for Fisheries Act (1996) (Fisheries Act) purposes. Bay of Plenty Regional Council and Northland Regional Council have recently created new no-take fishing areas under their Plans to protect significant biodiversity values. Such regulatory tools are yet to be applied in the Gulf.

Fish stock sustainability

Knowledge about the status of fish stocks has improved, but gaps remain. The status of 10 of the top 20[a] finfish stocks have been assessed (two more than the previous report).

Stocks of some fish species need rebuilding. Tāmure and tarakihi stocks were estimated to be below fisheries management targets. Additional commercial harvest reductions for tarakihi were implemented in 2022, and the rebuild of the stock towards target levels is expected over time.

Other stocks (skipjack tuna, kahawai, araara (trevally), tīkati (gemfish), kumukumu (gurnard), kuparu (John dory), tope (school shark) and haku (kingfish)) are fluctuating around target levels.

Insufficient information is available to determine the status of seven types of fish (tawatawa (blue mackerel), kanae raukura (grey mullet), hauture (Jack mackerel), hokarari (ling), makō (rig), parore, and pātiki (flatfish)).

Three of the top 20 species (by weight) commercially caught are non-quota species (mirror dory, whai repo (eagle ray), porcupine fish) so sustainable catch limits have not been set.

[a] By commercial harvest volume.

Ngā kōura

Kua kaha te mimiti haere o te rāngai kōura ki Te Pātaka Kai. Kua korehāhā noa atu te kōura ki ngā wāhi kua haoa tuhenetia, ā, e tere nei te rangiwhāwhā kē atu o ngā papa tītōhea o te kina nā te kōpaka o ngā konihi rarahi.

Kei te whakatau rāhui ngā mana whenua ki Waiheke me Aotea hei taupā i te mau o te kōura me ētahi atu kaimoana e tipu mai anō ai ngā kaimoana o te rohe.

I te tau 2017, ka matapaetia, kei raro iho te kōputu CRA2 i te tepe mōkito (te taumata, e ai rā ki te kaupapa here a MPI, e whakatinanahia tētahi mahere whakatipu anō, e ōkawa ana, e herea ana hoki ki te wā kua whakaritea).

I poroa māriretia ngā tepe hao ā-arumoni, ā-rēhia hoki, i te tau hī ika o te 2018-2019 kia tipu anō ai te kōputu.

Hei tā te aromatawai kōputu 2022, i whaihua ngā whakahekenga hao - kua rearuatia te kōputu o te papatipu koiora mai i te tau 2017, ā, i tēnei wā kei runga ake i te tepe mōkito me te paetae taupua mō te kōputu. E kawatautia ana te ngaringari ake o te rāngai i ngā tepe hao o te wā nei.

Ināia tata nei whakataungia ai e Te Kōti Teitei me whai whakaaro a Tini a Tangaroa ki te whānuitanga o ngā pānga hauropi a te hī ika, pēra i te rangiwhāwhā o ngā papa tītōhea kina, i te wā ka whakariteritehia te tapeke o ngā hao ika e āhei ana. I whakahaua te Minita kia tirohia ngā āheinga kaimoana i te mahinga kōura o Te Tai Tokerau (CRA1) i te tau 2023, nāwai rā, ā, ka whakahekengia ngā tepe hao ā-arumoni, ā-rehia hoki.


He anga tipa 📷 Shaun Lee

Ngā tipa

I ngā tau e toru, ki te tau 2021, e 50% te hekenga iho o te rahi o ngā whiwhinga arumoni i hua ai i te tipa i ngā tau e toru i mua atu. I ngā tau e toru, ki te tau 2021, e 39% te hekenga iho o ngā hirou tipa ā- arumoni.

I whakatauria e ngā mana whenua he rāhui kohi tipa huri i Te Rāwhiti o Waiaua, Waiheke, me te raki o Te Pātaka Kai tae atu ki Aotea, i mua i tā Tini a Tangaroa kati i te mahinga ika o Waiaua.

Ki tā ngā rangahau o te tau 2021, e 82% te hekenga iho o te nuinga o te papatipu koiora o te tipa mai anō i te rangahau o te tau 2012. Atu i ētahi pae iti i Te Hauturu-o-Toi me Te Korou o Colville, katoa, katoa, ngā mahinga ika o Waiaua me Te Tai Tokerau i kati i te Āperira o te tau 2022.

Ko ngā kitenga i ngā rangahau turuki, i roto i te kotahi tau, e 37-85% te hekenga iho o te papatipu koiora ki aua kōpure wātea e rua e toe ana, ā, i muri iho, ka kati hoki i te Tīhema o te tau 2022. I te Māehe o te tau 2023, ka kati te mahinga ika ki Waiaua mō ake tonu atu.

I kati ngā mahinga ika o Te Tai Tokerau me Waiaua i muri i te katinga o te mahinga ika ki Whakatū/ Wairau i te tau 2016, nō reira, kua korekore nei ngā mahinga tipa nunui ki Aotearoa.

Ngā tuangi

Nā te kohi mātaitai me ngā āhuatanga ā-taiao i mimiti ai ngā tuangi e pai ana kia kohia. Huri i te ao, kua tauheke te kiato o ngā tuangi e pai ana kia kohia (>30mm) i ngā tau e 20 kua pahure, i ngā wāhi kua aroturukihia, ā, e whakaaengia ana te kohi. Ko ngā wāhi e ngaringari nei te tuangi e pai ana kia kohia, ko Umupuia me Okokino, kei reira hoki ngā rāhui kohikohi i te roanga o te tau, heoi, kāore i te pērā ki Whangateau ahakoa 12 ngā tau e rāhuitia ana te kohikohi ki reira.

Mā te āhuarangi hurihuri e kaha kē ake ai te tāmitanga o ngā rāngai tuangi, i te ākinga pūputu a te pāmahana teitei me ngā parakiwai, matū tāoke hoki ka pū ake i a parawhenuamea.

Te matematenga

Tērā tonu pea, ka kaha ake te kitea noatia o te matematenga o ngā ika, o ngā mātaitai me ngā manu o te moana i ngā pānga o te āhuarangi hurihuri. I ngā tau e toru nei, inā noa atu ngā hautai kua matemate, ā, kāore he kōrero i mau mō tērā āhuatanga i Te Pātaka Kai i mua rā.

Te kapoke kino, te kapoke pōrearea

Ko ngā kēhi tuatahi o Aotearoa, i kitea ai te tāhawahawatia o ngā mātaitai na ngā kapoke kino, i tuhia i te tau 1992. Mai i taua wā, 19 ngā pūkohu ngaruru kino kua kitea ki Te Pātaka Kai, me te aha, ka rāhuitia, ka tukuna rānei he whakaohiti tūmatanui.

Te ahumoana

Kei te tipu tonu te ahumoana ki Te Pātaka Kai, i te whakaaetanga o tētahi pāmu kūtai e 221 ha i ngā tau e toru kua pahure. E whakaritea ana hoki ngā tono i te 116 ha hei pāmu tārore i ngā punua mātaitai, i te 46 ha hei pāmu mātaitai, me te 300 ha hei pāmu raupapa rauropi (tae ana ki ngā ika pakihau).

E kawatautia ana te tipu ake anō o te ahumoana. Ko tā Te Rautaki Ahumoana a te Kāwanatanga ā-Motu e whai nei, ko te whakarahinga ake i te ahumahi mai i te $600+ miriona o te te whakaputa hokonga ā-motu kia $3 piriona te whakaputa hokonga i mua o te tau 2035.

Crayfish

The kōura (crayfish) population in the Marine Park has been substantially reduced. Kōura are now regarded as functionally extinct in heavily fished areas and kina barrens are expanding rapidly due to the lack of large predators.

Rāhui are being used by mana whenua around Waiheke and Aotea to prevent the harvest of kōura and other kai moana to allow local populations to rebuild.

In 2017 the CRA2 stock, which encompasses the Marine Park, was estimated to be below the soft limit (the level at which it is MPI policy to implement a formal, time-constrained rebuilding plan). Substantial cuts were made to commercial and recreational catch limits in the 2018–19 fishing year to allow the stock to rebuild. The 2022 stock assessment indicates that catch reductions have been effective—the stock biomass has doubled since 2017 and is now above the soft limit and interim target for the stock. Further population increases are expected at current catch limits.

The High Court recently ruled that Fisheries NZ are required to consider the wider ecological impacts of fishing, such as the expansion of kina barrens, when setting the total allowable catch. The Minister was ordered to review the catch allowances for the Northland kōura fishery (CRA1) for 2023, and subsequently, the commercial and recreational catch limits were reduced.


Tipa (Scallop) shell 📷 Shaun Lee

Scallops

Commercial tipa landings in the three years up to 2021 decreased by 50% from the previous three years. The number of commercial tipa dredge tows in the three-year period to 2021 was 39% lower than the previous three years.

Rāhui were implemented by mana whenua around East Coromandel, Waiheke, and the northern part of the Marine Park, including Aotea, on the harvest of tipa prior to the closure of the Coromandel fishery by Fisheries NZ.

Surveys conducted in 2021 found the overall tipa biomass had decreased by 82% since the previous survey in 2012. The entire Coromandel and Northland fisheries were closed in April 2022, except for two small areas around Te-Hauturu-o-Toi and Colville Channel. Follow up surveys found that the biomass in these two remaining open areas had decrease by 37–85% within one year, and subsequently, they were also closed in December 2022. In March 2023, the Coromandel fishery was closed indefinitely.

Closure of the Northland and Coromandel fisheries follows the closure of the Nelson/Marlborough fishery in 2016 and means that Aotearoa no longer has any substantial tipa fisheries left.

Cockles

Shellfish gathering and environmental factors have reduced the availability of harvestable tuangi. There has been a universal decline in the density of harvestable (>30 mm) tuangi (cockles) over the last 20 years at the monitored sites where harvesting is allowed. Increases in harvestable tuangi have occurred in Umupuia and Eastern Beach where year-round harvesting bans are in place, but not at Whangateau despite a 12-year harvesting ban.

Climate change will add increasing stress to tuangi populations as they are more frequently subjected to higher temperatures and large loads of sediment and contaminants from flood events.

Mass mortalities

Mass mortalities of fish, shellfish and seabirds are likely to become increasingly common due to the impacts of climate change. In the last three years, mass mortalities of sponges have occurred due to prolonged marine heatwaves.

Harmful and nuisance algae

Aotearoa's first recorded cases of shellfish poisoning caused by harmful algae occurred in 1992. Since then, 19 harmful algal blooms have occurred in the Marine Park that resulted in harvest closures and/or public warnings.

Aquaculture

Marine farming continues to increase in the Marine Park, with consent granted for a new 221 ha mussel farm and a 300 ha multitrophic farm (including finfish) in the last three years. Applications are also underway for 116 ha of spat catching farms and 46 ha of shellfish farms.

Further growth in aquaculture is expected. Central Government's Aquaculture Strategy seeks to grow the industry from one that produces $600+ million in annual sales nationally, to $3 billion in sales by 2035.

Pae Uta ki Pae Tai

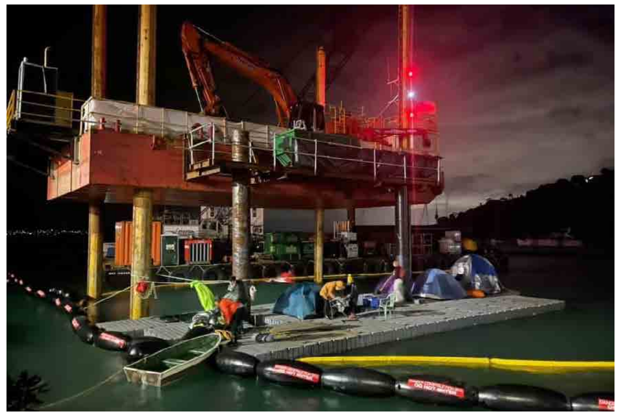
Te whakawhānuitanga atu ki te moana

Ko ngā whakawhanaketanga matua ki te moana kua whakaaengia i ēnei tau e toru nei: ko te aratini ki Te Whau, ko te whakaaetanga mā Tāmaki Herenga Waka hei hirou waihanga, hei hirou whakatika hoki i te hawai o Rangitoto, ko te whakahoutanga i te whanga o Te Ariki Tahi, me te hanganga houtanga o te Whaitua o te Moana o Kōpū.

Kua pīrahia ngā tatūtanga mō ngā tono e toru hei huke i tua o Te Tāhuna o Pākiri.

Neke atu i te 3000 ngā whakaaetanga kua tukuna i ngā tau e toru kua hipa hei hanga whare noho hou kāore nei e 200 m te tawhiti mai i te takutai o Tāmaki Makaurau.

Kua komoa he tono hei panoni i tētahi mahere tūmataiti e āhei ai te whanaketanga o te 200 ha whenua takutai i Kahawairahi.



Te Herenga Waka o Pūtiki - Te Motu Ārairoa
Bianca Ranson / Protect Pūtiki

Te mautohe huke onepū
Andy Bruce / Elevated Media

Ngā matū tāoke

Kei te Waitematā me te Wahapū o Tāmaki ngā pae teitei rawa atu mō te tāhawa konganuku. E hia kē ngā takotoranga o aua wāhi he tahetoka (he āhua ngāwari) rānei, he whero (he kaha) rānei te taumata o te konukura, o te konuoi, o te konumatā me te konutea.

I te nuinga o te wā, he iti noa ngā pae o ngā tino matū tāoke o ngā parakiwai nō ngā wahapū i ngā riu hopuwai o tuawhenua. Hāunga ia ko te hautea o ngā wāhi i Te Tara o Te Ika a Māui kua roa e hukea ana (Tairua, Waiaua, Pārāwai), me ngā wāhi Whakateraki i Te Waitematā. I aua wāhi, kei te pae tahetoka, kei te pae whero rānei ngā kukū o te konukura, o te konumatā, o te konutea, o te konuioi anō hoki. E upa ana te kounga o ngā parakiwai i te nuinga o ngā wāhi e 41 kua aroturukitia. E rua ngā wāhi kua hē kē atu te konumatā, ko tētahi he kino ake te konukura, kotahi e kino kē ana te konutea, ā, e rua ngā wāhi kua pai ake te konutea.

Ngā taiora

Ko ngā utanga hauota nunui rawa ki Te Pātaka Kai e ahu mai ana i ngā awa e rere nei i Pare Hauraki. I waenganui i ngā tau 2011 me te 2020, ko tōna 3,730 t i ia tau te utanga hauota i ngā awa o Hauraki. Hei whakataurite, ko te utanga i ngā taupuni whakatika waipara kaitā e rua i te rāwhiti o Tāmaki Makaurau he 245 t i ia tau, ahakoa 120 t i ia tau te rukenga i te awa matua o Tāmaki Makaurau.

Tapeke rawa ake, 10% te pikinga tōpū o te utanga hauota o ngā tau 2011-2020 i ērā o ngā tau tekau i mua atu, ahakoa e 27% te hekenga o te utanga pūtūtaewhetū. Tērā tonu pea, nā te ngaringari o te marara o ngā matatiki ahuwhenua i ngaringari ai te tapeke hauota, ā, i heke ai te tapeke o te pūtūtaewhetū nā te iti haere o te puta i ngā matatiki takitahi pērā i ngā rukenga waipara kua whakatikahia.

Ākene pea, mā te ahumoana e nui ai te ngaringari ake o ngā utanga hauota. Ko tā te Mahere ā-Rohe o Waikato he whakarato āheinga rukenga hauota 1,100 t pea te rahinga i ia tau mā ngā pāmu ika. Ko ngā āheinga tūturu ka whakaarongia ā te wā e tatū ai ngā tono.

E heke haere ana te pānga o te hauota e tukuruatia ana ki te taiao (te tuku hauota) i te kokoru o Tīkapa Moana. E hāpai nei ngā taiora uru kaha kia iti ngā pae hāota, kia ngaringari ake te pūkawatanga, ā, kia heke iho te tuku hauota ki ngā papamoana.

Mountains to sea

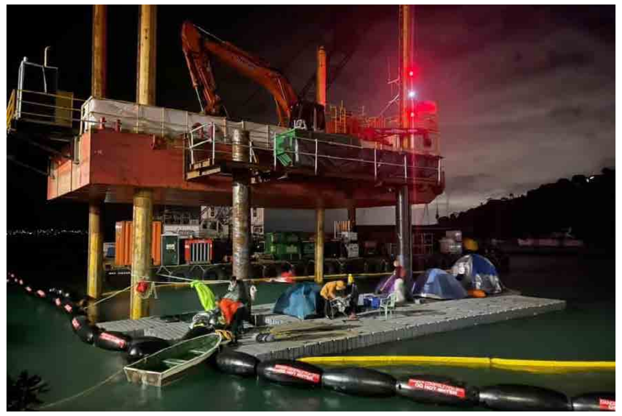
Coastal urban and ocean sprawl

Significant coastal developments that have been granted consent over the past three years include: the Te Whau shared pathway, Ports of Auckland capital and maintenance dredging consent of Rangitoto Channel, an upgrade of the Te Ariki Tahi Sugarloaf Wharf, and redevelopment of the Kōpū Marine Precinct.

Decisions on three consents for sand mining off Pakiri Beach have been appealed.

Over 3000 building consents for new residential buildings within 200 m of the coast were issued in Auckland over the past 3 years.

Application for a private plan change to provide for the development of 300 ha of coastal land at Beachlands lodged.



Kennedy Point Marina - Waiheke Island
Bianca Ranson / Protect Pūtiki

Sand mining protest Andy Bruce / Elevated Media

Toxic chemicals

Waitematā Harbour and Tāmaki Estuary have the highest levels of metal contamination. Multiple sites in those areas are in the amber (moderate) or red (high) ranges for copper, mercury, lead and/or zinc.

Generally, sediments from estuaries with mainly rural catchments have low levels of key metal contaminants. The exceptions are a scattering of sites on the Coromandel Peninsula associated with historic mining activity (Tairua, Coromandel and Thames), and sites in the Upper Waitematā Harbour. At those locations, copper, lead, zinc, and/or mercury concentrations are in the amber or red ranges.

Sediment quality at most of the 41 sites monitored over the past three years have been stable. Two sites have worsened for lead, one site has worsened for copper, one site has worsened for zinc, and two sites have improved for zinc.

Nutrients

Greatest loads of nitrogen to the Marine Park come from rivers draining the Hauraki Plains. Between 2011 and 2020 total nitrogen loads from Hauraki rivers were estimated to be 3,730 t per year. In comparison, the load from Auckland's two largest, east coast wastewater treatment plants is around 245 t per year, while Auckland's largest river has been estimated to discharge around 120 t per year.

The combined total nitrogen load was 10% higher in 2011–20 compared to the previous decade, while total phosphorus load decreased by 27%. The increase in total nitrogen is likely due to increases in diffuse agricultural sources, while the decrease in total phosphorus is mainly due to decreases from point sources, such as treated wastewater discharges.

The recently consented multitrophic farm in the Coromandel Marine Fish Zone will substantially increase nitrogen loads, with a consented discharge of up to 800 t of nitrogen per year.

The rate that nitrogen is being recycled back to the atmosphere (denitrification) in the Firth of Thames is decreasing. High nutrient inputs are promoting low oxygen levels, increased acidification, and decreased denitrification in bottom waters.

Te toitūtanga o te wai hei wai kaukau

I waenganui i te tau 2019 me te 2022, ko te 25% o ngā tāhuna i Tāmaki Makaurau i matapaea rā he wāhi kauhoe haumaru-kore nā te tūraru hauora e kitea ana i te 10% o te wā, ā, ko te 4% o ngā tāhuna i matapaea he wāhi kauhoe haumaru-kore i koni atu i te 20% o te wā. E rua ngā wāhi e whakaarohia ana he haumaru-kore mō te kauhoe i ngā wā katoa.

I te rohe o Waikato, 12 ngā wāhi e pai nei te kounga o te wai, he iti iho i te 5% ngā tīpakotanga i pahika i te keu pae Whakatakataka. E rua ngā wāhanga o te wahapū (Te Awa o Waitoko me te Piriti o Te Awa o Pepe) i te Whanga o Tairua kei te 16 ki te 22% o ngā tīpakotanga i pahika i te keu pae Whakatakataka.

E haere tonu ana ngā mahi hanga i te Ara Koti Waipara. Hei konei, ka 80% te heke haere o te toharite o te rahinga pūhake waipara ā-tau i te riu hopuwai kino rawa atu ki Tāmaki Makaurau.

Te oranga o te parakiwai me te papamoana

He nui ngā uru parakiwai i ētahi wahapū. E kitea ana tēnei tūāhua i te ngaringari o te hautanga paru me te one rauiti i ngā wāhi maha i aroturukitia rā i te tekau tau kua pahure.

E 38% o ngā wāhi, i aroturukihia rā i Te Pātaka Kai, e pai ana, e tino papai ana rānei te oranga papamoana. Ko ngā wāhi e ora nui ana ko ērā kei waho atu o Waiwera, o Pūhoi, o ngā wahapū i Ōrewa me Okura, engari ko ngā wāhi kei raro iho te kounga, ko ērā kei roto mai i te Waitematā, i Te Awa o Tāmaki, i Mangemangeroa Awa, me Te Awa o Weiti.

Ko tā ngā raraunga paetawhiti i ēnei tau 10-20 kua hipa e whakaatu nei i te pai ake o te oranga papamoana o ngā wāhi e rua i Te Whanga o Tairua (te roma o Oturu me te kokoru o Pepe), ā, e whā ngā wāhi (Pūkorokoro, Manaia Rd ki Te Whanga o Tairua, Awataha, me Motu Pākihi ki te Waitematā) kua tauheke. Ko te nuinga o ngā wāhi kīhai i kitea te pūmau o te ia i ngā tekau tau kua pahure.

Ngā mānawa

Kua ngaringari ake te horanga o te mānawa ki ngā wahapū kua aroturukihia i ngā tau e 30 kua pahure. 1.2% te pikinga o te horanga toharite i ia tau, ā, ko te tino pikinga i kitea i Pūhoi (3.5% i ia tau) me Tairua (3% i ia tau). I ētahi atu wahapū, pērā i Whitianga, he iti noa iho te panoni o te horanga ki te takiwā, engari kua ngaringari kē ake te apiapi o te mānawa.

Ko tā Ngā Paerewa Taiao ā-Motu mō Te Wai Māori 2020 (NES-FW) e whakaatu ana i te āpiti whakamarumarutanga ki ngā kūkūwai māori, tae atu ki ngā mānawa, kei waho atu i Te Taiāpure. Ko tā ngā paerewa he whakatina i ngā mahi pērā i te tango mānawa, i te rukenga me ngā manioro e kātata ana ki ngā ngahere mānawa.

Te Awa o Piako © Shaun Lee

Piako River © Shaun Lee

Suitability of water for swimming

Between 2019 and 2022, 25% of Auckland beaches were predicted to be unsafe to swim due to potential health risks for more than 10% of the time, and 4% of beaches were predicted to be unsafe to swim for more than 20% of the time. Two sites are considered to be unsafe to swim all of the time.

In the Waikato Region, 12 sites had good water quality, with less than 5% of samples exceeding the Action level trigger. Two estuarine sites (Grahams Stream and the Pepe Stream Bridge) in Tairua Harbour exceeded the Action level trigger in 16–22% of samples.

Work is progressing on the construction of the Central Interceptor. This should reduce the average annual overflow volumes in Auckland's worst catchment by 80%.

Sediment and benthic health

High sediment inputs occur in some estuaries. This is reflected in the increasing proportion of mud and very fine sand at many monitored sites over the last decade.

38% of monitored sites in the Marine Park have good or extremely good benthic health. The healthiest sites are in the outer areas of Waiwera, Pūhoi, Ōrewa and Okura estuaries, while the poorest quality sites are in the inner areas of the Waitematā Harbour, Tāmaki Estuary, Mangemangeroa Estuary and Weiti River.

Longer term data for the last 10–20 years show that two Tairua Harbour sites have improved in benthic health (Oturu Stream and Pepe Inlet), and four sites (Miranda, Manaia Rd in Tairua Harbour, and Shoal Bay and Herald Island in Waitematā Harbour) have declined. Most sites show no consistent trend over the last decade.

Mangroves

Mānawa coverage has increased in monitored estuaries over the last 30 years. Average cover increased by 1.2% per year, with the greatest increase in Pūhoi (3.5% per year) and Tairua (3% per year). In other estuaries such as Whitianga there has been little change in area covered, but mānawa density has greatly increased.

The National Environmental Standards for Freshwater 2020 (NES-FW) provides for additional protection of natural wetlands, including mānawa, outside of the Coastal Marine Area. The standards restrict activities such as mānawa removal, and discharges and earthworks near mānawa forests.

Te Kanorau Koiora

Te kanorau koiora ā-moutere

He punanga ngā motu riha-kore mō ngā manu māori me ngā kararehe. I tēnei wā, e 42 ngā motu i Te Pātaka Kai kua kore he riha whāngote mohoao, i eke ai te tapeke ki te 10,700 ha. Nō te 2020 tauākītia ai a Rakitu hei wāhi riha-kore.

Kāore i ārikarika te tāmata anō i te māheuheu ki runga o Motuora me Rotorua i ēnei tau nei. Kua pai haere te ora o te kiwi me te pōpokatea i te 'Tūraru-Tauheke' ki te 'Te Whakaraerae Kore' i te aromatawai whāomoomo o te tau 2021.

Ko ngā whanaketanga mai i te pūrongo o mua o Te Āhua o Tīkapa Moana ko:

- te tauākī he riha-kore Te Motu o Rakitu;
- te uakitanga o Tū Mai Taonga nā Te Poari o Ngāti Rehua Ngātiwai ki Aotea, he kaupapa e kore ai te tori mohowao me te rīroi i te motu o Aotea;
- tā Te Kaunihera o Tāmaki Makaurau, tā Ngāti Manuhiri hoki me ētahi hoa pakihi, uaki kaupapa i tipi haurarotia ai ngā rīroi, ngā toriura, ngā paihamu me ngā warapī i Te Kawau Tūmāro o Toi;
- te kōkuhunga o ētahi whakamarumaru āpiti ki Te Mahere Whakahaere Riha o Tāmaki Makaurau 2020-30, a ka whai wāhi atu ngā kaupapa e aro ana ki te kaupare i te taunga mai o ngā taru kino hou, o ngā ika, o ngā manu, me ngā mokopeke ki Aotea;
- he whakahou i Te Pānui Whakamatua o Tīkapa Moana e kaha ake ai ngā tikanga whakamarumaru mō te Moana, i raro tonu i te Ture Haumaru Koiora.

Te tohorā

Mai anō i te tau 2014, kāhore he tohorā i mate i te tukinga ōna e te kaipuke ki Te Pātaka Kai.

Kei te Taumaha ā-Motu te noho o te tohorā i te tūnga whāomo. Kei reira tonu ngā māharahara mō te āhei o te tohorā ki te tiki kai e rawaka ana. I roto i te tekau tau kua hipa, kua whakawhiti ngā tohorā i te kai ika mororiki nō te aumoana ki te kai i te meroiti, otirā, he iti iho te kiato o te taiora. Ko tēnei whakawhitinga kai he tohu pea i te tauheke o te rahinga ika mororiki nō te aumoana i Te Pātaka Kai.

Tohorā (Bryde's whale) Jo Logan

Ngā manu o te moana

18% o ngā manu o te moana e whakaputa uri ana ki Te Pātaka Kai kei te Whakaraerae, ā, e 67% kei te Tūraru.

Ko te āhua nei, i ngā tau o nā noa nei, ko ngā manu kai ki uta pērā i ngā kawau, i ngā hoiho me ngā karoro, e whakakohukitia ana i te kaha panoni o te tūāhua o ētahi momo, otirā, ko ngā manu kai ki tai ket te āhua pai ake i Te Pātaka Kai. Kua hē kē atu te tūāhua whāomoomo o te pārekareka, o te kawaupaka, o te kawau tūī me te rako, heoi anō rā, kua tino pai ake te tūāhua o te toanui me te tarāpuka.

Tākoketai Shaun Lee

Kua āhua ngaringari ake ngā aituā nā te hī i te tākoketai, i te toanui hoki i te rāwhiti-mā-raki o Aotearoa mai i te pūrongo ō mua. Ko ngā pānga hopu tākoketai o te wā kāore tonu pea i te toitū, ko tōna 70% pea te nui ake o ngā aituā hao ika arumoni ā-tau i ō te āheinga o te kāhui tākoketai e whakaraerae ana ki te tautīnei.

Ngā manu o tātahi

E whā ngā manu o tātahi e noho nei ki Te Pātaka Kai kua pai haere i te tūnga whāoma i te tau 2021 (te ngutu pare, te huahou, te pohowera, me te tōrea pango), ā, kāore i tauheke te tūāhua o tētahi mea kotahi.

Ngā taonga o tāwāhi

He kōrero kua mau mō te 157 o ngā momo nō ngā moana o tāwāhi kua tae mai ki Te Pātaka Kai. Ngahuru mā tahi ngā momo hou nō tāwāhi kua tae mai ki Te Pātaka Kai i ēnei tau e toru nei, otirā, o aua momo ka tautapatia ngā rimu rāwaho Caulerpa brachypus me te Caulerpa parvifolia hei rauropi waingaio nā te tūpono whakawehi mai.

10 ngā riha moana i tāpirihia e Te Kaunihera o Tāmaki Makaurau ki tā rātou Mahere ā-Rohe Whakahaere Riha 2020-30, ā, kua rāhuitia te nekeneke a aua riha moana i Te Pātaka Kai e tū nei i te rohe o Tāmaki Makaurau. Ko te herenga o te mahere e mea ana kia kōmāmā noa iho te koiora hēhē i ngā waka o te hunga nō rātou aua waka.

E whāia nei e ngā kaunihera ā-rohe o Te Tai Tokerau, o Tāmaki Makaurau, o Waikato me Te Moana a Toi he Mahere Takere Mā e ngātahi ana, kia rite tonu ai ngā tikanga takere hēhē o ngā waka, hei āwhina i te whakahaeretanga o te horapa o ngā riha moana huri i te tūāraki o Aotearoa.

Biodiversity

Island biodiversity

Pest-free motu (islands) provide sanctuaries for native birds and animals. Currently 42 motu in the Marine Park are free of wild mammalian pests, totalling around 10,700 ha.

Significant revegetation has occurred on Motuora and Rotoroa in recent years.

North Island brown kiwi and pōpokatea (whitehead) have improved from 'At Risk–Declining' to 'Not Threatened' in the 2021 conservation assessment.

Developments since the previous State of Our Gulf report include:

- Rakitu Island being declared pest-free;
- Ngāti Rehua Ngātiwai ki Aotea Trust launched Tū Mai Taonga, an initiative to make Aotea free of wild cats and rats;
- Auckland Council, Ngati Manuhiri and partners launched an initiative to eradicate rats, stoats, possums and wallabies from Kawau Island;
- the introduction of additional protections under Auckland's Regional Pest Management Plan 2020–30, including programmes aimed at preventing the establishment of new pest plants, fish, birds and reptiles on Aotea;
- an update of the Hauraki Gulf Controlled Area Notice to strengthen legal protections for the Gulf under the Biosecurity Act.

Bryde's whales

No Bryde's whales have been killed by ship-strike in the Marine Park since 2014.

The conservation status of Bryde's whales remains Nationally Critical. Concerns remain about the ability of whales to obtain sufficient food. Over the past decade, Bryde's whales have switched from mainly eating small pelagic fish to eating zooplankton, which are less nutritionally dense. This change in diet may indicate a decline in small pelagic fish abundance in the Marine Park.

Tohorā (Bryde's whale) Jo Logan

Seabirds

18% of seabirds that breed in the Marine Park are Threatened, and 67% are At Risk.

Inshore feeders such as shags, penguins and gulls appear to be particularly impacted in recent years with large shifts in the status of some species, while seabirds that feed in offshore waters appear to be improving in the Marine Park. Pārekareka (spotted shags), kawaupaka (little shags), kawau tūī (black shags) and rako (Buller's shearwaters) have worsened in conservation status, whereas toanui (flesh-footed shearwaters) and tarāpuka (black-billed gulls) have made large improvements in status.

Tākoketai Shaun Lee

Tākoketai (black petrels) and toanui fishing fatalities in northeastern Aotearoa have increased slightly since the last report. Current tākoketai capture rates are unlikely to be sustainable with an estimated 70% likelihood that annual fatalities from commercial fishing are greater than what the population of threatened tākoketai can sustain.

Shorebirds

Four shorebirds that live in the Marine Park have improved in conservation status in 2021 (ngutu pare (wrybill), huahou (lesser knot), pohowera (banded dotterel) and tōrea pango (variable oystercatcher)), while none have decreased in status.

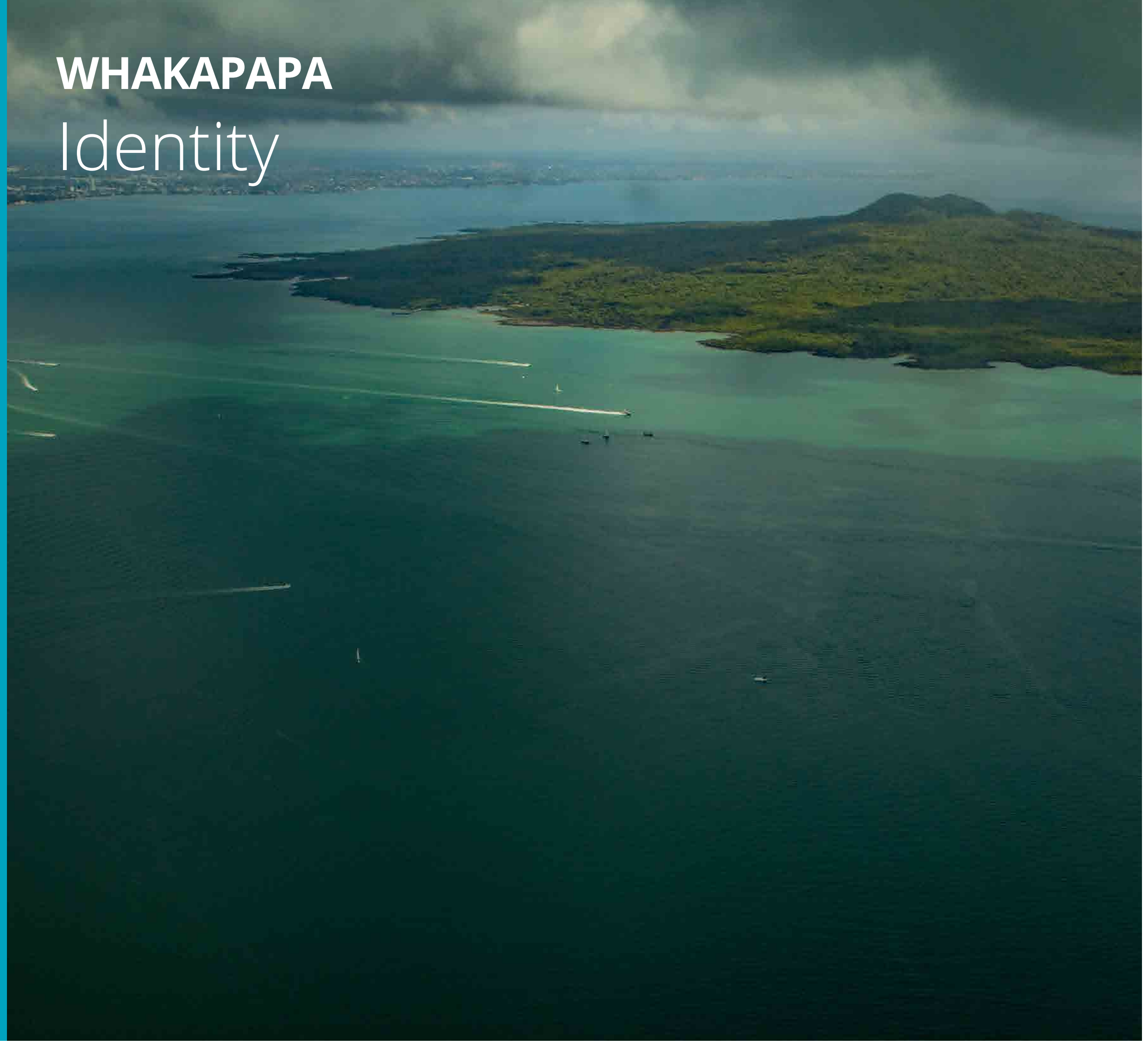
Marine non-indigenous species

Around 157 non-indigenous marine species have been recorded in the Marine Park. Eleven new non-indigenous species have arrived in the Marine Park over the past 3 years, of which, *Caulerpa brachypus* and *Caulerpa parvifolia* were designated as unwanted organisms due to their potential threat.

Auckland Council added 10 marine pests to their Regional Pest Management Plan 2020–30, and has prohibited the movement of those marine pests within the Marine Park that lies within the Auckland Region. The plan requires all boat owners to have no more than light biofouling on their vessels.

Northland, Auckland, Waikato and Bay of Plenty regional councils are currently working towards a shared Clean Hull Plan, which would provide a consistent set of rules relating to hull fouling on vessels and help manage the spread of marine pests around northern Aotearoa.

WHAKAPAPA
Identity



Rangitoto Island Shaun Lee

Whakapapa lies at the centre of Te Ao Māori (the Māori world view). It links te hunga tangata (mankind) with te taiao (the environment). It binds a child to its parents, grandparents, siblings, cousins, uncles and aunties, and back through time to distant tīpuna. To names and places; to the land and sea. To plants, birds, fish and other creatures. And further back to the deities at the core of Māori spiritual beliefs. Ultimately to Rangi (Sky father) and Papatūānuku (Earth mother). Our collective whakapapa is etched into the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. Our actions, those of our tīpuna, and those of natural processes, have shaped the Gulf we see today.

The Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf is ancient. It has been moulded by powerful natural forces. Some explosive, such as the volcanoes that produced motu (islands), roto (lakes), maunga (mountains) and toka (reefs). These include the many maunga of Tāmaki Makaurau and Moehau (Coromandel Peninsula). Motu such as Rangitoto and Te-Hauturu-o-Toi. Others involved the power of time, sun, wind and water to slowly weather features away, leaving only remnants of once grand formations, or exposing ancient rock that was once buried deep within the earth. Seas have risen and fallen, great rivers have been diverted, and sand and mud have washed into the sea and slowly accumulated—often far from their points of origin.

The original plants and animals of Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf also had an ancient lineage. Some, like the tuatara directly whakapapa back to Gondwana, the distant ancestor of Aotearoa. Others evolved over many thousands, if not millions, of years to create a unique assemblage of species found only here. The ancient forests and seas teemed with life. Great shoals of fish, together with seals, sharks, whales and dolphins swarmed the ocean, while flocks of seabirds swirled above. Vast beds of kūtai (mussels), tio (oysters), tipa (scallops), tuangi (cockles), pipi and kina (sea urchins) peppered the seabed and toka (reefs), while masses of kōura (crayfish) roamed the toka and sandflats, gathering together to release their larvae, search for food, and mate.

Moko pirirākau (Forest Gecko) Shaun Lee

Forests covered much of the land. Forests of kauri, tōtara, rimu, pūriri and a myriad of other species. Kahikatea-lined wetlands stretched across the southern shores of the inner Gulf and for miles into the hinterland of the Hauraki Plains. Birds, reptiles, and insects of all shapes and sizes flew, slithered, wandered, waded or swam, free from the threat of mammalian predators.

This is the world that Māori of the first ancestral waka encountered when they entered and settled in and around the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. The history of Māori settlement, occupation and events during the centuries that followed is recorded in waiata (song) and kōrero tuku iho (oral tradition); in the names of landmarks, waters, pā and kāinga; and in wāhi tapu. It can be seen in the physical footprints of trenches, terraces, storage pits, and middens left on the land. It is reflected in the mātauranga (knowledge) and tikanga (customs and practices) developed through centuries of occupation and experience. It is lived through the relationships that iwi, hapū and whānau have with their lands and environment.

The iwi and hapū within the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf rohe (region) are numerous and fiercely independent of each other. This is not unusual, as one size does not fit all in Māoridom. Each have their own stories, their own whakapapa and their own traditions, even if some overlap.

The diversity of tangata whenua in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf includes:

- Ngāti Wai, Ngāti Manuhiri and Ngāti Rehua—the rohe stretching from around Whāngārei to Aotea (Great Barrier Island) and Te Hauturu-o-Toi (Little Barrier Island) and back to Warkworth;
- Ngāti Whātua ō Kaipara, Ngāti Whātua ō Ōrākei and Te Uri ō Hau—covering the rohe Kaipara Harbour to Mahurangi and into Central Auckland;
- Te Kawerau-ā- Maki, Ngāti Te Ata Waiohua, Ngāti Tamaoho, Ngāi Tai ki Tāmaki, Te Ahiwaru and Te Akitai Waiohua—from the mouth of the Waikato River to the western beaches north of Auckland, across the Auckland isthmus and inner islands back to the northern Kaiaua coastline;
- Ngāti Hako, Ngāti Hei, Ngāti Porou ki Harataunga ki Mataora, Ngāti Pūkenga, Ngāti Rāhiri Tumutumu and Ngāti Tara Tokanui—the Hauraki rohe;
- The Marutuahu Confederation consisting of Ngāti Maru, Ngāti Tamaterā, Ngāti Paoa, Ngāti Whanaunga and Te Patukirikiri—the Hauraki rohe extending toward Tauranga;
- Waikato-Tainui—whose interests date back to the landing of the Tainui waka in Tāmaki Makaurau before journeying south.

The Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf that Māori first encountered had already changed by the time Europeans arrived around 200 years ago. The new arrivals brought different perspectives, different values, and new governance systems. New knowledge and technology. New plants and animals. They also had the ability to accomplish previously unimaginable feats of engineering and extraction. Step-by-step, decade by decade, the lands and ocean were progressively transformed by the generations that followed. By the 1990s, we had drastically altered the ecosystem. Gone were great swarms of spawning mature tāmure (snapper) that greeted Māori when they first arrived. Gone were shellfish beds that once blanketed the seabed. Gone was the vast Hauraki wetland. Gone were moa, snipe, huia and other birds, whose calls will never again be heard. And still, new and diverse pressures were facing the region. Tāmure stocks had recently reached an all-time low, concerns were growing over a 'gold-rush' for aquaculture space, our population was


Changes in the Gulf
pre-1200
1200-1800
1800-1950
1950-2000
2000 ...
The Gulf is pristine
Māori used fire to clear forests from large parts of the country
Remnants of bush that still remained in steep gullies
Dairy cow numbers in the Waikato aproach 140,000
Sediment rates in FOT 1878-1918 were 750% higher than today
More than 1 million cows producing effluent in the Waikato
24% of Auckland Harbour had been claimed by coastal structures by 1983
Escalating climate change impacts
Restoration efforts are increasing
Crayfish in rockpools
75% of wetlands drained in the Waikato
Waitematā catchment has 106 closed landfills, many leech
Human population of Aotearoa c100,000
Human population of Aotearoa approaches 2 million
Human population of Aotearoa approaches 4 million, sewage a significant pollutant
More stringent fishing, biosecurity and pollution rules
Abundance of seals, whales and sharks
More than 1500 km of shellfish beds remain
Shellfish beds dredged to near extinction
Massive declines in top predators
Crayfish no longer playing a role in the ecosystem

growing, demand for new urban development was increasing, public awareness of climate change was rising, and more species were being pushed towards extinction.

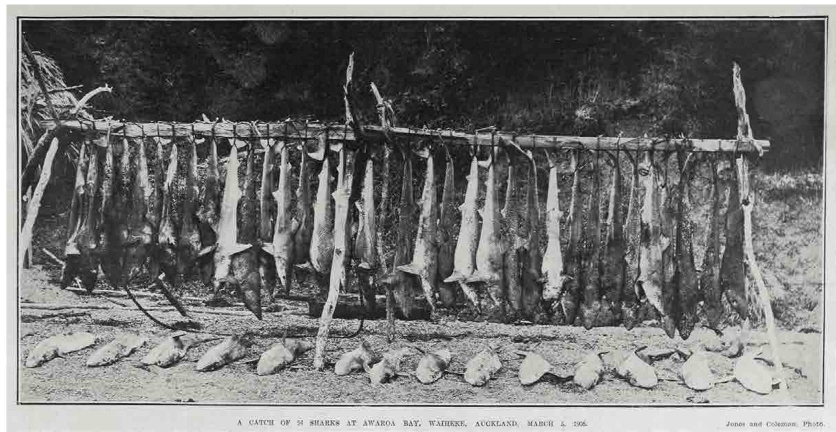
At the same time, new and exciting possibilities were emerging. Environmental awareness and knowledge were increasing. Some birds and reptiles were being brought back from the brink of extinction. Marine and terrestrial habitats were being restored, and new regulations were being hailed as world leading.

Yet reversing the historic and on-going decline was still proving difficult, with progress being hampered by agencies working in silos. Local, regional and central government therefore sought a more integrated management approach. In February 2000, the Hauraki Marine Park Act (2000) was passed by Parliament and quickly came into force. It established the park and set objectives for its management; recognised the historic, traditional, cultural and spiritual relationship of tangata whenua; and formally established the Hauraki Gulf Forum—a group formed to advance integrated management.

It has now been 23 years since the Act came into effect. This is the seventh State of the Gulf report prepared in accordance with the Act. Previous reports have already provided a comprehensive assessment of the state of the Gulf. They have also described management decisions that have influenced outcomes in the Gulf, and actions taken by people and organisations to protect and enrich it. However, up until 2020 those efforts had not been enough to offset the tide of population and economic pressures on the moana.

This report provides an update on changes occurring since 2020 and finally suggests we may have reached a crossroad in the journey of the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf Marine Park.

The result of an hour's fishing in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf Marine Park – a record catch of Hapuka (1913) NZG-19130122-0027-01



A catch of 54 sharks at Awaroa Bay, Waiheke, Auckland (1906) Auckland Libraries Heritage Collections AWNS-19060315-05-01

Beautiful, but profitless. Coral as bycatch on the trawler Nora Niven (1907) Auckland Libraries Heritage Collections NZG-19071116-0009-03

Show Your Heart for the Hauraki event
Echo Valley / Greenpeace

TE TURE
The Act

The Hauraki Gulf Marine Park Act (Act) was the first enactment of the new millennium, coming into effect on 27 February 2000. It recognises the national significance of the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf.

The Act established the Marine Park and the Hauraki Gulf Forum. It recognises the historic, traditional, cultural, and spiritual relationship of the tangata whenua with the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf and its islands. It provides objectives for the management of the waters, islands, and catchments of the Marine Park, including their use. And it seeks to integrate the management of the natural, historic, and physical resources within each of those elements.

The Act specifies that the purposes of the Hauraki Gulf Marine Park (Marine Park) are to:

a. recognise and protect in perpetuity the international and national significance of its land and natural and historic resources;

b. protect in perpetuity and for the benefit, use, and enjoyment of the people and communities of the Gulf and New Zealand, the natural and historic resources of the Park including scenery, ecological systems, or natural features that are so beautiful, unique, or scientifically important to be of national significance, for their intrinsic worth;

c. recognise and have particular regard to the historic, traditional, cultural, and spiritual relationship of tangata whenua with the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf, its islands and coastal areas, and the natural and historic resources of the Park:

d. to sustain the life-supporting capacity of the soil, air, water, and ecosystems of the Gulf in the Park.

It also defines what the Marine Park does and what areas it can include.

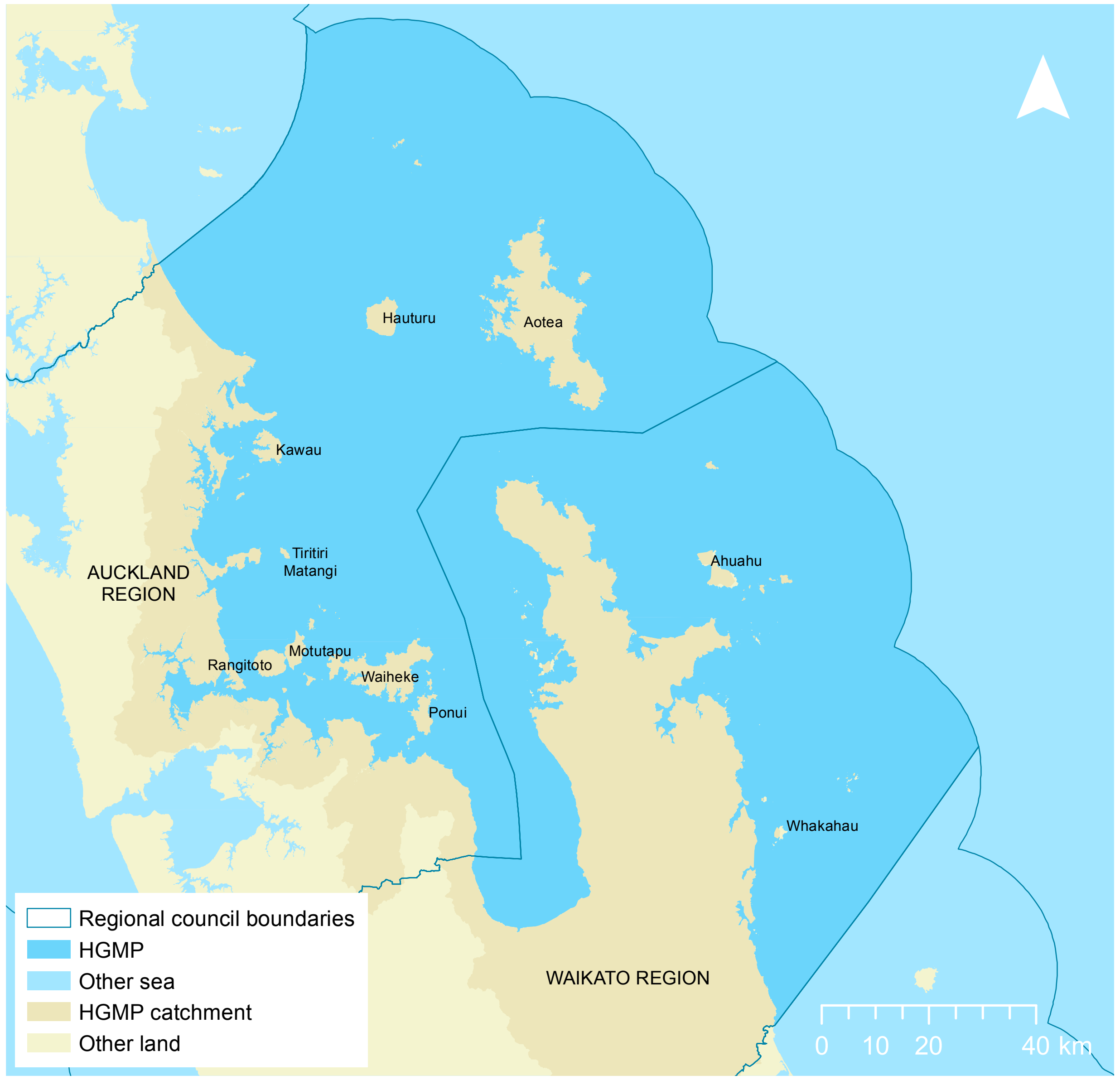


Figure 1. Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf Marine Park and its catchment.

KO TE PĀTAKA KAI O TĪKAPA MOANA / TE MOANANUI A TO
The Hauraki Gulf Marine Park

The Marine Park includes the foreshore, seabed (excluding defence areas) and seawater on the east coast of the Auckland and Waikato regions, as well as Te-Hauturu-o-Toi (Little Barrier Island), the Mokohinau Islands, more than half of Aotea (Great Barrier Island), Cuvier Island, Rangitoto Island, Motutapu Island, Mount Moehau, Mansion House on Kawau Island, North Head Historic Reserve, other small islands administered by the Department of Conservation (DOC), six marine reserves, and the internationally recognised RAMSAR wetland in the Firth of Thames. It also includes several reserves owned by, or previously owned by, Forest and Bird, Waitakere City Council and Sir Rob Fenwick.

The marine environment in the Marine Park 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 Marine Park are also a critical refuge for rare plants and animals.

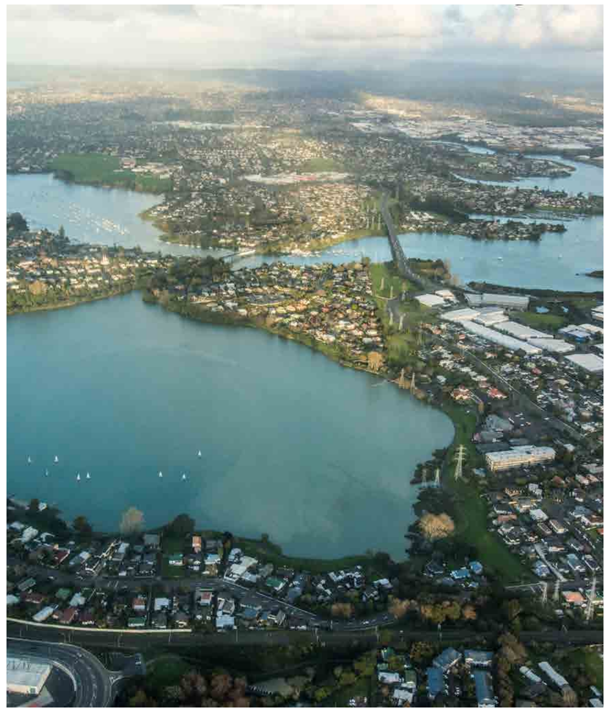
Although the Marine Park does not include its entire catchment[b], the Hauraki Gulf Marine Park Act 2000 (Act) does recognise the inter-relationship between the Marine Park and its islands and catchments, and therefore contains objectives related to catchment management.

The Marine Park is economically important, and most of its catchments are intensively developed and settled. Its shores contain Aotearoa'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 supports commercial enterprises and transport.

The Marine Park enriches people's lives. We live beside it. We play, swim, fish, and compete in its waters. We are invigorated by its vistas and constantly changing nature. By its dolphins, whales, sharks, rays and other fish life. By the kōura and octopus pulled from its waters. By seabirds, shorebirds and endangered forest birds brought back from the brink. We happily work together to restore island and marine biodiversity. And we are mutually saddened when its special values are degraded or lost.

The Marine Park, 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 Marine Park 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.

[b] The area of land that collects water that flows into the Marine Park.



Panmure Basin & Tāmaki Estuary Shaun Lee

[c] Constituent parties are any Minister or local authority who has the power under to appoint one or more representatives to the Forum, including tangata whenua representatives.

TĪKAPA MOANA
The Hauraki Gulf Forum

In addition to establishing the Marine Park, the Act established the Hauraki Gulf Forum (subsequently referred to as the Forum). The Forum is made up of 12 representatives from local and regional councils, six tangata whenua representatives, and representatives of the Ministers of Conservation, Oceans & Fisheries and Māori Development. The Forum is not a decision-making body, but among other things it is required to:

- promote and advocate the integrated management and, where appropriate, the sustainable management of the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf, its islands, and catchments;
- prepare a list of strategic issues, and to require and receive reports from constituent parties[c] of the Forum regarding the development and implementation of policies and strategies for addressing those issues;
- prepare and publish a report on the state of the environment in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf every three years, which includes information on progress towards integrated management, and responses to the strategic issues it has identified.

TE PŪRONGO NEI
This report

The Marine Park is now 23 years old. In this report, we provide an update on what has changed over the past three years. For consistency, the information presented here is largely based around the key environmental indicators used in past State of the Gulf reports since 2011, although some indicators have been regrouped or rearranged in this report.

The final section of the report, Weaving the Strands, examines progress towards integrated management and responses to the strategic issues, and the influence of the Hauraki Marine Park Act (2000) on those matters. It recognises that the Act is only a single strand in a much larger kete (basket) of historical, political, social, and regulatory events and outcomes. That context is important and the influence of the Act is considered through that lens.

NGĀ TOHU MĀORI

Core Māori values

Te Ao Māori can be defined as a value system that is universal throughout Māori communities, wherever they might be. It is a mosaic of checks and balances that determine how the world is seen through Māori eyes, and how that world is shaped in addressing those checks and balances. There is a mingling of the spiritual and existential that calls for careful nurturing of all things animate and inanimate. Te Ao Māori does not necessarily make the distinction between the living and the non-living in the way that western science does, but it does not make the Māori world view any less relevant. Significant Māori uara (values) that apply to environmental management are described here.

KAITIAKITANGA
Guardianship

A key overarching value in this report is kaitiakitanga (guardianship)—a means to care for and protect the environment. Tangata whenua are kaitiaki (guardians) of both the land and waterways in their rohe, and it is this resp onsibility that traditionally ensured the continued good health and abundance of resources. Such was the intimate relationship between people and their environment that it was said that the health of a community was reflected in its environment, and vice versa. For example, if the marine space was under stress something was obviously amiss with the people of a coastal rohe.

What is more in question these days is the ability or freedom of tangata whenua to exercise kaitiakitanga. Modern day legal and other bureaucratic constraints often get in the way of the ability of kaitiaki to practice kaitiakitanga to ensure the on-going prosperity of a taonga.

MANAAKITANGA
Caring for/showing respect

The mana (prestige/authority) of iwi, hapū, or whānau is extremely important in Māori society, and can be measured in different ways. It can, for example, be assessed by the ability to manaaki (care for/host) manuhiri (visitors), especially on important occasions such as tangihanga (funerals) or other traditional hui. Being able to cater for manuhiri, particularly with delicacies known to be rohe specialties, is expected, in some instances obligatory. For coast dwellers like those across the Marine Park's expanse it is usually generous helpings of kai moana (seafood) that manuhiri will remember. Kai moana like kōura (crayfish), ika (fish), kina, kūtai (mussels), parengo (seaweed), tītī (mutton birds) and pipi. To not cater accordingly—for whatever reason—brings great shame (whakamā) on the iwi.

Caring for the environment from which such riches are gathered is a function of kaitiaki. Without a healthy and thriving environment in which food resources are plentiful, the ability to properly host manuhiri is diminished, perhaps even nullified.

Tangata whenua are expected to be exemplary custodians of breeding grounds on the one hand, and hosts par excellence on the other. Whilst some might argue the two don't always go hand-in-hand, it is nevertheless important that there are checks and balances to ensure that they do. This is a challenge that iwi in the Marine Park rohe deal with constantly.

"Kai ana mai koe he atua, noho ana au he tangata" — You eat like a God while I sit here as a mere mortal.

MAHINGA KAI
Food gathering places

Mahinga kai in marine environments include traditional fishing grounds, diving spots, and shellfish gathering places. Some will be well known and frequented; others not so—they may be well-guarded secrets, or in out of the way, less visited, locations.

The health of mahinga kai is a perennial concern for iwi, often reflecting a yearning to recapture a time when the mahinga kai were an indisputably resplendent pātaka kai (food cupboard) full of the bounties of the sea god Tangaroa. Whilst there are various factors that contribute to a poorly performing mahinga kai, one that iwi are all too familiar with is their own inability to control how they are managed and monitored in the face of overwhelming overuse.

RANGATIRATANGA
Right to exercise authority/sovereignty

The right of an iwi/hapū/whānau to participate in meaningful decision-making about the marine and terrestrial environment in which they hold mana whenua is fundamental in Te Ao Māori. As a Māori scholar once said: rangatiratanga is ***"high-order leadership, the ability to keep the people together in order to maintain and enhance the mana of the people."***

Rangatiratanga is about being in control, having the right to determine one's own destiny, often in ways that have, until now, been absent or withheld in some way. That right is normally inherited.

Indicators of Māori values

Ideally, this report would include Māori-specific indicators that measured and tracked changes in relation to key values of importance to tangata whenua. But such indicators are currently lacking for Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. It is hoped that this gap will soon be filled, with work by researchers and organisations offering tools developed by and for Māori. For instance, funding was recently obtained for ***"Pou rāhui, pou tikanga, pou oranga: reigniting the mauri of Tīkapa Moana and Te Moananui-ā-Toi"***, a collaborative project involving five iwi that have implemented rāhui (Ngāti Pāoa, Ngāti Tamaterā, Ngāi Tai ki Tāmaki, Ngāti Hei and Ngāti Rehua Ngāti Wai). The project aims to develop innovative, replicable, pragmatic, in-water, mātauranga Māori solutions and actions to assist the regeneration and restoration of rohe moana and kaimoana.[2] While the development of indicators is not a direct outcome being sought, it is likely that appropriate measures will be used to assess the success of regeneration and restoration efforts. It is anticipated that those measures will be able to be applied more broadly. More importantly, the project aims to be an exemplar of approaching, actioning and normalising mātauranga-led research for the benefits of iwi, their wider communities and Aotearoa New Zealand.

NGĀ TOHU TAIAO
Environmental indicators

Sediment plumes in the inner Gulf © Shaun Lee

The Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf is never static. It naturally varies over time. It responds to changes in weather and climatic conditions, shoreline features, and a myriad of other factors. The influences of human actions get superimposed upon these natural rhythms. Some, such as the accumulation of sediment or small changes in fish or shellfish populations, are hard to separate from the natural ebb and flow of the Marine Park, especially over short periods. Other actions, such as reclamation, construction, island revegetation, and the reintroduction of threatened species occur more rapidly and are hard to miss.

It can be difficult and costly for scientists to separate natural from human-related change. Complex techniques are often required, and answers can be similarly complex. This feeds through to complicated regulation and management practices. In this report we try to cut through the complexity, by purposely limiting the amount of technical detail. Rather, we focus on the key results and findings that illustrate changes over the past three years. More technical detail was presented in previous State of Our Gulf reports and readers are referred back to them (and the material they reference) if they require more detailed explanations.

The indicators presented in the report are listed here.

TIAKINA TE PĀTAKA KAI
Preserving the food basket

- **TE HĪ IKA** — Fishing
- **TE TOITŪTANGA RĀNGAI IKA** — Fish stock sustainability
- **NGĀ KŌURA** — Crayfish
- **NGĀ TIPA** — Scallops
- **NGĀ TUANGI** — Cockles
- **TE MATEMATENGA** — Mass mortalities
- **TE KAPOKE KINO, TE KAPOKE PŌREAREA** — Harmful and nuisance algae
- **TE AHUMOANA** — Aquaculture

PAE UTA KI PAE TAI
Mountains to Sea

- **TE WHAKAWHĀNUITANGA ATU KI TE MOANA** — Coastal urban and ocean sprawl
- **NGĀ MATŪ TĀOKE** — Toxic chemicals
- **NGĀ TAIORA** — Nutrients
- **TE TOITŪTANGA O TE WAI HEI WAI KAUKAU** — Suitability of water for swimming
- **TE ORANGA O TE PARAKIWAI ME TE PAPAMOANA** — Sediment and benthic health
- **NGĀ MĀNAWA** — Mangroves

TE KANORAU KOIORA
Biodiversity

- **TE KANORAU KOIORA Ā-MOUTERE** — Island biodiversity
- **TE TOHORĀ** — Bryde's whales
- **NGĀ MANU O TE MOANA** — Seabirds
- **NGĀ MANU O TĀTAHI** — Shorebirds
- **NGĀ MOMO RĀWAHO O TE MOANA** — Marine non-indigenous species

TIAKINA TE PĀTAKA KAI
Preserving the food basket

Tamure at the Whanganui A Hei / Cathedral Cove Marine Reserve Shaun Lee

Tangaroa, the God of the Sea and the progenitor of fish is a central figure in Māori mythology, and in wider Polynesian mythology. He played a significant part in the separation of his parents Ranginui (Sky Father) and Papatūānuku (Earth Mother), much against the urgings of his brother Tūmatauenga (God of Man and War) who wanted them killed. Tūmatauenga was infuriated by the actions of Tangaroa. From that time, when the descendants of Tūmatauenga go fishing they are said to be continuing the war against the progeny of Tangaroa, the fish.

The ability of an iwi, hapū or whānau to tiaki (take care of) the food resource in their rohe has always been important in Te Ao Māori. The successful management of a plentiful food supply, or pātaka kai, is as much a matter of iwi/hapū/whānau pride as it is about satisfying human hunger. For tangata whenua of Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf rohe, this is reflected in the abundance and health of ngā tamariki ā Tangaroa (the children of the Sea God, Tangaroa). If they are in great abundance, fat and juicy, the pātaka is in good hands.

Tikanga (customs) guides the fishing practices of tangata whenua. Tikanga that has been passed from generation to generation. Tikanga built on mātauranga (knowledge) of hidden reefs, holes and shellfish beds. When and where to catch tāmure, kahawai and other ika, based on the time of year, tide and weather conditions, and phases of the moon. Times when shellfish are fat, kina bulge with roe, and kōura are soft or in berry. And practices to sustain the mauri of fishing grounds and ensure harvests provide for the needs of their people, now and into the future.

Tikanga adapts, but contemporary fishing practices and pressures are nothing like those experienced by tīpuna (ancestors). This is a challenge for tangata whenua and contemporary managers alike. This section looks at food resources in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf, and provides information on: who's catching fish, how and where are they catching them, the status of key fish and shellfish species, the broader effects of fishing on the Gulf, marine farming, kai moana safety and the incidence of mass mortalities of sea life.

TOHU (Indicator)

TE MAHI HĪ IKA

Fishing

"Revitalising the Gulf is driving integrated marine management in order to reverse environmental decline in the Hauraki Gulf, including increasing marine protection threefold and delivering an area-based fisheries plan"

– 2022 work programme report-back to Cabinet, from the Minister of Oceans and Fisheries

Kina barren Waiheke Island © Shaun Lee

Fishing was, and is, an important practical and spiritual activity for Māori. It has also become a major economic and recreational pursuit. Fishing has one of the greatest environmental impacts on the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf, where over 100 different finfish and a variety of other kai moana are caught. Fish are caught using a variety of methods. Bottom trawling, purse seining, longlining, Danish seining and set netting provide the bulk of the commercial catch, but a range of other netting, trawling, lining, and potting methods are also used.

Regulations govern how, where and when fishing can occur, and how much can be taken. They range from complete 'no-take' zones to areas or times where certain fishing methods are prohibited. Other restrictions such as catch and size limits are used to regulate commercial fishing. Bag and size limits, and fishing seasons are also placed on recreational fishers, while permits are required for Māori customary fishing. The use of rāhui is also becoming a commonplace method of addressing the local effects of overfishing *(see Case Study on Rāhui)*.

The regulations clearly define the areas where Danish seining is prohibited in the Gulf. However, Fisheries NZ are of the view that the coordinates, landmarks and bearing used to define an exemption area for single vessels under 20 m in length, were an unintended outcome of regulatory changes made in 1986. A slightly amended version of the pre-1986 regulations is still being applied. Fisheries NZ acknowledges there is a discrepancy between how the legislation that defines this area has been interpreted and presented in this report, and what is currently understood and enforced in practice. They have recently developed a Draft Hauraki Gulf Fisheries Plan, which, if implemented, will restrict Danish seining and bottom trawling to defined areas within the Marine Park. It also proposes to exclude commercial scallop dredging from the Hauraki Gulf, except within defined commercial dredging access areas.[3]

The latest 3-year landings data provided by Fisheries New Zealand[d] for the Hauraki Gulf show:

The total reported commercial catch of fish in the most recent three-year period was very similar to that caught in the previous three years. In both periods around 21,000 tonnes (t) of fish (greenweight) were caught commercially.

The top five species caught in the Marine Park is unchanged from the previous report. Reported catch weights of tawatawa (blue mackerel; 5,853 t) and tāmure (4,357 t) remained greater than all other species. Skipjack tuna (1,996 t) was third in terms of landed greenweight, followed by hauture (jack mackerel) (1,751 t) and trevally (838 t) (*Figure 2*).

A notable increase (69%) in the commercial landings of whai repo (eagle ray) in the past three-year period.

The greatest proportion (by greenweight) of fish landed by commercial fishers was caught by purse seining (50%, down from 57%), followed by single bottom trawling (14%) and bottom longlining (12%). Precision bottom trawling, also took a notable quantity (7%) (*Figure 3*).

Purse seining mainly targets skipjack tuna, hauture (jack mackerel) and tawatawa (blue mackerel)—three of the top four species captured in the Marine Park. All three species are mainly found in the outer Gulf out to the continental shelf, and therefore, the majority of the catch is often taken outside of the Marine Park. Changes in catch in the Marine Park can reflect changes in the fishing areas (inside or outside the Marine Park), rather than actual changes in commercial landings. Since 2002, tawatawa commercial landings in EMA1 (North Cape to East Cape) have been relatively stable, generally around 6,600–8,500 t per year, and hauture commercial landings in JMA1 (North Cape to Wellington) have varied between 5,000–10,000 t per year. Skipjack tuna are not managed under the QMS but under an international catch agreement, and therefore, reported data is limited.[4]

The number of bottom trawls (5,588) over the most recent three-year period (based on October fishing years covering the 2019–20 to 2021–22 period) was 27% lower than in the previous three-year period (*Figure 4*).

The number of Danish seine events (3,072) over the most recent three-year period was 21% lower than in the previous three-year period (*Figure 4*).

[d] Data as provided by Fisheries New Zealand. Fisheries New Zealand prepared the data on the basis of information provided to it in returns provided by fishers. Fisheries New Zealand does not accept responsibility for the completeness or accuracy of the data.

No new recreational catch data are available, but a national panel survey of recreational fishing is currently being undertaken. The previous national panel survey estimated that 2000 t of tāmure were caught by recreational fishers in the Marine Park in 2017–18. Recreational catches of tāmure, haku (kingfish) and kahawai exceeded commercial catches in the Marine Park *(see 2020 State of the Gulf report for more details)*.[5,6]

Fishing doesn't only affect the species captured, it also has direct and indirect impacts on non-target species and the seabed. Fishing methods such as bottom trawling and Danish seining damage the seabed and the animals and plants that grow there. Undersized or non-target fish are captured and discarded. Some changes are very difficult to reverse. For example, historic mussel beds once covered much of the Firth of Thames but were completely removed by dredging in the mid-20th century, and have never recovered. Those beds were one of the most important biogenic habitats in the Marine Park, providing food for other animals, filtering capacity, and a suite of broader biodiversity values.

Fishing also affects the dynamics of food webs and the characteristics of marine ecological communities. The reduction of top predators such as tāmure and kōura allow prey such as grazing kina to flourish. This results in the loss of kelp forests. Elsewhere, the reduction of small pelagic fish reduces the food available for larger fish, marine mammals, and seabirds. Food web modelling of the impact of removing small to medium pelagic fish (e.g., jack mackerels, blue mackerel, pilchard and anchovy) found that predatory species that had limited diet flexibility were most affected. Seabirds (particularly tara (white-fronted tern), rako (Buller's shearwater), pakahā (fluttering shearwater), taranui (caspian terns) and tītī wainui (fairy prions)) and popokanua (common) and terehu (bottlenose) dolphins were the species most affected by changes in small pelagic fish.[7] Ecosystems that are damaged by bottom trawling and are fished close to their maximum sustainable yields are less resilient to other stressors, such as climate change.[8] Ecosystem-based management is now accepted as best practice in fisheries management, but we are still managing species individually.

Recreational fishers with Tākapu (Australasian gannet) bycatch 📷 Jo Logan

Central Government has signalled its intent to take significant actions towards increasing marine protection and shifting further towards ecosystem-based approaches to fisheries management within the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. Currently, there are no taiāpure or mātaitai reserves in the Marine Park, but fishing is prohibited in six marine reserves that cover around 0.3% of the Marine Park. Apart from the conversion of Tāwharanui Marine Park to a marine reserve in 2011, the last marine reserve to be approved was Te Matuku in 2003. All forms of fishing (apart from research fishing) are also prohibited in cable protection zones, which cover around 4.9% of the Marine Park. However, there is little evidence of ecological change occurring within the largest cable protection zone in the Marine Park. The reasons for that have not been determined, but it is important to note that it was not set aside with biodiversity or habitat protection in mind.[9]

Revitalising the Hauraki Gulf: Government action on the Sea Change Plan was released in 2021.[10] Following on from that, the Department of Conservation has sought feedback in September 2022 on a proposal to establish:

- 12 High Protection Areas (HPAs) to protect and enhance marine habitats and ecosystems while providing for the customary practices of mana whenua;
- 5 Seafloor Protection Areas (SPAs) to protect sensitive sea floor habitats while continuing to allow for compatible activities; and,
- 2 protected areas adjacent to Whanganui-a-Hei and Cape Rodney-Okakari Point marine reserves. These areas will be established as HPAs or marine reserve extensions.

Fisheries New Zealand also released a draft Hauraki Gulf Fisheries Plan[3] for public feedback in January 2023 (with submissions closing in March 2023) that, among other things, seeks to:

- limit bottom trawling and Danish seining dredging to defined areas, exclude commercial tipa (scallop) dredging except in defined areas, and ban recreational tipa dredging;
- protect marine habitats of ecological importance from the adverse effects of fishing;
- mitigate the impacts of fishing on the marine food chain;
- reduce fishing-related deaths of 'non-fish' and protected species, working towards zero by 2050;
- ensure all harvested stocks of wild marine species are at or above target levels for quota management areas, and address localised depletion of fisheries resources within the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf;
- decrease the mortality of undersized fish and ensure the harvesting of intertidal species is sustainable.

Recently, mana whenua and conservation groups have been challenging local and national government decisions, in order to improve the management of marine resources. Significant decisions include the:

- Court of Appeal's 2019 findings in relation to regional councils being able to manage the indirect effects of fishing, provided they are not doing so for Fisheries Act purposes. This led to the 2021 establishment of the Motiti Protection Area, under the Bay of Plenty Regional Coastal Environment Plan, where fishing is no longer permitted.[11]
- Environment Court's 2022 decision regarding an appeal on the proposed Northland Regional Plan that initially failed to set aside areas where fishing activities and their impacts were controlled. This led to the creation of two new no-take fishing areas (Maunganui Bay-Oporua Bay and Mimiwhangata Peninsula), and prohibition of commercial seining and trawling from a large area around Cape Brett.[12]

Such regulatory tools are yet to be applied in the Gulf.

Toanui (Flesh-footed shearwater) caught by a commercial snapper longline fisher 📷 Released by MPI

KEY EVENTS

2003: Te Matuku marine reserve established.

2004: Aerial survey/boat ramp interview methods developed for estimating recreational harvest developed in 2003–04, with the methods being applied outside of the inner Hauraki Gulf in 2004–05.

2011: National Panel Survey methods developed to estimate the recreational harvest, which produced estimates which were corroborated by an aerial/boat ramp survey conducted concurrently for the 2011–12 fishing year.

Tāwharanui Marine Park converted to a marine reserve.

2012: Panel of experts rank bottom trawling 3rd equal highest threat to Aotearoa's marine habitats (behind ocean acidification and global warming).[13]

2013: Tāmure stock assessment indicates the fishery is overfished and depleted. In response, new recreational limits are set.

2014: MPI made aware of discrepancy between fisheries regulations and how the Danish seining regulations were being applied. MPI continues to allow Danish seining in areas where it is prohibited by the regulations.

2017: Second national panel and concurrent aerial surveys aerial completed in the 2017–18 fishing year.

Tarakihi stock assessment indicates the fishery has been overfished and is depleted. Commercial catch allowance decreased by 20% in 2018–19 fishing year.

Sea Change, Tai Timu Tai Pari makes recommendations to manage the indirect effects of fishing. A Ministerial Advisory Committee is established to consider Central Government's response to Sea Change.

2018: A total allowable catch for kuparu (John dory) is set for the first time, with recreational and customary catch allowances, and a reduced allowance for commercial catch being set.

2019: Minister decides on additional measures (10% cut to the commercial catch limit) to rebuild the tarakihi stock.

Court of Appeal rules the RMA does not prevent regional councils from controlling fishing activities through their RMA functions, provided they are not doing so for Fisheries Act purposes.

2020–23

2021: Revitalising the Gulf: Government action on the Sea Change Plan is released.

2022: Two Hauraki Gulf and Bay of Plenty trawl surveys completed.

DOC releases proposal for the establishment 12 High Protection Areas, five Seafloor Protection Areas, and two Protected Areas, for consultation.

Application to establish Hākaimangō-Matiatia (Northwest Waiheke) Marine Reserves submitted by Friends of the Hauraki Gulf Inc.

Third national panel survey conducted in the 2022–23 fishing year.

Changes to recreational daily bag limits to include all finfish species (except for specified small pelagic finfish) in a combined daily limit of 20 fish. Previously, only 43 species were subject to daily bag limits, and tāmure and haku (kingfish) were counted separately to the combined daily limit of 20 fish.[14]

2023: Fisheries New Zealand releases draft Hauraki Gulf Fisheries Plan for consultation.

Recreational fishing boats in Ahaaha Rocks 📷 Shaun Lee

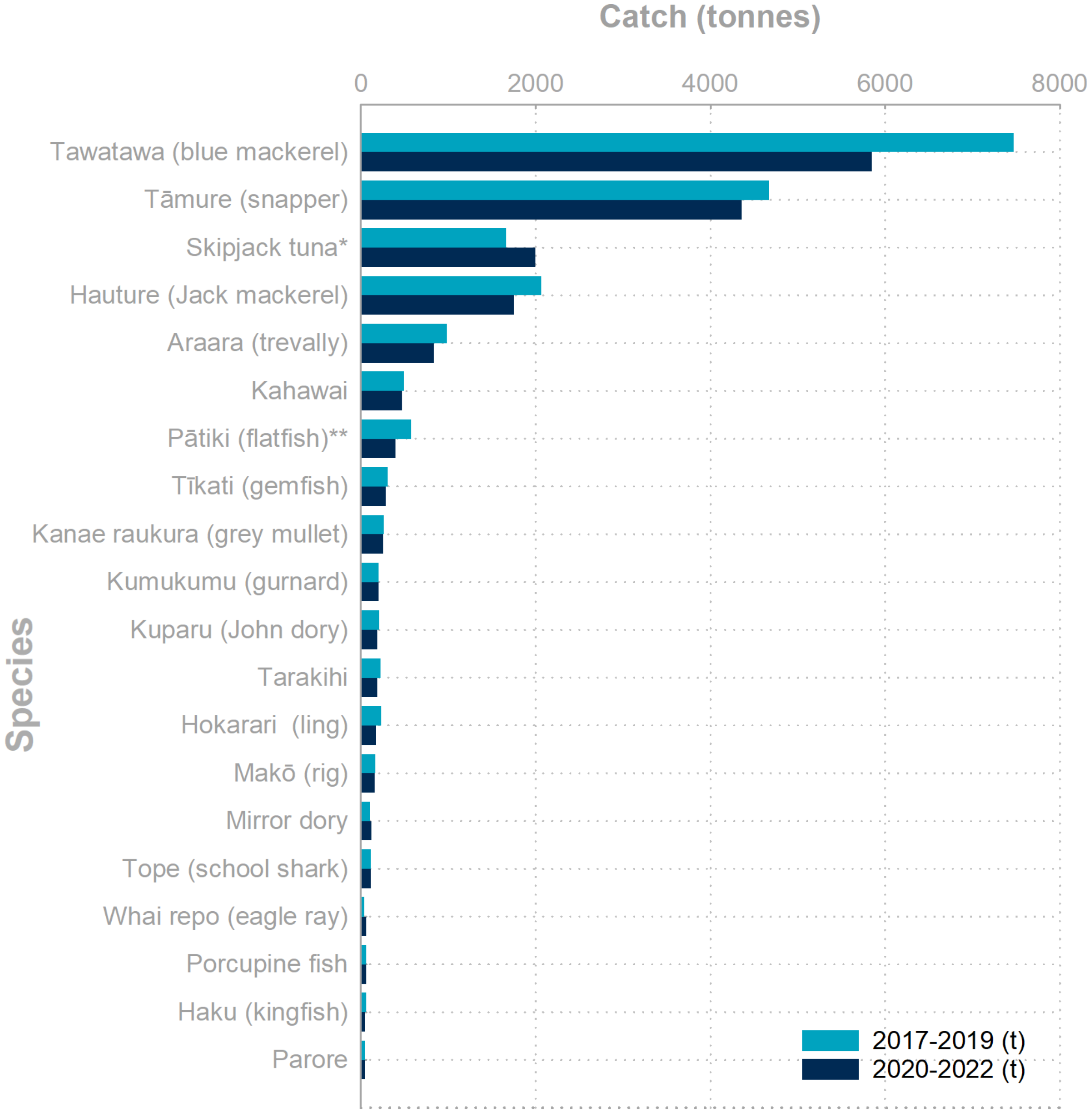


Figure 2: Pooled, estimated commercial catch of the top 20 finfish species (by reported greenweight) caught in the Marine Park between the 2016–17 to 2018–19 (2017–19) , and 2019–20 to 2021–22 (2020–22) fishing years[g] (southern bluefin tuna, hoki and tuna (short-finned eel) have been excluded as they are likely to have been mainly caught outside the Marine Park). *A proportion of Skipjack tuna catch is likely to be taken beyond the offshore boundary of the Marine Park. ** Pātiki (flatfish) includes pooled data from yellow-belly flounder, sand flounder, black flounder, greenback flounder, lemon sole, New Zealand sole, brill, and turbot (data provided by Fisheries NZ).

[g] For April fishing year stocks the date range is 1 April to 31 March, for October fishing year stocks the date range is 1 October to September. (Data was obtained on 1 Oct 22, so it is probable that not all of the catch had been declared for the full 2021–22 fishing year).

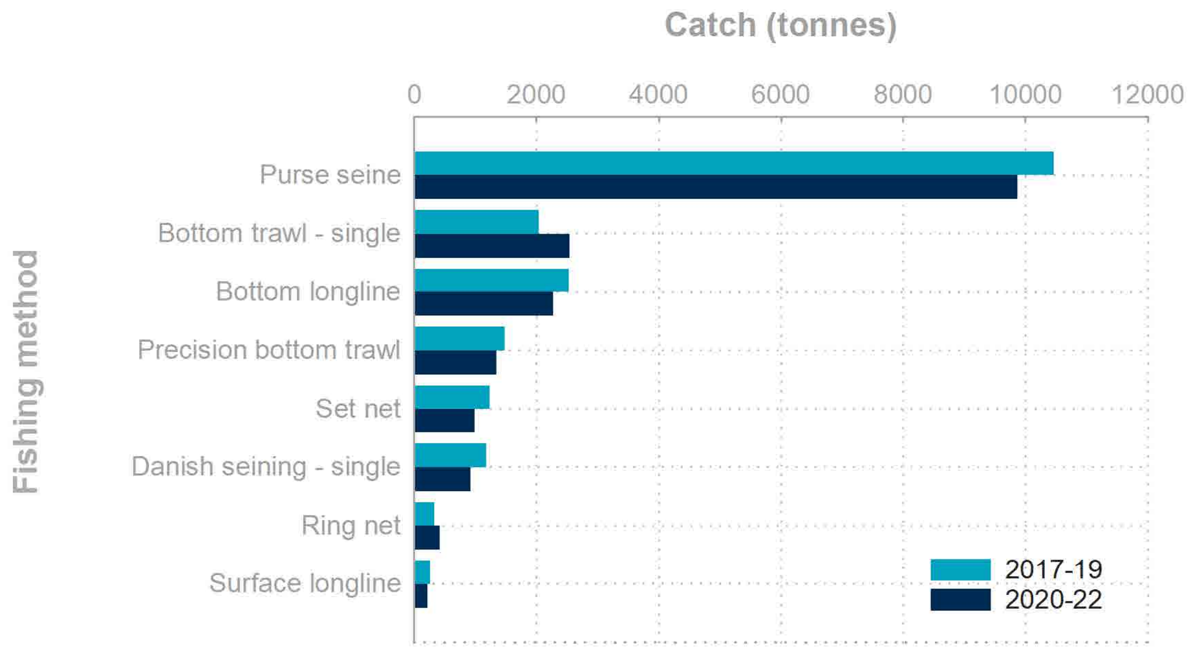


Figure 3: Pooled, estimated commercial catch for methods that caught at least 50 tonne of finfish (by reported greenweight) in the Marine Park between the 2016–17 to 2018–19 (2017–19), and 2019–20 to 2021–22 (2020–22) fishing yearsg (southern bluefin tuna, hoki and tuna (short-finned eel) have been excluded as they are likely to have been mainly caught outside the Marine Park – also see earlier footnote on skipjack tuna) (data provided by Fisheries NZ).

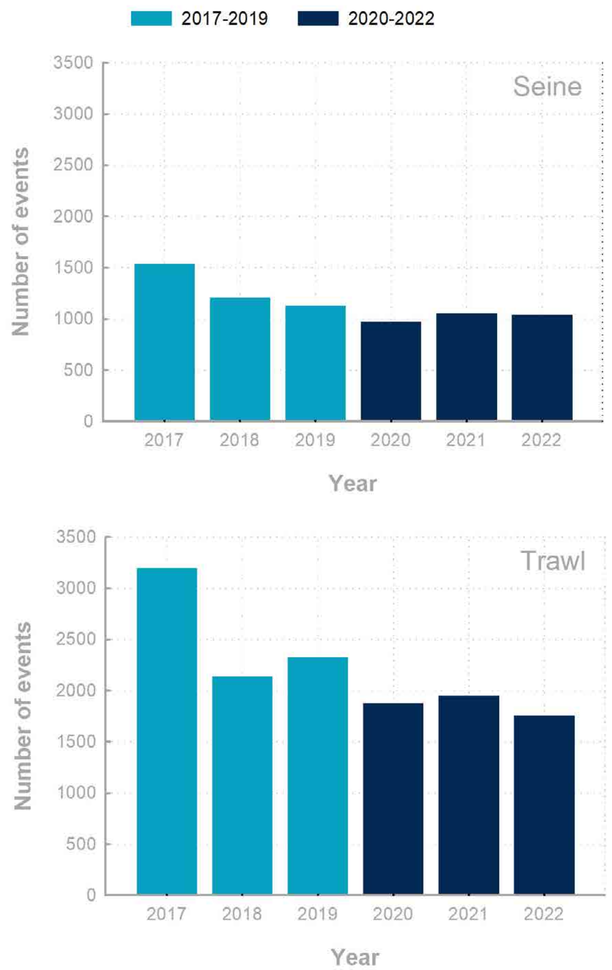


Figure 4: Annual variation in the number of Danish seine (single and pair) and bottom trawling events (single, pair and precision) in the Hauraki Gulf in the latest and previous three-year periods. Data are from fishing years starting in October.

Commercial fishing boats in the Marine Park. 📷 Shaun Lee

HE RANGAHAU WHAKAPŪAHO (Case study)

HE RANGAHAU WHAKAPŪAHO: TE RĀHUI, ME TĀ TE TIKANGA MĀORI WHAKATIKA HAPA O INAMATA NEI

Ancient Māori practices addressing modern issues

"It's not just about the science. It's the cry of our people saying enough's enough. We've had enough, we can't even feed our own mokopuna."

– Herearoha Skipper, Ngāti Pāoa speaking about the Waiheke rāhui

Tāwharanui, Waitangi Day © Richard Robinson

On the shores of Tāwharanui, a rōpū (group) wait for Tamanui- te- rā (the sun) to rise. A kuia sends her karanga to call the incoming tide. Under the veil of mist and rain, her people of Ngāti Manuhiri send incantations and karakia to place a rāhui across the sea. For the people of Ngāti Manuhiri, this rāhui is about restoring the mauri of the moana, which carried their people to Aotearoa. It is about reviving the beating heart of the Tangaroa who continues to sustain us.

Nicola MacDonald, Chief Executive of Ngāti Manuhiri Settlement trust explains *"A rāhui acts as a korowai, cloak, of protection and says to all communities taihoa, let's stop, let's allow the natural world to recover. Let's respect this for a period of time until we see the regeneration and when it does regenerate, let's work with our mana whenua until we have sustainable fisheries."* [14]

Rāhui are, and have been, used by Māori for centuries prior to the arrival of Europeans. Simply put, they are a customary practice which leaves natural systems undisturbed to bring about the regeneration of a resource and the regeneration of tapu. In some instances, they were enacted for protection or gain. In essence, rāhui are a common-sense tool for resource management, grounded in tikanga and guided by mātauranga. Traditionally, breaking a rāhui had serious repercussions, with retribution bringing about illness or death to those who broke it.

In today's world rāhui remain lore-based, and in some cases law-backed. Fisheries-related rāhui are accommodated under the Fisheries Act. Section 186a provides a mechanism for the Minister of Oceans and Fisheries to temporarily restrict or prohibit fishing in an area to recognise and provide for the use and management practices of tangata whenua (referred to here as 'formally approved rāhui'). In practice, the Act confers on the Minister

Terrence (Mook) Hohneck and Wyvern Rosieur laying the rāhui on Waitangi Day © Richard Robinson

a role traditionally only held by tohunga and chiefly members of a hapū or iwi.[15]

"An influential person establishes a rāhui, one with magical powers (supernatural) or deadly to the meddlesome. Probably someone that could make you sick or heal you. Someone with mana". [16]

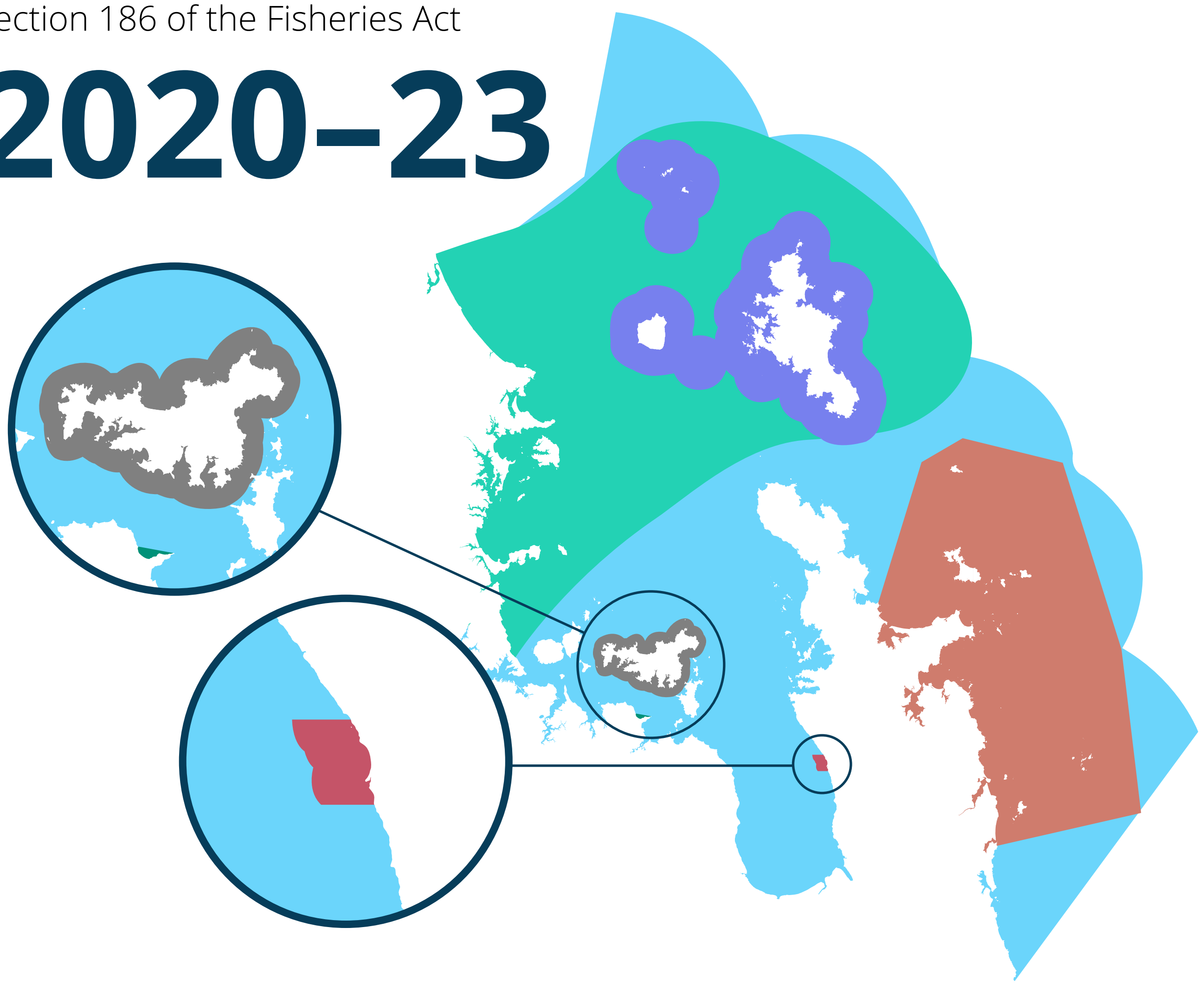
Why is having legislation in place important?

Unlike the old days, retribution for breaching a rāhui doesn't come in the form of spiritual reprisal or a mere (club) to the head, but rather a gavel to the courtroom bench. Today, it is unfortunate that many people don't respect rāhui until they become formally approved under the Fisheries Act. *"Getting people to honour and respect our customs, especially rāhui has been challenging. Relying on the minister to bring rāhui into law is a shift of mana motuhake (self-determination). While we wait, it is key to work with our community to ensure the rāhui is upheld."*—Joe Davis, Ngāti Hei.

Hapū can also find it difficult to get the Minister to 'honour and respect' the exercise of rangatiratanga by formalising a rāhui they have established in accordance with tikanga. For example, rāhui set by Ngāti Manuhiri in February 2022 to protect dwindling tipa (scallop) beds around Aotea and Te Hauturu-o-Toi, were excluded from the Minister's March 2022 decision to close tipa beds throughout northeast North Island down to Maketu, Bay of Plenty under Section 186 of the Fisheries Act except for two small areas that lay within the rāhui area (south of Hauturu and in the Coville Channel). On that decision, Nicola MacDonald noted: *"both of the areas the Minister has chosen to leave open to dredging are covered by tikanga rāhui laid down on Waitangi Day this year, and a formal s186a Fisheries Act application for temporary closure. The decision today diminishes the mana of the iwi, hapū, whānau, communities, and all those involved in supporting the rāhui. The Minister should reconsider this aspect of the decision, and/or confirm the temporary closure application."* [17]

Outcomes of applications to have Rāhui recognised through closures under Section 186 of the Fisheries Act

2020–23



4,000 km^2

Mangawhai-Aotea / Great Barrier Island-Takapuna.
Ngāti Manuhiri

Tikanga Feb 2022.
Declined by the Minister.

2,715 km^2

East Coromandel
Ngāti Hei Trust

Tikanga Dec 2020.
Endorsed by Minister in Sep 2021.

1,430 km^2

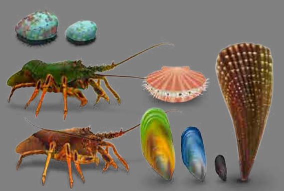
Outer Gulf islands
Motairehe Marae

Active application
- yet to be decided.

132 km^2

Waiheke Island
Ngāti Paoa Iwi Trust

Tikanga Jan 2021.
Endorsed by Minister in Dec 2021.



7.1 km^2

Te Mātā and Waipatukahu
Ngāti Tamaterā

Tikanga Dec 2019.
Endorsed by Minister Jan 2020.

1.5 km^2

Umupuia Beach
Ngāi Tai ki Tāmaki Trust

First endorsed by Minister in 2008.

Additional Section 11 and Section 16 fisheries closures are in effect in the HGMP

Ngāti Manuhiri's Section 186 application was declined by the Minister. However, in December 2022 the Minister implemented a short-term emergency measure under Section 16 of the Fisheries Act to close the two remaining open areas, after a new camera-based survey of the beds indicated a serious rapid decline in tipa numbers *(see section on Tipa for more details)*.[18] In March 2023 the entire Coromandel tipa fishery was closed indefinitely.[19]

Other rāhui applications have had more success, with four Section 186 closures currently in place in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. The Minister for Oceans and Fisheries most recently approved three rāhui applications covering eastern Coromandel, Waiheke Island, and Te Mata and Waipatukahu. The recent increase in the number of rāhui stems from concern over the health and abundance of the Gulf's kaimoana and ecosystems, and the stress they are under.

At a localised level, rāhui are often effective at replenishing mahinga mātaitai (gathering sites or beds). For instance, in 2008, Ngāi Tai ki Tāmaki obtained a formally approved rāhui on tuangi (cockles) at Umupuia Beach, due to a decrease in quantity and size within the mahinga mātaitai. After 15 years under rāhui, the number of individual and harvestable (30mm) tuangi has increased significantly, to a level similar to those seen in 2000 *(see Section on Te tuangi)*.[20] ***"We've seen good recruitment and growth within the cockle beds, we need to continue to manage the beds under rāhui due to the sheer pressure from Auckland's growing population."***— Laurie Beamish, Ngāi Tai ki Tāmaki.

However, in other cases implementation of rāhui has not resulted in an increase of harvestable kai moana, suggesting that other environmental factors also contribute to population declines. For example, Hauraki Māori Trust Board obtained a formally approved rāhui on shellfish gathering along most of the eastern Firth of Thames coastline (from Ngarimu Bay to Wilson Bay) between 1998 and 2006. Despite the 8-year harvesting ban, surveys conducted by the Board showed that tuangi and pipi remained small and were not growing to harvestable size. Despite the lack of improvement, the Board's application to continue the rāhui was rejected by the Minister on the basis that Section 186 closures are not intended as a permanent tool for fisheries management.[21] Ongoing concern about the shellfish populations in this area led to Ngāti Tamaterā successfully applying for a Section 186 closure of a smaller subset of the area (Te Mātā and Waipatukahu) in 2020. Despite this, MPI monitoring of the pipi populations in Te Mātā in 2020 and 2022 showed the population continued its decline over the last two years.[20]

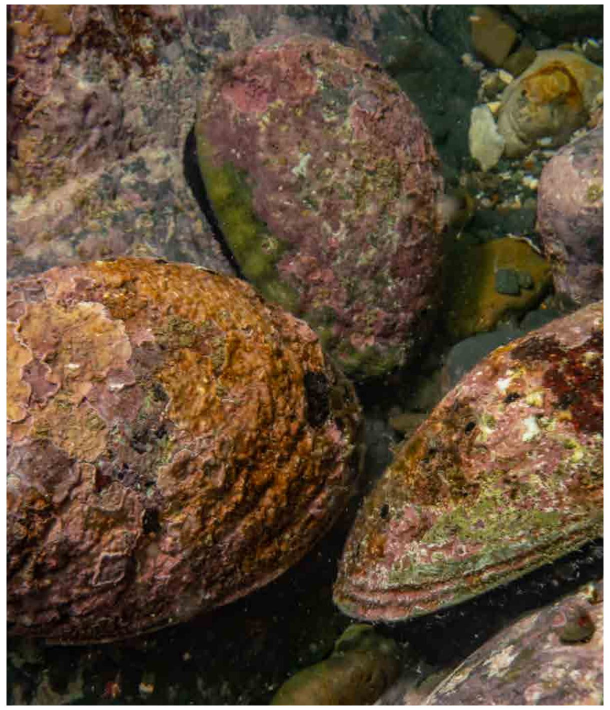
Tipa have long been a delicacy for people living on the shores of the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. Opito Bay, on Coromandel's east coast was once home to a large tipa bed. Unfortunately, the area's tipa population has declined severely after successive years of poor recruitment and overfishing. To stop the decline in the fishery, a voluntary rāhui was placed by Ngāti Hei. This was followed by an application to have the rāhui formally approved under the Fisheries Act. Ngāti Hei kaumatua, Joe Davis said in their section 186a application

Commercial dredging during the Opito Bay rāhui Mike Bhana / Wild Films

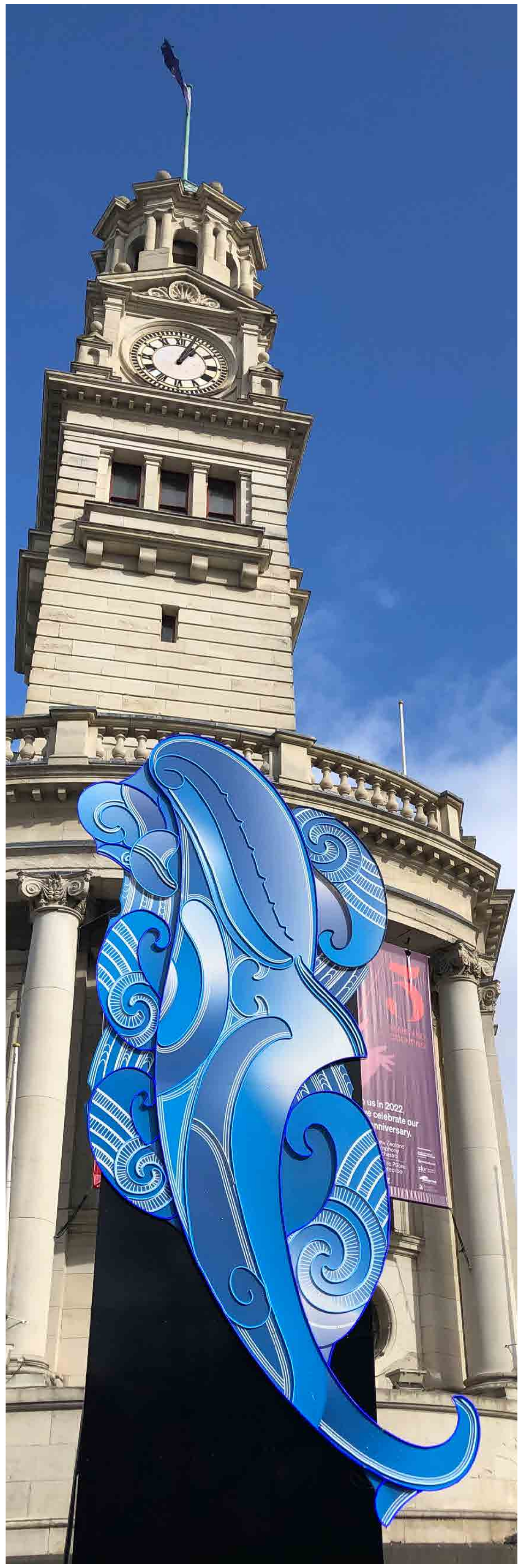
"Urgent action is required before scallop beds become so diminished, that generations yet unborn will not even know the area was once not so long ago abundant with scallops". The observations of Ngāti Hei were supported by a 2021 Fisheries New Zealand review of the Coromandel tipa fishery (SCA CS), which found biomass levels had declined by 82% since 2012. This led to the closure of the Coromandel fishery.[22]

Similar concerns about the state of tipa, koura (crayfish), kūtai (mussels) and pāua populations around Waiheke Island led to a rāhui on the gathering of those species being placed by Ngāti Pāoa and formally approved by the Minister.

Dean Ogilvie, Ngāti Pāoa explains, the rāhui is much more than a simple ban, as the mauri of the people is intimately linked to the mauri of the taiao (environment). *"Being able to fulfill our role as mana whenua. Being able to manaaki properly and know that we have got a resource out there that we can feed those people under our care and know that there is a plentiful supply that's ongoing for generations down the track. We'll see it in the wellbeing of our people."* [23]



Blackfoot Pāua 📷 Shaun Lee



Auckland Town Hall 📷 Shaun Lee

Rāhui Waiheke Island 📷 Rachel Mataira

Learnings

Mātauranga Māori (traditional knowledge) and recent experience shows that rāhui are often effective at managing the depletion of kaimoana at scales of relevance to mana whenua and local communities. Mana whenua live, work, fish, gather and recreate in, on and around the water. They experience changes first-hand. Mana whenua can react quickly to changes in the local availability of important kaimoana species through rāhui. On the flip side, the quota management system (QMS) manages fish stocks at large scales, often covering multiple regions (e.g., SNA1 covers Cape Reinga to East Cape). That system typically deals with stocks at much broader population levels, with decisions primarily informed by costly, scientifically-based stock assessments that may take years to complete and repeat *(see case study on 'What is a stock assessment')*. Although equally important, the QMS is slow to detect changes of relevance at local scales (or does not detect them at all), and even slower to respond. It is simply not designed to do that.

Rāhui therefore have important traditional and contemporary roles in fisheries management. Mana whenua of Tīkapa Moana / Te Moananui-ā-Toi have a track record of exercising them cautiously, as would be expected based on tikanga. However, there are weaknesses in the current system. Adverse effects on the use and management practices of mana whenua must be shown before a rāhui can be applied under the Fisheries Act, and even then, there is no guarantee an application to formalise a rāhui under the Fisheries Act will be approved. Consequently, they tend to be implemented as a last resort; an action taken when all other options have failed.

Is it time to consider how this integration of traditional and modern practices can be improved? What if, hapū could formally approve rāhui in a similar manner to the emergency powers of the Minister— to provide the breathing space needed to prevent further decline while a detailed plan of action that addresses local circumstances is developed? What if, rāhui weren't only used as a tool of last resort—could they also be used to achieve and maintain local resources and features in a desired state? What if mechanisms were in place to allow rāhui to be lifted in a way that does not undermine the gains made? Given that we live in a world where kai moana resources have been greatly diminished through contemporary environmental and harvesting pressure, the traditional use of rāhui is possibly more relevant than it has ever been.

TOHU (Indicator)

TE TOITŪTANGA RĀNGAI IKA
Fish stock sustainability

"If people see it as their birth right to continue to extract for today, there'll be nothing for tomorrow. We're doing it for our great-great-grandchildren, who will never know us."

– Jeff Cleave, Ngāti Rehua, Ngātiwai ki Aotea[24]

Set net fishing Whau River 📷 Shaun Lee

Fishing is a major environmental stressor that affects the whole of the Marine Park. In this report, the focus is on environmental outcomes rather than fisheries sustainability or productivity. While there is considerable overlap between the two, readers should be aware that current fisheries targets are not designed to maintain healthy, naturally functioning ecosystems. Rather, they are set to maximise productivity, while also maintaining the ongoing viability of fish stocks and sustainability of fishing. Highest, sustainable catches are typically obtained when stocks are fished down to 30–60% of unfished levels. The Minister of Oceans and Fisheries manages stock levels by adjusting commercial catches, altering restrictions on recreational fishers, or applying other measures. Since 2008, stocks have been assessed against the 'Harvest Strategy Standard': a set of guidelines that aid in decision making. Stock assessments can vary from relatively simple exercises to extremely large and complex programmes of data gathering and modelling *(see Case study on 'What is a stock assessment?')*. The areas covered by stock assessments are generally much larger than the Marine Park. In Aotearoa, the results of stock assessments are consolidated and presented annually in Plenary reports prepared by Fisheries New Zealand.

Kanae raukura (Grey mullet) Tāwharanui Regional Park 📷 Shaun Lee

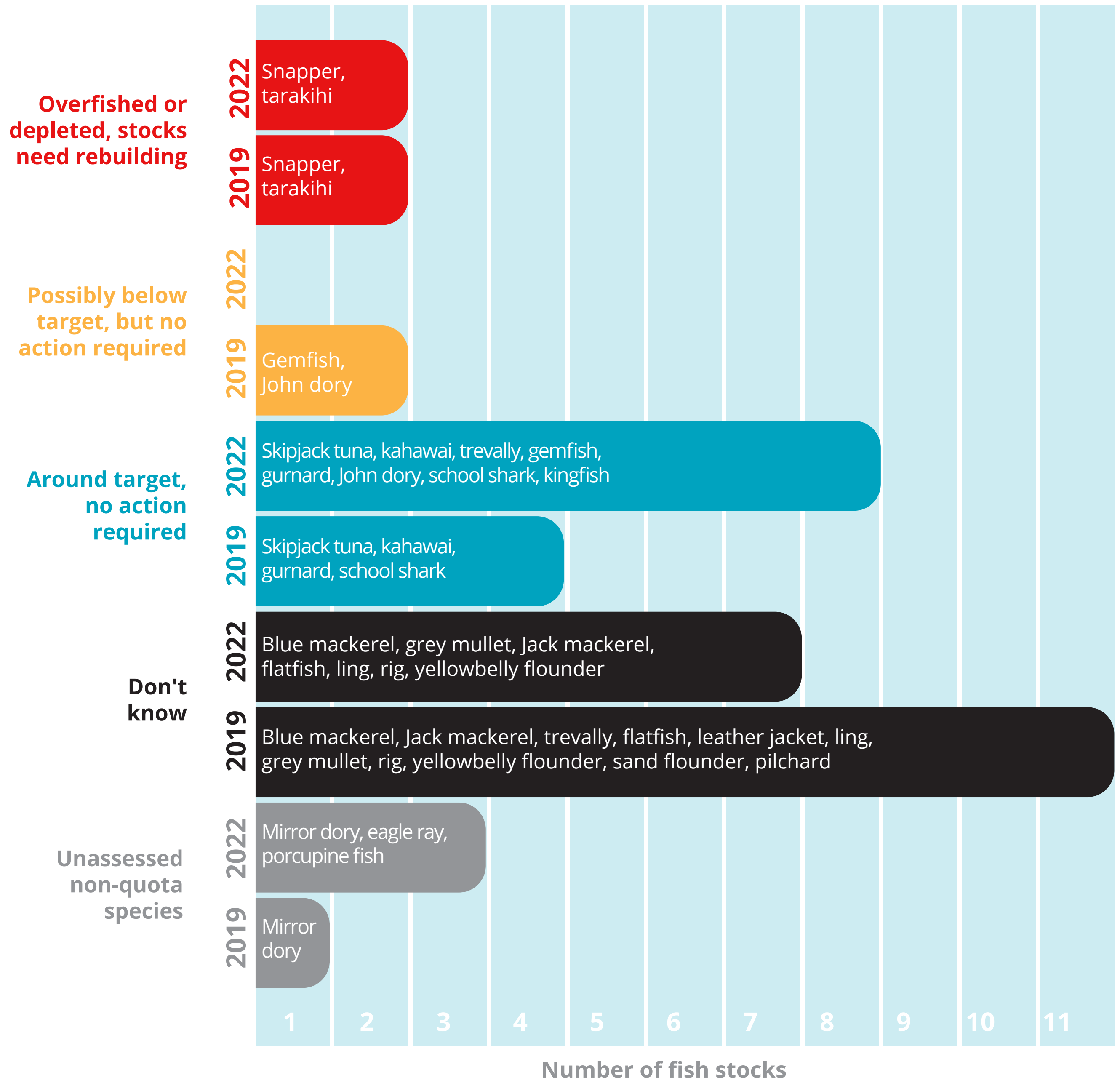


Figure 5: Status of the top 20 fish stocks caught commercially in the Marine Park in relation to the targets set by the Minster of Oceans and Fisheries.

Stock size and sustainable catch assessments against fisheries targets have been produced for 10 of the top 20 fish caught in the Marine Park between the 2020 and 2023 State of Our Gulf reports (***Figure 5***): tarakihi, tāmure, tīkati (gemfish), kuparu (John dory), Skipjack tuna[h], kahawai, kumukumu (gurnard), araara (trevally), tope (school shark) and haku (kingfish).[4] Eight species were assessed in 2020.

Latest reports indicate that eight of the 10 species assessed are fluctuating around target levels (Skipjack tuna, kahawai, araara (trevally), tīkati (gemfish), kumukumu (gurnard), kuparu (John dory), tope (school shark) and haku (kingfish)).[4] In contrast, four of the eight species assessed in 2020 were fluctuating around target levels.

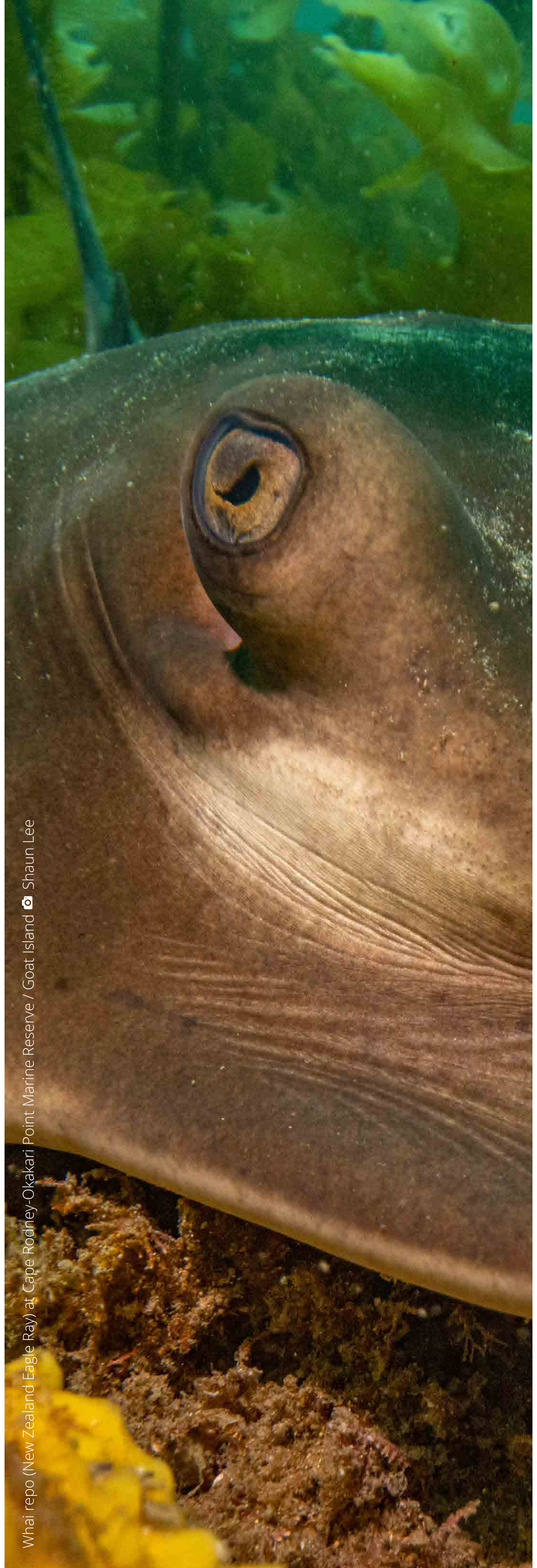
The Hauraki Gulf/Bay of Plenty tāmure substock was last assessed in 2013. An interim target of 40% of the unfished level was set, with the stock sitting just below 20%, meaning that it should be actively rebuilt. An update to that assessment is being undertaken, with preliminary findings indicating that the 2021 biomass may have increased slightly from 2013 estimates, but it was very unlikely to be at, or above, the target level. It is not known if the stock had risen above the 20% 'soft limit' for this species.[4]

The Aotearoa east coast tarakihi stock was reassessed in 2021, following an appeal of the Minister's 2019 decision on catch limits *(see below for more details)*. The updated assessment indicated that current stock levels were 19% of the unfished spawning biomass. In October 2022, the total allowable commercial catches of East Coast tarakihi stocks were reduced by a further 15% to allow the stock to rebuild to the management target of 40% of the unfished spawning biomass within 15 years.[25]

Insufficient information is available to determine the status of seven quota management species (tawatawa (blue mackerel), kanae raukura (grey mullet), hauture (Jack mackerel), pātiki (flatfish), hokarari (ling), makō (rig), and parore compared with 11 quota management species in 2020.

Three of the top 20 species caught are non-quota species (mirror dory, whai repo (eagle ray), porcupine fish) so sustainable catch limits have not been determined for these species (compared to one species in 2020).

[h] A proportion of skipjack tuna catch is likely to have come from beyond the offshore boundary of the Marine Park. The management of this species throughout the western and central Pacific Ocean (WCPO) is the responsibility of the Western and Central Pacific Fisheries Commission (WCPFC). New Zealand is responsible for ensuring skipjack tuna management within our waters is compatible with their procedures.



Whai repo (New Zealand Eagle Ray) at Cape Rodney-Okakari Point Marine Reserve / Goat Island 📷 Shaun Lee

Tarakihi 📷 Sarah Milicich

Update on the Tarakihi stock

A 2017 assessment of the East Coast tarakihi stock indicated that the stock had been depleted since the mid-1970s, following high catches during the 1950s and early 1960s. In 2018, a staged approach was implemented to rebuild the stock to the management target of 40% of the unfished spawning biomass.[25-27] It provided industry with a short period to plan and adjust their operations before further changes were implemented. Commercial catch rates were initially reduced by 20% in 2018–19 to allow the stocks to rebuild. An additional 10% cut was implemented in October 2019, along with the Minister agreeing to the implementation of a rebuild plan prepared by the fishing industry (Industry Rebuild Plan), and cameras to be fitted to vessels operating in TAR 2 and TAR 3 areas (which are outside the Marine Park). The Minister noted his decision reflected his understanding of the economic impacts on fishers, their families, and communities, balanced against his responsibility to ensure the sustainability of the fishery. The combined effect of these decisions was a reduction in the total allowable catch (which includes commercial, recreational and Māori customary catch) for East Coast tarakihi of 22%.[26]

The Minister's 2019 decision was appealed on multiple grounds to the High Court by Forest and Bird. Among other things, the Court found:

that the Minister made an error of law by not assessing whether the period set for the stock rebuild was appropriate based on technical advice concerning the stock's biological characteristics and environmental conditions, before applying social, cultural, and economic factors to their determination;

guidance on probability in the Harvest Strategy Standard and the Standard's Operational Guidelines was a mandatory relevant consideration, which the Minister failed to have regard to when making the 2019 decision;

the Minister had regard to an irrelevant consideration, the Industry Rebuild Plan, in relation to setting a rebuild period appropriate to the stock;

the 2019 total allowable commercial catch decisions were affected by the material errors made in setting the total allowable catch.

As noted earlier, the East Coast tarakihi stock was reassessed in 2021, and in October 2022 the total allowable commercial catches of those stocks were reduced by a further 15% to allow them to rebuild to the management target within 15 years. In making his 2022 decision, the Minister for Oceans and Fisheries highlighted, *"I have had regard to the findings in the High Court judgment, along with my statutory obligations under the Fisheries Act. Specifically, I have determined a period appropriate to the stock before applying socio-economic factors in my decision. I have also determined an acceptable probability of achieving the target, having regard to both the Harvest Strategy Standard and its associated Operational Guidelines."*[28]

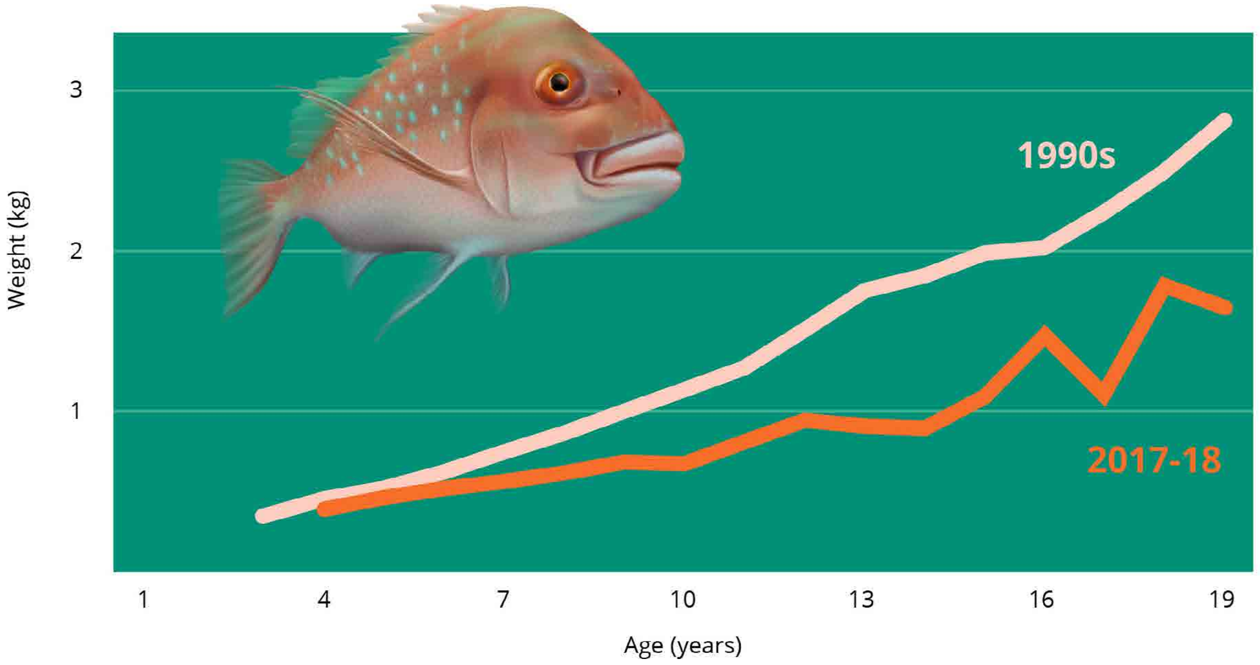


Figure 6. Change in the growth rate of tāmure from the Hauraki Gulf substock between the 1990s and 2017–18. Figure adapted from Figure 22 in the New Zealand Fisheries Assessment Report 2019/45.[32]

Milky flesh in Tāmure—a sign of starvation?

Concerned fishers in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf have been reporting occurrences of 'milky flesh' in tāmure during summer of 2022-23.[29] Affected fish are noticeably skinny and have white-coloured, mushy flesh. Testing conducted by Biosecurity NZ indicates that the milky flesh is caused by chronic malnutrition, with affected fish showing a range of indicators of nutritional deficiency such as:

- low weight-length ratio;
- unhealthy looking viscera;
- muscle degeneration and changes associated with a prolonged period of starvation;
- liver atrophy (shrinking) and a lack of polysaccharides;
- presence of macrophage aggregates that are associated with the breakdown of fat;
- evidence of iron accumulation in the livers that was attributed to chronic starvation, tissue breakdown and poor haemostatis of iron in the body.[30]

Analysis of length-weight data over the past 30 years clearly shows that growth of tāmure from the inner Gulf (Hauraki Gulf substock) has slowed markedly over this period. In 2017–18, five to fifteen year old tāmure were 34% lighter than they were in the 1990s (*Figure 6*).[32] Fish from northeastern Aotearoa were less affected, with tāmure from the East Northland and Bay of Plenty substocks being, on average, about 30% heavier and 10% longer than the Hauraki Gulf substock.[31]

A recent estimate of the size of the tāmure population in the Gulf is not yet available, though preliminary findings indicated that the 2021 biomass was likely to be similar to the 2013 estimates.[4] However, trawl surveys of juvenile (1+ and 2+ year) snapper in the Gulf show that the 2018 and 2019 year classes were well above the average year class strength for the Gulf, which indicates that strong recruitment has occurred in recent years.[33]

The slowing of the growth rate over the last three decades, the strong recruitment of recent year classes, and the increasing signs of malnourished fish suggest that the tāmure population in the Gulf may be food-limited and displaying a density-dependent effects on growth and fish health. It is unknown whether the recent occurrences of 'milky flesh' are a sign that the Gulf, in its current state, has reached its current carrying capacity for tāmure, or whether climate or other environmental factors have contributed to an unusually 'lean' summer during 2022–23. On-going research on the incidence of 'milky flesh' will hopefully provide more information on its causes in the future.

KEY EVENTS

2002: Mohimohi (pilchard) and tawatawa (blue mackerel) introduced into the quota management system.

2003: Haku (kingfish) introduced into the quota management system.

2004: Kahawai introduced into the quota management system.

2008: Ministry of Fisheries implement the Harvest Strategy Standard, setting default targets and lower limits for fish stocks.

2009: Fisheries 2030 released.

2011: Draft national plans for inshore finfish and shellfish released.

2013: Tāmure stock assessment indicates the fishery is overfished and depleted.

2015: Review of the fisheries management system initiated.

2016: Tāmure (SNA1) management plan released and accepted by the Minister.

2017: Tarakihi stock assessment indicates the fishery is overfished and depleted.

2018: A total allowable catch for kuparu (John dory) set for the first time, introducing recreational and customary catch allowances and reducing the existing commercial catch allowance.

Tarakihi commercial catch reduced by 20%.

2019: Minister decides on additional measures to rebuild the tarakihi stock, but that decision is appealed.

2020–23

2020: Decision on tarakihi appeal released.

2021: Tarakihi stock reassessed.

2022: Total allowable commercial catch of East Coast tarakihi those stocks were reduced by a further 15% to allow them to rebuild to the management target within 15 years.

A normal snapper filet (top) and an abnormal 'milky' filet (bottom) Aaron Styles / The Fishing Website

Koura (Crayfish) at the Whanganui A Hei / Cathedral Cove Marine Reserve Shaun Lee

HE RANGAHAU WHAKAPŪAHO (Case study)

HE RANGAHAU WHAKAPŪAHO: HE AHA TE AROMATAWAI RĀNGAI IKA?

What is a stock assessment?

"Managing fisheries is hard; it's like managing a forest in which the trees are invisible and keep moving around"

—Professor John Shepherd (from an unpublished lecture at Princeton University, ~1978).

Juvenile tāmure (snapper) Cape Rodney-Okakari Point Marine Reserve © Shaun Lee

Professor Shepherd's insight is as accurate today as it was half a lifetime ago; only very rarely do we get to see and count the fish accurately, so we have to rely on other types of observations and mathematical models or algorithms.

Broadly speaking, a stock assessment is an analysis of available information used to infer the history and current status or condition of what is assumed to be a population or 'stock' of fish. Some stock assessments are quite simple, using only limited information on the stock in question, perhaps the growth rate and an estimate (often tenuous!) of maximum age or the rate of natural mortality (what proportion die each year of natural causes). Conversely, stock assessments for key fisheries can involve tremendously complicated numerical models bringing together information from many years on fish size distributions, age measurements, tagging studies, field surveys of biomass, distribution, or catch, and detailed industry records of fishing effort and success. Knowledge of the catch over time is almost always an important input, and sometimes it's the only one.

The choice of a stock assessment approach is driven by the availability of information and the nature of the fishery concerned. It is normal for stock assessments to become more and more sophisticated as a fishery develops; in the early years of a fishery, little information is available and only simple models can be applied, but as the fishery grows and more information is collected, more complex analyses and models become possible. The drive to collect a wide range of detailed data is stronger for fisheries that are considered particularly important or at risk.

Whatever the level of complexity, the aim of stock assessment model is to find a representation of reality (a model) that best fits the available data. That is done by finding the 'best' combination of values for the key variables in the model structure that drive the number of fish in a model's population, the average productivity of those fish, and how they vary over time or with fishing. Finding those values is done by comparing a developing model's predictions of how things have varied over time with whatever real-world data we can supply.

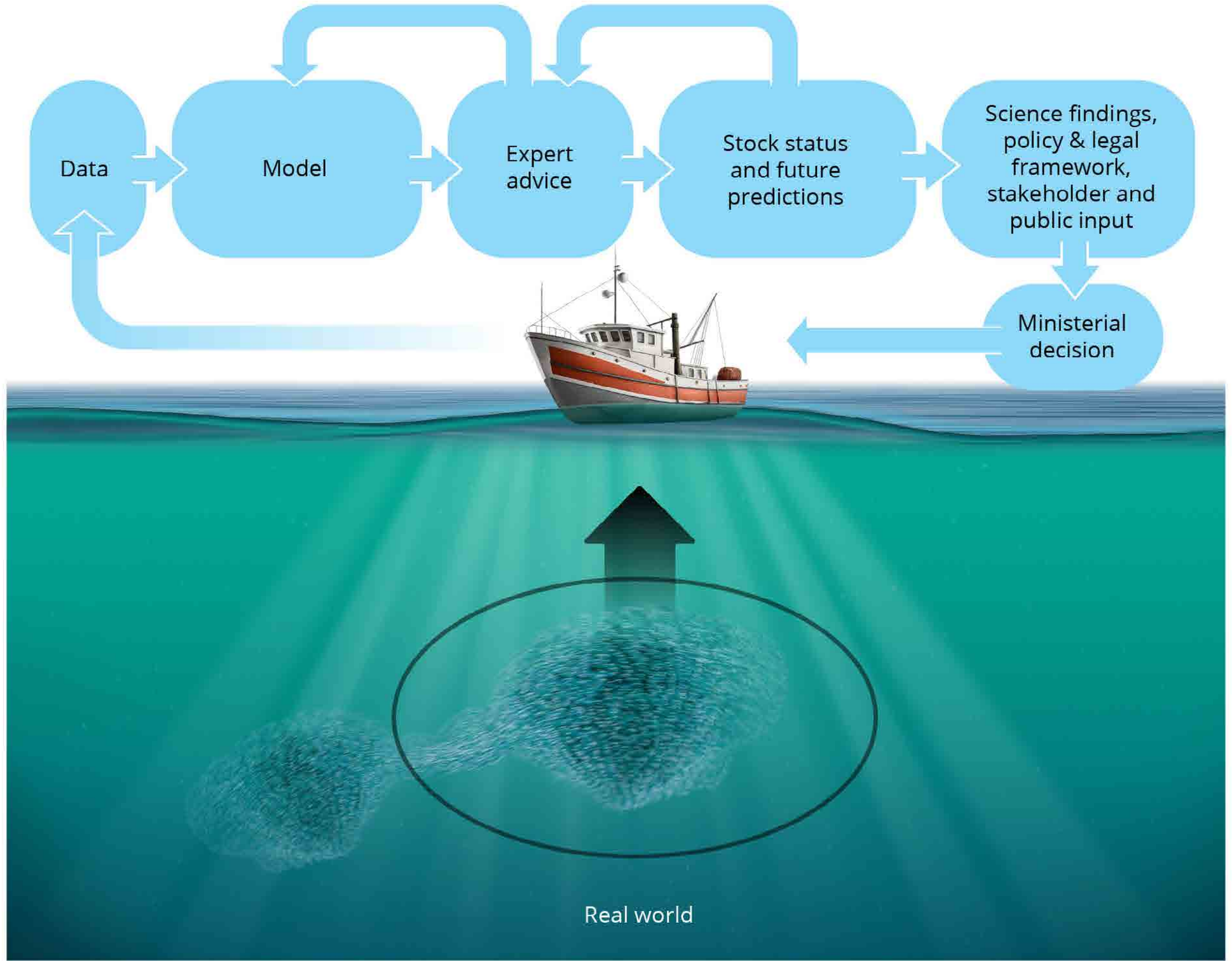


Figure 7: Our current stock assessment process.

Stock assessments are usually commissioned by government agencies or (less commonly) by industry groups, and are usually conducted by specialised fisheries scientists. Increasingly, flexible and powerful software packages using sophisticated statistical methods are used to conduct the more complex stock assessments.

In New Zealand, most work on stock assessments is reviewed by technical working groups and/or expert panels who scrutinise the model structure and assumptions (***Figure 7***). Typically, after several meetings and a lot of analysis by the assessment team, the review group should be able to settle on what they believe to be the 'best' model and stock assessment. This is usually called the 'base case'. The group should also be able to agree on the set of sensitivity models that, together, describe the uncertainty related to that model's key assumptions.

Sometimes the review group cannot agree on a single base case because they are so uncertain about one or more of the assumptions involved. In this case, two or more models and stock assessments are produced and documented. They might produce very different estimates of status or forecast for the fish stock.

For an important stock assessment in New Zealand, and for most stock assessments that seem likely to lead to changes in management settings (catch limits, size limits, etc.), the work of the assessment team and the standing working group will then be reviewed by another expert panel comprised of appropriately skilled scientists who have not been involved in the work previously. These reviews are conducted

Hauture (Jack Mackerel) at Cape Rodney-Okakari Point Marine Reserve 📷 Shaun Lee

twice a year during Fishery Assessment Plenary Meetings. The Reports from the Fishery Assessment Plenary Meetings summarise what is considered to be the best available information on fish stock assessments each year. Stock assessments that are unusually novel, complex, or contentious may also be reviewed by panels of international experts.

Given this process, some stock assessments, especially complex or contentious ones, can take a long time. The process of building, testing and refining an acceptable model can take months or years, even if information is already available. If new information is deemed necessary to reduce some key uncertainty in a previous stock assessment, it can take several years to collect that data. For example, a science project to design, conduct, analyse, and report on a tagging study to estimate the number of fish in a particular stock is likely to take at least three years. Fitting a 'big ticket' (multi-million dollar) item like a large tagging programme within a constrained research budget is also hard, as science and fishery managers constantly need to prioritise and reprioritise their information needs as the world changes around them.

The key strengths of good stock assessments are that they can: integrate a wide variety of available data together; describe the history of the fishery well (giving confidence to those who have observed changes over time); and estimate the current status of a fish stock with acceptable precision. In New Zealand, status is judged, wherever possible, as the current biomass (total weight of fish in the stock) against stock-specific targets and limits AND as the current intensity of fishing (total catches divided by the biomass) against stock-specific targets and limits. These are all documented in publicly available reports from the Fishery Assessment Plenary Meetings.

Complex stock assessments can also predict what is likely to happen in the near future, if

Tāmure (Snapper) in the Whanganui A Hei / Cathedral Cove Marine Reserve 📷 Shaun Lee

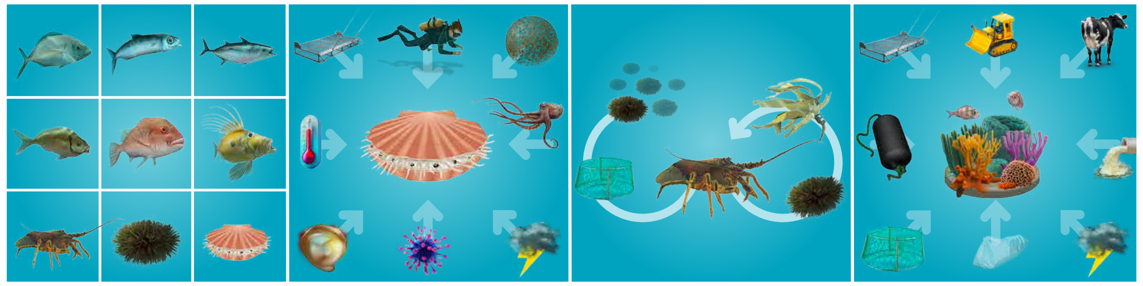
management settings remain the same or are changed, as well as describing uncertainty. Fishery managers use these assessments of status to prioritise management interventions (changes to catch limits, size limits, etc.) to meet the purpose of New Zealand's Fisheries Act (1996), i.e., to provide for utilisation while ensuring sustainability. Broadly speaking, they focus on keeping fish stocks around target levels and away from the pre-defined limits on biomass and fishing intensity.

But stock assessments are only as good as the data and assumptions that are necessary to build a model, which is always a caricature of a more complex real world. Remember, fish are not like trees, and we can only rarely count them, and they're always moving around, sometimes unpredictably.

The many methods we use to follow trends in biomass all have their issues, as do the methods we use to estimate growth, mortality, and migration. Different data sets may tell slightly different stories, and sometimes there are strong tensions in a model with some data pulling the model one way and other data pulling in the opposite direction. Dealing with such conflicts is difficult and often relies on changing or estimating the statistical weight attached to different types of data. This relies on expert judgment as well as modelling skill. A good stock assessment will include estimates or descriptions of how important these uncertainties are, but the complexity of a fish stock's actual history and productivity can never be entirely described using single-species models with strong simplifying assumptions about how the world works.

Some factors that are important to the stock may not be represented at all in a stock assessment model, and these might include habitat extent or quality, temperature variability, interactions with other species, weather and circulation cycles, climate change, etc. In the past few decades, stock assessment models that include one or a few of these factors have started to appear, and some (not all) show that ignoring real-world complexities can lead to misleading assessments. But the great majority of today's stock assessments include just a single species in an area.

By no means is this a call to stop doing single species stock assessments and introduce more complex models including all manner of ecological interactions for all stocks. Stock assessment modelling as currently conducted, has provided, and can continue to provide, extremely valuable advice for fisheries managers, especially in a year-by-year context. We need to get better at understanding the implications of ecological interactions, regime shifts, and climate change, but this does not have to mean dropping single species assessments altogether. Stock assessment is difficult, and seeming simplistic in some of its assumptions, but it still has its place; ideally embedded in an increasingly ecosystem-based approach (***Figure 7***).



Management methodology	Single Species	Ecosystem approaches to fisheries management	Ecosystem-based fisheries management	Ecosystem-based management
Key sector/s	Fisheries	Fisheries	Fisheries	All sectors that use or influence marine ecosystems
Key focus	Stocks targeted by fisheries	Stocks targeted by fisheries	Marine ecological communities affected by fishing	Holistic management of the marine environment
Key objectives for assessments	Determine the status and productivity of a target stock. Identify levels where stock production is optimal. Evaluate the effects of fishing on the stock.	Determine the status and productivity of target stock. Identify levels where stock production is optimal, recognising that in addition to fishing, broader ecological and environmental factors affect the production of the target stock. Evaluate the effects of multiple drivers on the stock.	Assess ecosystem productivity and effects of fishing and environmental factors on target species and interactions. Evaluate cumulative fishing effects on the system. Establish Systemic Reference Points (SRPs) for optimising ecosystem yields while achieving conservation, resilience, and socio-economic outcomes.	Ascertain the ecosystem goods and services provided by the system. Evaluate cross-sector cumulative effects. Address cross-sector trade-offs.
Key outputs of assessments	Targets and management limits for the stock (i.e. biological reference points or BRPs).	Targets and management limits for the stock (BRPs).	Fishery systemic targets, management limits and other actions (SRPs).	Multi-sector systemic targets, management limits and other actions (SRPs).

Current

Proposed plan

Hauraki Gulf Marine Park Act 2000

Figure 8: Changes in assessment complexity and objectives along the continuum from single species fisheries management to holistic ecosystem-based management. Our current position and potential positions along the continuum are shown as the Hauraki Gulf Fisheries Plan is introduced and if the integrated management envisioned under the Hauraki Gulf Marine Park Act was realised.

TOHU (Indicator)

NGĀ KŌURA
Crayfish

"He tūtū kākā ki uta, he toka koura ke ti moana"

"On the shore a tree for snaring parrots, in the sea a crayfish rock"

A whakatauki highlighting that subsistence requirements could always meet with the supply of such delicacies, with surplus' available for exchange. [1]

Kōura at Cape Rodney-Okakari Point Marine Reserve © Shaun Lee

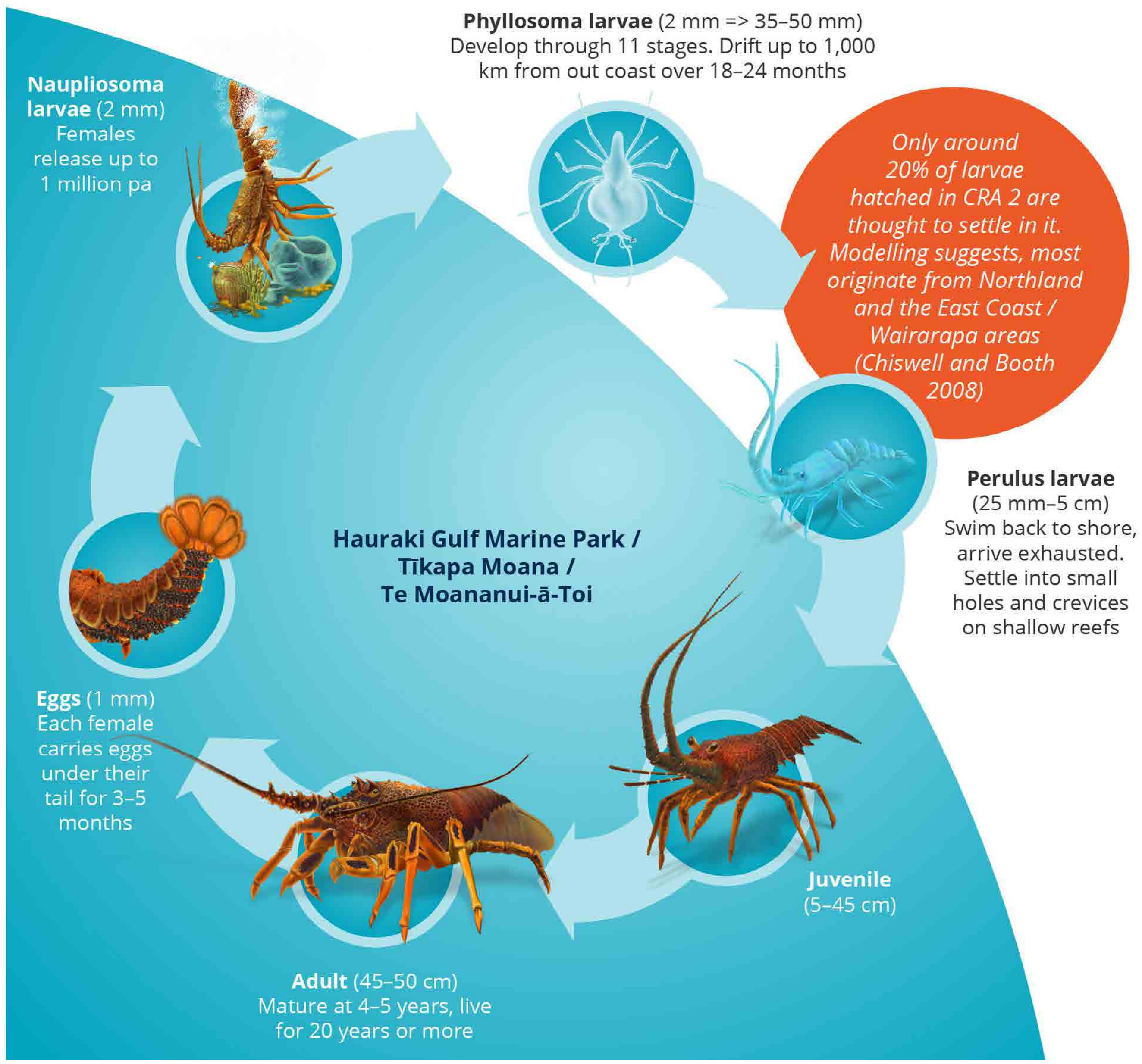
Kōura (crayfish), are a relatively slow-growing and long-lived spiny lobster. They are the most important lobster species in Aotearoa, both in terms of their ecological role and their economic importance. Kōura have a broad diet, feeding on a wide variety of marine animals and rimurimu (seaweeds). Research on large, adult kōura in the Marine Park indicates that they make seasonal movements between inshore and offshore sites to forage, moult, mate and release their larvae.[34,35] However, they usually remain in the same general area, commonly returning to the same inshore den after offshore movements. Juvenile kōura tend to be more mobile than adults, and in some parts of Aotearoa, are known to undertake large-scale migrations.

Kōura have an extended and complicated planktonic larval phase, spending around 12–18 months drifting in the ocean, potentially hundreds of miles from where they originated. During the latter part of this stage they metamorphose into a non-feeding puerulus larvae and swim towards the shore. The complex and extended nature of their larval phase means that settlement of kōura in the Marine Park is sporadic and unpredictable.

Previous reports have described changes in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf kōura population. Although commercial landings in CRA2 (which includes the Marine Park) were relatively static between 1990 and 2013, commercial catch rates (catch-per-unit-effort) fell sharply between 1997 and 2003, and after a slight rebound between 2004 and 2007, bottomed out in the 2015–16 season. In the 2017 stock assessment, the biomass of mature female kōura (i.e., the spawning stock biomass) was estimated to have dropped to 18.5% of the unfished spawning stock biomass, while the biomass of all kōura able to be caught legally in autumn-winter (i.e., the vulnerable biomass) was estimated to be 5.2% of the unfished vulnerable biomass. Note that the interim target for the CRA2 stock is currently set at around 12% of the unfished vulnerable biomass[i,35]

[i] The average vulnerable biomass in 1979–81.

Kōura (Crayfish) lifecycle



Estimates of the vulnerable biomass of koura inside and outside Cape Rodney-Okakari Point Marine Reserve and Tāwharanui Marine Reserves obtained through dive and potting surveys in 2018 and 2019, produced similar estimates to the 2017 stock assessment. The biomass of fished populations around the reserves was estimated to be 2.6–3.6% of the unfished biomass inside the reserves. However, results for mature female kōura were much lower than those produced by the stock assessment, with the spawning stock biomass of the surrounding fished population only 1.9–3.1% of the unfished population.[36]

Substantial cuts were made to commercial catch limits for kōura in 2018 to rebuild the stock, reducing the total allowable catch from 416.5 t to 173 t, and the total allowable commercial catch from 200 t to 80 t. Recreational catches were also reduced from 140 t to 34 t, and in 2019 daily bag limits for recreational catches were reduced from 6 to 3 per person. In 2020, a requirement was also introduced for recreational fishers to clip the telson (tail fan) of kōura taken from CRA2 to reduce illegal sales.[37]

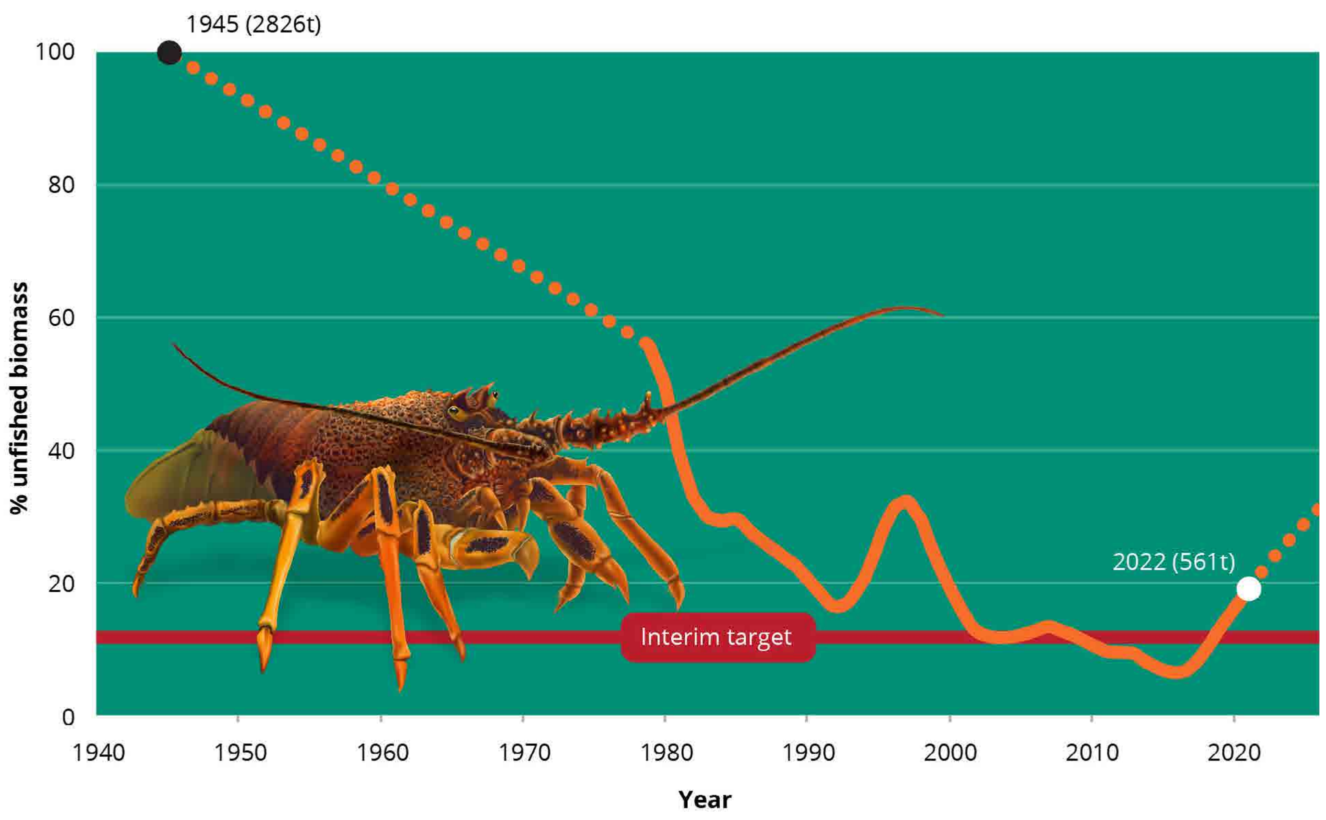


Figure 9: Predicted changes in the biomass of the vulnerable CRA2 kōura stock during the autumn winter period (straight pre-1979 dotted line simply connects 1945 and 1979 predictions, solid line represents mean model predictions of biomass between 1979 and 2021, and dotted line from 2022 to 2026 represents future projections). The vulnerable biomass during this period mainly consists of male kōura, because most mature females are carrying eggs and cannot be legally caught. The interim fisheries target for the stock is based on the vulnerable biomass and provided for reference (adapted from "Historical Stock Status Trajectory and Current Status" of CRA2 in the November 2022 Fisheries Assessment Plenary).[38]

Five years on, the 2022 stock assessment of CRA2 indicated that the vulnerable biomass and spawning stock biomass had doubled since 2017. The vulnerable biomass was estimated to be 20% of the unfished vulnerable biomass (based on the median projection)—exceeding the interim management target of around 12% by 68% (*Figure 9*). A similar trajectory was estimated for the spawning stock biomass, which was estimated to be 40% of the unfished spawning stock biomass—now well above the soft limit of 20%. The total biomass of the stock was predicted to be sitting at around 32% of the unfished biomass in 2022. Biomass estimates are predicted to continue increasing over the next five years at the current total allowable catch levels.[38]

However, concerns remain about koura populations, with a rāhui being placed on harvesting around Waiheke *(see Rāhui Case Study)*. Kōura surveys conducted in 2021 and 2022 as part of the Waiheke Marine Project and Noises Marine Protection and Restoration Group found very few kōura.[39,40] The latest monitoring results from the Cape Rodney-Okakari Point Marine Reserve and Tāwharanui Marine Reserve showed a slight increase in lobster abundance in unprotected areas and in the Tāwharanui reserve over the past few surveys. However, there was little change in lobster abundance within the Cape Rodney-Okakari Point Marine Reserve. Lobster abundance in the unprotected and reserve sites also remained well below levels recorded in 1995.[41]

The removal of a large proportion of the kōura population from the Gulf has had consequences well beyond the impacts on a single species. Kōura have been described as functionally extinct in the Gulf.[42] An upsurge of urchin barrens, and associated decline in kelp forests in the Gulf have been attributed to numbers of kōura and tāmure being too low to control grazing kina populations.[43] The increase in kina barrens around the Gulf has long been a topic of concern, but only recently have scientists started measuring the extent of the problem. Aerial imagery shows that no urchin barrens were present around Te-Hauturu-o-Toi in 1953, but by 1979 urchin barrens covered 12% of subtidal reefs, and in 2019 this had increased to 33%. Similarly, urchin barrens covered 24% of the reef around the Noises in 1979, which increased to 50% in 2019.[44]

Kōura at the Whanganui A Hei / Cathedral Cove Marine Reserve Shaun Lee

Marine Protected Areas can help reverse the expansion of kina barrens. Numbers of large kōura and tāmure increase within protected areas, which have been shown to gradually reduce the size of kina barrens.[43] However, Marine Protected Areas need to be sufficiently large to protect kōura from moving beyond their boundaries and getting caught. Examination of long-term kōura monitoring data from three small marine reserves (Cape Rodney-Okakari Point, Tāwharanui and Whanganui A Hei) found that most of the initial gains in kōura numbers made by the marine reserves were lost over time, which was likely due to fishing extraction along the reserve boundaries.[45-47] The Department of Conservation and Fisheries NZ are proposing to increase the size of the Cape Rodney-Okakari Point and Whanganui A Hei marine reserves by 2.6 times and 1.7 times, respectively,[48] which would provide greater protection for kōura living within the reserves.

In a related 2022 decision, the High Court highlighted that Section 9 of the Fisheries Act sets out 'mandatory environmental principles' that the Minister must take into account when making a decision. These include maintaining the long-term viability of associated or dependent species; maintaining biological diversity; and protecting habitat of particular significance for fisheries management. In relation to the role of kōura in controlling the expansion of kina barrens, the High Court accepted that when setting the 2022–23 total allowable catch for Northland (CRA1), the advice provided to the Minister by the National Rock Lobster Management Group and Fisheries NZ, and upon which he based his decision, was not the best available information and was materially inaccurate.[49] The High Court therefore directed the Minister to reconsider the 2022–23 decision.

The Minister has recently reduced the total allowable catch in CRA1 from 193 to 172 tonnes, reduced the total allowable commercial catch from 105 t to 89 t, and reduced the recreational allowance from 27 to 22 tonnes. To manage recreational catch to within the revised allowance the Minister also reduced the recreational daily limit to 3 per person.[50]

The principles set out in Section 9 of the Fisheries Act also apply to the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf and are expected to be reflected in future decisions on the CRA2 kōura stock.

KEY EVENTS

1980: Commercial landings in CRA2 peaked at 441 t.

1990: Crayfish stocks introduced into the Quota Management System.

1997: Total allowable catches set for the first time for CRA2.

1997–1998: Onset of large, rapid decline in commercial catch rates per unit effort (but not commercial landings).

2000: Kōura numbers in Cape Rodney to Okakari Point Marine Reserve were substantially below those recorded in 1995.[51]

2007–2016: Commercial catch rates continue to gradually decline. Similar declines in kōura numbers are picked up in marine reserve monitoring data.[51,52]

2013: Scientists declare kōura functionally extinct in terms of the role they play in the ecosystem.

2014: Management procedures introduced with pre-determined triggers for adjusting commercial catch allowances based on catch per unit effort data. Total allowable commercial catch reduced from 236 t to 200 t.

2016: No change in the total allowable commercial catch, but concern about declining catch rates leads commercial fishers to voluntarily shelve 49 t of their catch allowance.

2017: Total allowable commercial catch unchanged, but commercial fishers continue to shelve part of their catch. Stock assessment was brought forward by a year and found that vulnerable biomass was below the reference level and needed rebuilding.

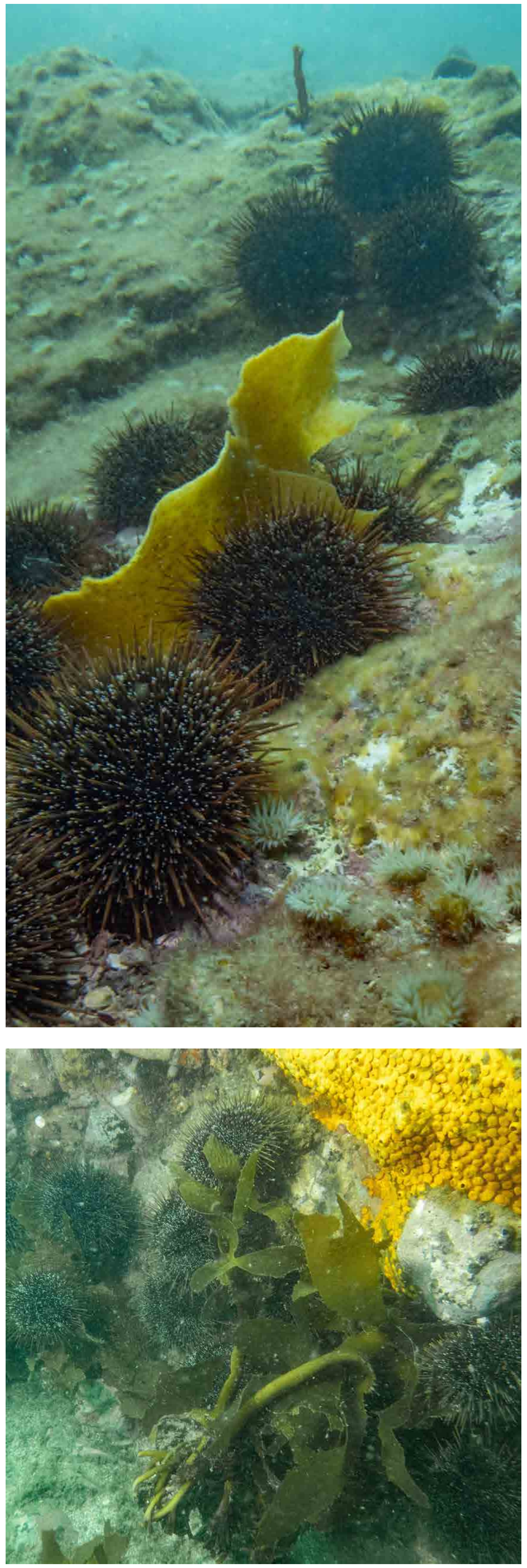
2018: Major cuts in total allowable recreational and commercial catches by the Minister aimed at rebuilding the stock in 4 years.

2020–23

2020: The Minister approves proposals for reducing recreational bag limits and to introduce telson clipping.

2022: CRA2 stock assessment shows that the vulnerable biomass and spawning stock biomass have doubled over the past 5 years and were above their reference level and soft limit, respectively. Commercial catch rates have also increased significantly.

High Court decision that the Minister of Oceans and Fisheries needs to consider the wider effects of fishing on the marine environment when setting total allowable catches.



Depletion of predatory kōura and tāmure populations has allowed an upsurge in kina numbers, whose grazing turns highly productive kelp forests into barren reef habitat 📷 Shaun Lee and Shane Kelly

Photogrammetry of a kina barren on Te Hauturu-o-Toi (Little Barrier Island). 📷 Arie Spyksma / Seascape

TOHU (Indicator)

NGĀ TIPA
Scallops

"The results of the 2022 surveys are alarming, and I share the concerns expressed by stakeholders regarding the sustainability of the Little Barrier and Colville areas, as well the concerns expressed by tangata whenua and stakeholders regarding sustainability of the wider SCA CS stock"

— Minister for Oceans and Fisheries, Hon. Stuart Nash regarding his decision to close the Hauturu and Colville Channel scallop beds.[19]

Empty Tipa (Scallop) bed at The Noises 📷 Shaun Lee

Tipa are a fast-growing shellfish species that form discrete beds. In the Marine Park, tipa can reach harvestable size (100 mm) within 18 months, but growth rates vary considerably with depth; among areas, years and seasons; and, probably with the nature of the seabed. Growth tends to be much faster in shallow water. Scallops live for a maximum of 6–7 years. Larvae initially settling on fine filamentous structures such as hydroids and filamentous rimurimu (seaweeds). Small, juveniles are mobile, but they become sedentary as they grow. However, adults do move short distances to escape predators and can be swept around during storms.

The abundance, size and extent of scallops in beds can vary substantially from year to year due to natural processes and harvesting. The aggregation of tipa into beds increases their breeding success allowing greater mixing of eggs and sperm, and high-density beds are likely to be disproportionately more important for reproductive success.[22]

Interestingly, tipa are hermaphrodites, which means that individuals have both male (white) and female (orange) gonads.

Tipa are gathered from the Marine Park in accordance with fisheries regulations by Māori, recreational and commercial fishers. Māori and other non-commercial fishers target a variety of beds using small dredges and diving, while all commercial fishing is done by dredge.

Tipa dredging flattens the seabed by removing physical features, biogenic habitat and killing emergent plants and animals in the path of the dredge. It also damages and stresses discarded or uncaptured tipa and makes them more vulnerable to predators. The number of tipa dredging events (707) in the three years to 2021 was 39% lower than in the previous three years (***Figure 10***).

Commercial fishing over the past 25 years has mainly occurred around Te-Hauturu-o-Toi and between east Coromandel and Ahuahu. From 1992 onwards the base catch limit for the

Tipa protected by rāhui on Waiheke Island 📷 Shaun Lee

Coromandel fishery was set at 22 t meatweight, but fishers could request increases in the catch allowance during the fishing season. Those requests were usually supported by information from in-season bed surveys, and actual catch limits were up to 325 t (***Figure 11***).

A large new bed west of Cape Coville was discovered in 2011 that prompted a marked in-season increase in the commercial catch allowance, and a concentration of fishing effort around the new bed over the next few years. However, by 2014 the bed had collapsed and commercial fishers moved to other areas. Similarly, other beds, such as those east of Waiheke Island and around northwest Coromandel have previously been commercially fished but are no longer productive (***Figure 12***).

Changes in how the fishery was managed occurred in 2013. In-season adjustments were discarded, and the commercial catch was raised from 22 t to 100 t. A voluntary catch-per-unit-effort rule was also introduced that encouraged harvesting to be halted in an area if catch rates dropped below a set level. These changes eliminated the cost of in-season surveys and consultation processes, but as a result no tipa surveys were conducted in the Coromandel between 2012 and 2021.

Commercial catches and the abundance of tipa in commercial beds have fluctuated over the years. The lowest catches and population estimates occurred in 1999–2000. Population decline was thought to be due to the proliferation of 'black gill' disease and parchment tubeworms. Catch rates steadily increased until 2005, but have generally declined since then, apart from a brief increase in catch between 2011 and 2013 when the new Coville bed was discovered (***Figure 11***).

In recent years, concern amongst local communities and mana whenua about the ongoing declines in tipa populations prompted a number of iwi to take matters in their own hands, and a series of rāhui were announced to protect declining populations. Collectively, these rāhui cover a significant proportion of the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf *(see Rāhui case study)*.

Extensive surveys conducted in 2021 around commercial tipa beds found that there had been serious declines in tipa abundance, with an overall biomass decrease of 82% in the Coromandel fishery since 2012, and an overall decrease of 73% in the Northland fishery since 2007.[53] Estimated tipa densities and biomass indicated that most of the fishery areas would not support sustainable fishing. These

[1] *Pecten novaezealandiae*

KEY EVENTS

1999–2000: Record low catch and biomass estimates for commercial tipa beds surveyed reported.

2002: Tipa brought into the Quota Management System.

2005: Recreational rules changed to permit divers to collect bag limits for two non-divers acting as safety people.

2011: Large new bed discovered in deep water, west of Cape Colville. Dredging spikes in that area over the next two years.

2012: Coromandel tipa bed surveys carried out, including a survey of the bed discovered in 2011.

2012: Large increase in the commercial catch allowance for the year due to the discovery of the new bed.

2014: Bed discovered in 2011 collapsed and fishing ceased in the area.

2016: In-season adjustments replaced by 50 t commercial catch allowance and a voluntary catch per unit effort rule limit.

2020–23

2020: Ngāti Hei announce a rāhui around Opito Bay, east Coromandel in response to large declines in local tipa populations. This rāhui was extended to cover much of the east Coromandel (2413 km^2) and was formally approved for 2 years in 2021.

2021: Ngāti Pāoa announce a rāhui 1 nautical mile out from the Waiheke Island coastline for tipa, kutai, kōura and pāua. This rāhui was formally approved for two years in November 2021.

Extensive Coromandel tipa bed surveys carried out that showed large declines in abundance since the previous 2012 survey, with overall population size close to lowest recorded levels.

2022: Ngāti Manuhiri announce a rāhui for the area between Mangawhai and Whangaparoa including Te-Hauturu-o-Toi and Aotea to allow tipa beds to recover.

The Northland fishery and most of the Coromandel fishery was closed to commercial and recreational harvesters in April 2022, except for two areas around Te-Hauturu-o-Toi and in the Colville Channel.

Tipa surveys carried out at the two remaining fished areas showed serious declines in abundance at both sites since 2021. An emergency measure was implemented in December 2022 to close these two areas to fishing.

2023: The Coromandel fishery was closed to commercial and recreational harvesters indefinitely in March 2023.

results reinforced the concerns of iwi, local communities and fishers, and prompted the Minister of Oceans and Fisheries to close the Northland fishery and most of the Coromandel fishery to commercial and recreational harvesting in 2022, with the exception of small two areas (south of Te-Hauturu-o-Toi and in the Coville Channel; *Figure 11*), which were found to still have some areas of high-density tipa.[54] However, follow-up surveys conducted in these two areas in late 2022 found that the biomass of >90 mm tipa in Hauturu and Colville Channel had declined by 85% and 37%, respectively, since 2021. These biomass declines were much larger than the total allowable commercial catch of 5 t, indicating that factors other than fishing are likely to be also causing the decline in tipa populations. Given the serious and ongoing declines in the tipa populations in the Marine Park, the Minster implemented an emergency measure to close the remaining two areas in December 2022. In March 2023, the Coromandel fishery was closed to commercial and recreational harvesting indefinitely.[19]

The closure of the Northland and Coromandel fisheries follows the closure of the Nelson/Marlborough fishery in 2016 (which has not recovered since the closure) and means that Aotearoa no longer has any substantial tipa[j] fisheries left, with all other areas being commercially unproductive.

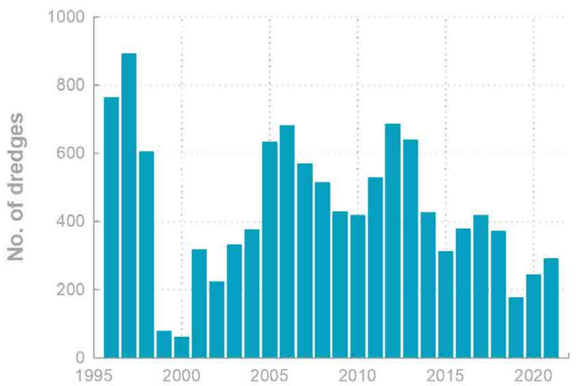


Figure 10. Number of commercial tipa dredges conducted in the Marine Park between 1996 and 2021.[k] Data from Fisheries NZ.

[k] Tows in statistical area 1R were excluded because the Marine Park only includes the offshore part of 1R, where scallop dredging is unlikely. Data provide by MPI

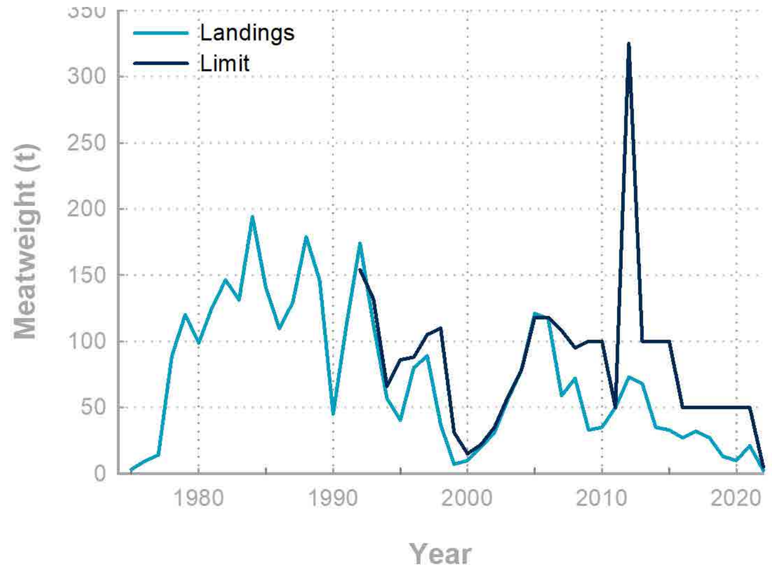


Figure 11: Changes in tipa commercial catch limits and landings for the Coromandel Fishery between 1974 and 2022. Meatweight prior to 1995 was estimated by dividing the greenweight by 8.[l] Data from Fisheries NZ.[55,56]

[l] The gazetted conversion factor.

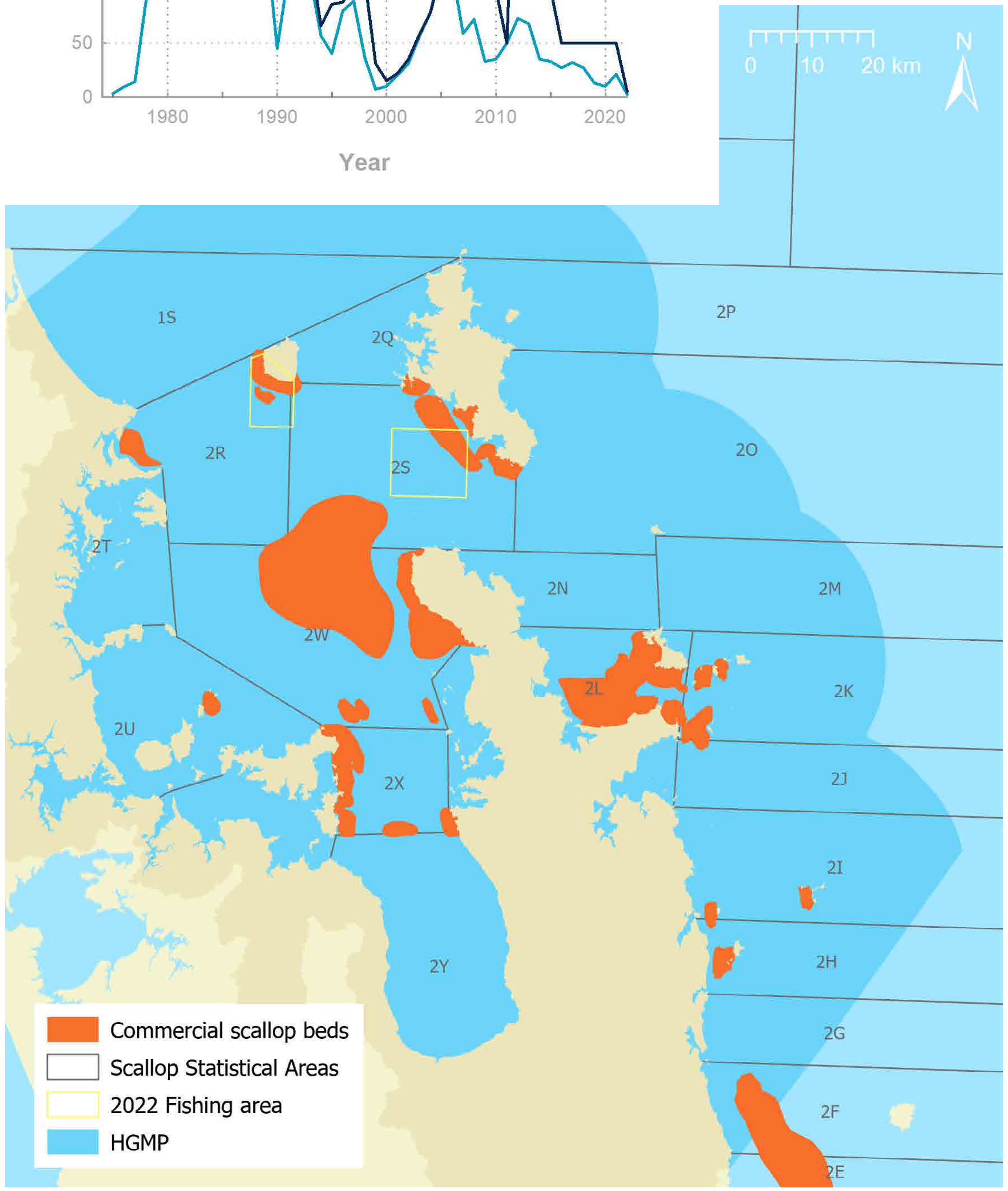


Figure 12: Boundaries of the Coromandel tipa fishery, the two areas that were open to fishing in 2022, and the main areas where tipa have been commercially fished.[57,58] Currently the entire Marine Park is closed to commercial and recreational fishing.

NGĀ TUANGI
Cockles

"Officers inspected the content and found 2,216 cockles, 10 whelks and 10 snails....it is extremely disappointing that greed and lack of consideration for the marine ecosystem is common among those we catch."

— Gary Orr, Director of Compliance MPI.[59]

Tuangi (New Zealand cockle) in Mangawhai Estuary © Shaun Lee

Tuangi play an important role in our bays and estuaries. Known as 'ecological engineers' they are efficient filter feeders, removing sediment and nutrients from the water, and their burrowing activity adds oxygen to the top 2–3 cm of the sediment. Tuangi are an important food source for numerous marine animals and waders, including mud whelks, pātiki (sand flounder), whai repo (rays) and tōrea (pied oystercatchers).

Tuangi were one of the most frequently consumed marine species by pre-European Māori and they remain a valued kai moana species for tangata whenua. Tuangi are not commercially harvested in the Marine Park, but they are frequently harvested by recreational and customary fishers.

Tuangi sit at the interface between the land and the sea. As a result, they are subject to other impacts such as pollution, sediment washed from the land, and high temperatures.[60-62] Environmentally stressed tuangi grow slower and are also more susceptible to disease. Tuangi prefer sandy mud, and their numbers decrease at high mud deposition rates and mud depth.[63,64] Mass mortalities due to disease, environmental stress and sedimentation, combined with over-harvesting, have decimated populations. Climate change will add increasing stress to tuangi populations as they are more frequently subjected to higher temperatures and large loads of sediment and contaminants from flood events.

Collecting a bucket of tuangi from the beach was once a common occurrence, but large tuangi have become increasingly scarce over time. Nowadays it is almost impossible to collect a bucket of large tuangi in the Marine Park, with only an average of 4% of the population of harvestable (≥30 mm) size at sites where harvesting is allowed (*Figure 13*).

Fisheries NZ have funded annual kai moana (shellfish) surveys at various sites around the upper North Island since 1992, which inform decisions on harvest closures. Complete harvest bans are in place at Umupuia, Whangateau, Eastern Beach, Cheltenham Beach, and Cockle Bay, but even in these areas, recovery of harvestable sized tuangi is very slow, and populations at some sites have not recovered, indicating that harvesting is not the only reason for the decline in large tuangi.

The tuangi population at Whangateau is the largest monitored population in the Marine Park. In 2010, a harvest ban was imposed at Whangateau following a mass mortality event. While the total population of tuangi at Whangateau has increased four-fold since the harvesting ban was implemented, the number of harvestable tuangi in Whangateau has not increased. Other factors such as high mortality of young adult tuangi, exceptionally slow growth rates, or a change in environmental conditions that no longer supports large tuangi may be preventing large tuangi from increasing.[65-67] Several mass mortality events of tuangi in Whangateau have occurred over the past decade, indicating that they are stressed by adverse environmental conditions *(see Section on Mass Mortalities)*.

Fisheries NZ surveys were complemented by a community monitoring programme that started in 2006, with funding provided by DOC, Auckland Council and Waikato Regional Council. The number of sites monitored by volunteers and school groups increased from three to 20 in the first few years of the programme. Data generated by community monitoring supported the implementation of the rāhui at Umupuia, and were the primary source of information behind the seasonal closures of Cockle Bay.[68] However, funding cuts in 2015 reduced the number of community monitoring sites to less than eight, and the data has not been analysed or reported since then.

KEY EVENTS

- **1992:** Fisheries NZ started funding tuangi and pipi surveys in northern New Zealand.
- **1998:** Reduced maximum daily bag limits introduced for recreational harvesting in the Auckland metropolitan area.
- **1999:** Reduced maximum daily bag limits introduced for recreational harvesting in the broader Auckland-Coromandel area.
- **2006:** HGF started the community monitoring programme with three sites.
- **2008:** Harvest at Cockle Bay closed annually between 1 Oct–30 Apr.
- **2008:** Formally approved rāhui placed on tuangi harvest at Umupuia that is still in place today.
- **2008–2009:** No MPI kai moana (shellfish) surveys conducted for 2 years.
- **2010:** Harvest at Whangateau closed following a mass mortality event.
- **2015:** Most funding for the community monitoring programme cut.[69]

2020–23

- **2020:** Formally approved rāhui placed on harvest of tuangi, pipi and kūtai (mussel) at Te Māta-Waipatukahu that is still in place today.
- **2021:** Harvest at Cockle Bay closed following population declines and lobbying from the local community.[71,72]

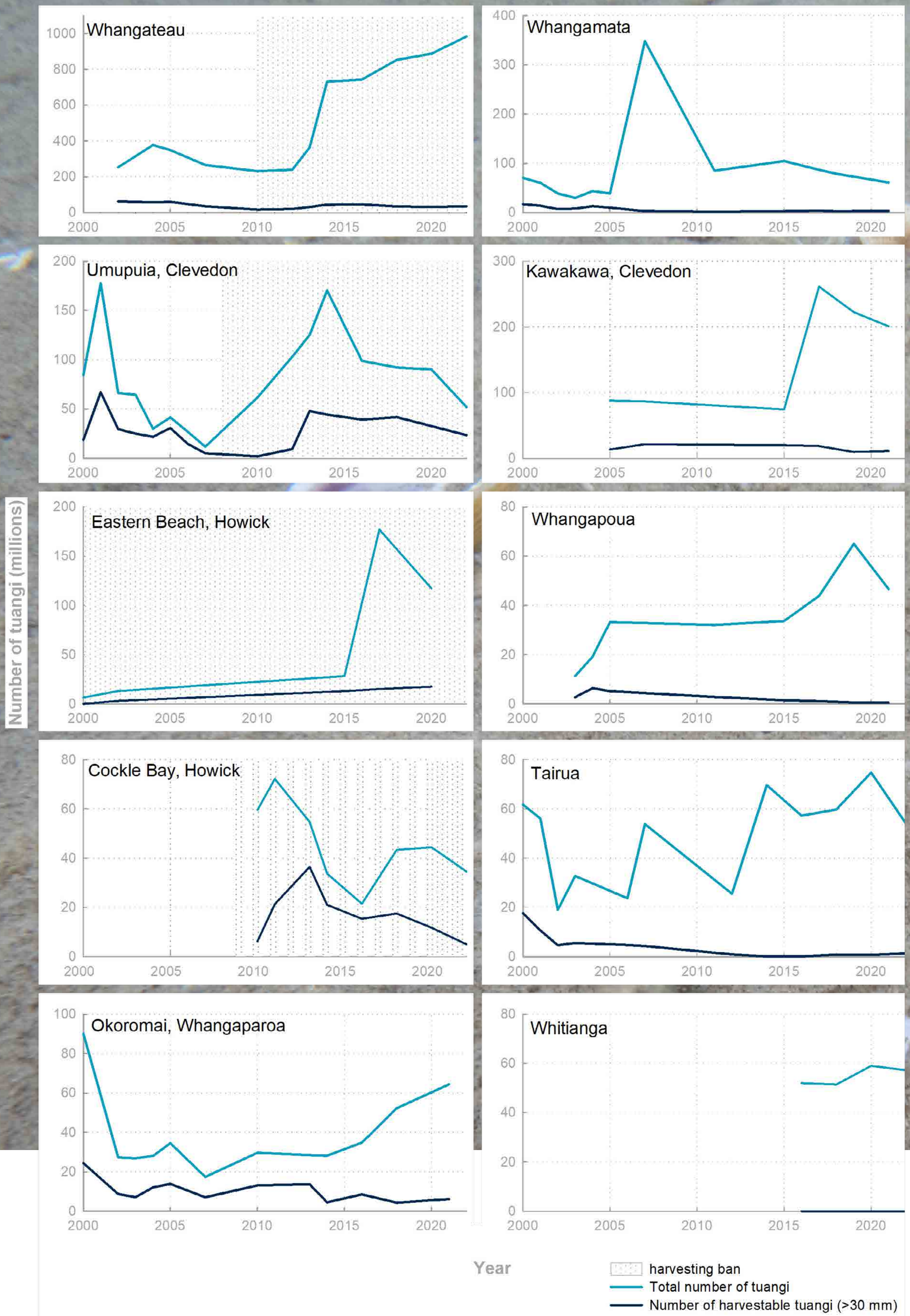
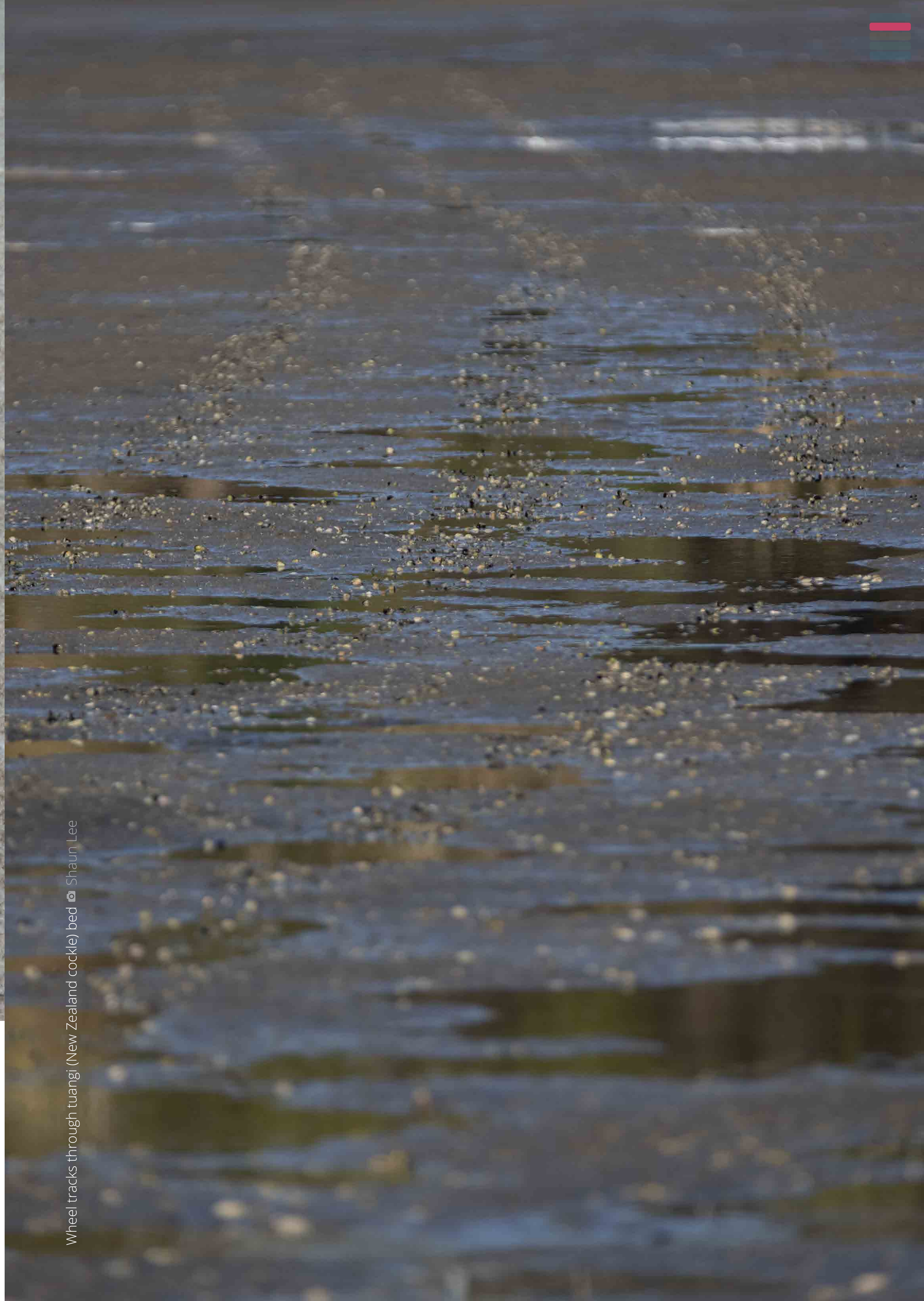
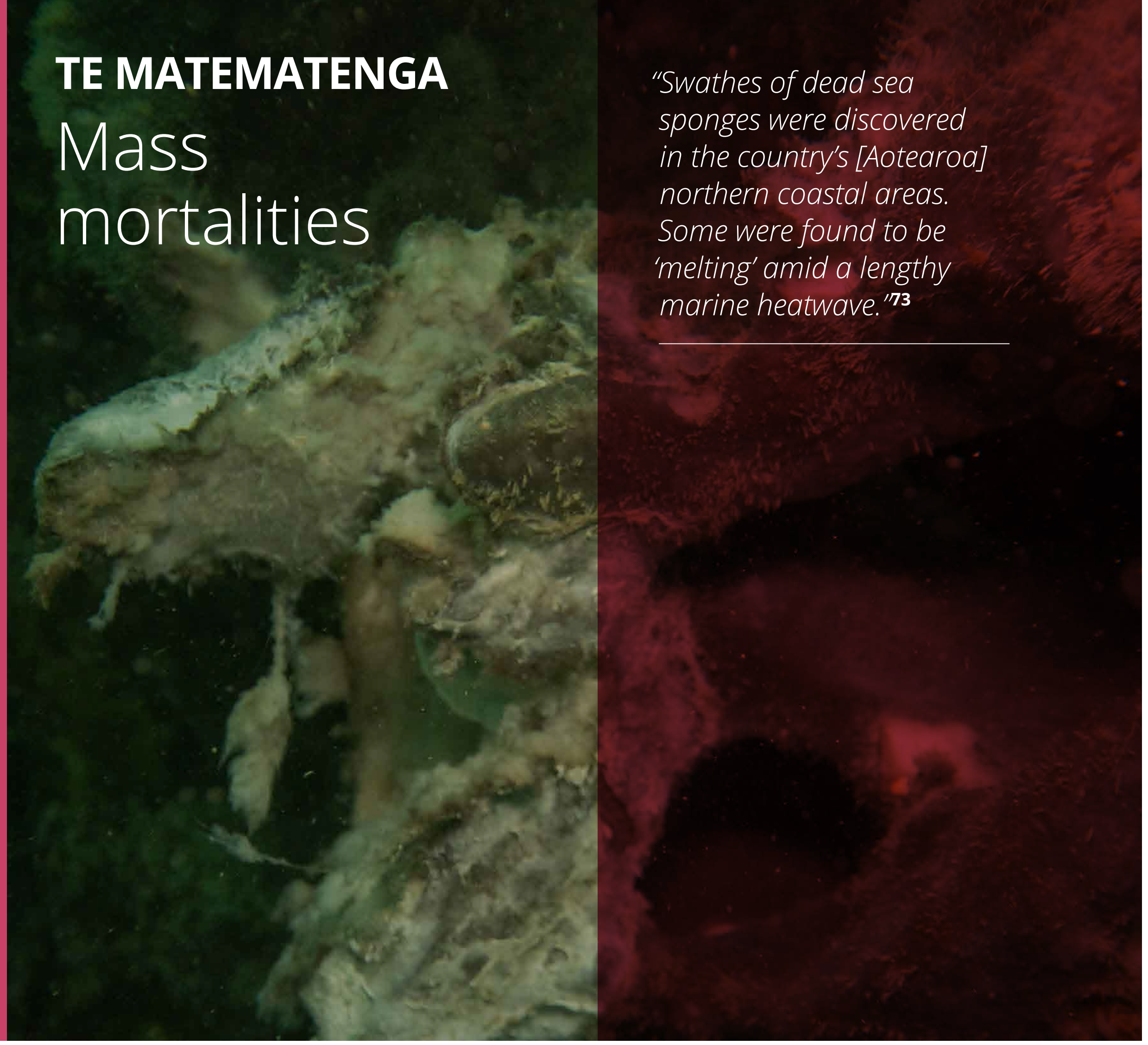


Figure 13: Estimated number of tuangi and number of harvestable tuangi at Marine Park sites that are regularly monitored by MPI.[20]



Wheel tracks through tuangi (New Zealand cockle) bed © Shaun Lee



TOHU (Indicator)

TE MATEMATENGA
Mass mortalities

"Swathes of dead sea sponges were discovered in the country's [Aotearoa] northern coastal areas. Some were found to be 'melting' amid a lengthy marine heatwave."[73]

'Melting' Grey massive sponge Shaun Lee

Disease, extreme environmental conditions and stress can cause mass mortalities of marine life. Larvae and small juveniles are usually the worst affected, but mortality events for these early stages are rarely seen due to their small size. Even mass mortalities of large animals may go unnoticed unless they wash ashore.

Biosecurity New Zealand run a disease diagnostic service for the public to report mass mortality events or suspected diseases.

Most reported mass mortalities in the Marine Park are not primarily caused by disease, but appear to be the result of unfavourable environmental conditions and stress, such as high temperatures, high sediment loads, starvation or post-spawning stress. These stresses may also increase the susceptibility of animals to disease. Mass mortalities are likely to become increasingly common as climate change impacts increase *(see Case Study on Climate Change)*.

KEY EVENTS

1992: More than 40% of kelp died in Cape Rodney to Okakari Point Marine Reserve, with mortalities associated with virus-like particles.[74,75]

2002: Mass mortalities of fish around Whangaparāoa Peninsula and pāua in Kennedy Bay, Coromandel associated with a bloom of the harmful algae *Karenia* spp.[76]

2006: Mass mortality of kororā (little blue penguin) in northern Aotearoa was thought to be caused by starvation and rough weather.[7]

2009: Bacterial infections and heat stress cause mass mortality of tuangi in Whangateau Estuary.[77]

Mass mortality of mohimohi (pilchards) and Jack mackerel (hauture) in the Marine Park due to an unknown cause(s).[77]

2010: Oyster herpes virus causes more than 80% mortality of juvenile Pacific oysters throughout the Marine Park and beyond.[78]

2011: Environmental stress, such as high sediment loads or high temperatures were thought to cause mass mortality of kai moana (shellfish) at Okura Estuary.[79]

2014: Mass mortality of kai moana (shellfish) at Whangateau Estuary possibly due to post-spawning stress and environmental conditions.[67]

2015: Fish die in Te Mata Creek, Firth of Thames due to unknown cause.[80]

2016: Mass mortality of pipi in Okura Estuary possibly due to post-spawning stress and adverse environmental conditions.[81]

2018: Mass mortality of kororā in northeast Aotearoa due to starvation, which was possibly a result of warm and stormy La Niña conditions.[82]

Mass mortality of kai moana at Okura Estuary was not disease-related. Particulate matter and parasites found in the gills may have affected the shellfish's feeding ability.[83]

Mass mortality of kai moana in Whangateau Estuary was not disease-related.[66]

2020–23

2021–23: Almost complete loss of the karepō (seagrass) beds in Wharekawa Harbour (WRC, pers. comm.).

2022: Mass mortality of kōpūpūtai (sponges) in the Marine Park is thought to be caused by a prolonged marine heatwave.[73,84]

Mass mortality of tuangi in Shelly Beach, Auckland was thought to be caused be post-spawning stress and opportunistic bacteria.[85]

Dead Kororā (Little penguin) Shaun Lee

Mass mortality of tuangi (Cockles) Geoff Reid

'Melting' Grey massive sponge Shaun Lee

TOHU (Indicator)

TE KAPOKE KINO, TE KAPOKE PŌREAREA

Harmful and nuisance algae

Lyngbya majuscula and seagrass on Blackpool Beach, Waiheke Island © Bianca Ranson

> *"It progressed quite quickly affecting my face. My head started to become numb and I was feeling dizzy. I couldn't speak clearly... Come the morning I was completely paralysed from my head to toes. I woke up and couldn't move."*
>
> *—account of a woman who had paralytic shellfish poisoning.*[85]

Clean water is important for the harvest of kai moana. Filter-feeding kai moana (shellfish) such as tuangi, pipi and kūtai (mussels) concentrate any chemicals or toxins present in the water, including toxins produced by several naturally occurring harmful algae species. This can make kai moana unsafe to eat when there are high concentrations of harmful algae in the water. High concentrations of harmful algae have been also linked to reduced health and mass mortalities in marine life.[86-88] Algal blooms (both harmless and harmful) are more common during hot and calm conditions, and where there is a plentiful supply of nutrients. This makes areas where these conditions frequently occur, such as the Bay of Plenty, more prone to algal blooms.[89]

Aotearoa's first recorded cases of kai moana poisoning caused by harmful algae occurred in the summer of 1992–93, when around 180 cases of kai moana poisoning were reported.[91] Since then, levels of harmful algae in coastal waters have been monitored weekly by the government and the aquaculture industry to ensure that kai moana are safe to eat. Around 13 sites in the Marine Park are routinely monitored for harmful algae, with most sites funded by the aquaculture industry (*Figure 14*). Public warnings are issued and areas are closed to harvest if unsafe levels of toxins are found in samples. Occurrences of unsafe levels of kai moana poison in the Marine Park over the past 30 years have been relatively infrequent (*Figure 15*). Harmful algal blooms in the Marine Park are typically short-lived, though they occasionally can last for 2–3 months.

Since 1993, only around 30 people in Aotearoa have suffered shellfish poisoning symptoms after eating recreationally harvested kai moana (often from areas that have public warnings in place). There have been no cases of kai moana poisoning from the consumption of commercially harvested kai moana due to stringent monitoring requirements.[92]

Blooms of harmless, nuisance algae can also occur such as 'red tides' caused by the alga *Noctiluca scintillans*, and the blue-green alga (a cyanobacterium) *Lyngbya majuscula*. *Noctiluca* is harmless to humans but is weakly toxic to fish and very dense blooms may result in the accumulation of ammonia and reduction in dissolved oxygen, which may result in fish deaths. *Lyngbya* has not been reported to cause health effects in Aotearoa, but certain strains can cause skin, eye and respiratory irritation. Large quantities of the black cyanobacterium have periodically washed ashore in the Marine Park causing a smelly mess on beaches as they decompose.[92]

Harmful and nuisance algal blooms may increase in frequency due to climate change—warmer waters, increased nutrient run-off from storm events, and ocean acidification may increase the frequency of blooms and toxin production.[93] New warmer water species may also arrive in Aotearoa. For example, an increase in the occurrence of the tropical dinoflagellate that causes ciguatera fish poisoning has been found in the Kermadec Islands and may arrive at mainland Aotearoa as ocean waters warm.[94]

KEY EVENTS

1992: Aotearoa's first recorded case of kai moana poisoning.

1993: Start of the Marine Biotoxin Monitoring Programme.

2002: Mass mortalities of fish around Whangaparāoa Peninsula and pāua in Kennedy Bay, Coromandel associated with a bloom of the harmful algae *Karenia* spp.[75]

2020–23

2021: Red tide bloom around Orewa and Whangaparāoa Peninsula.[95]

2022: A short-lived bloom of *Alexandrium sp.*, which produces paralytic shellfish poison occurred in the Mahurangi Harbour in January 2022 causing the closure of kai moana harvesting for around a week.[96]

2023: High levels of paralytic shellfish toxins were dectected in February and May 2023 in shellfish from the Firth of Thames.[97,98]

Lyngbya bloom around Waiheke Island during the summer of 2022–23.[99]

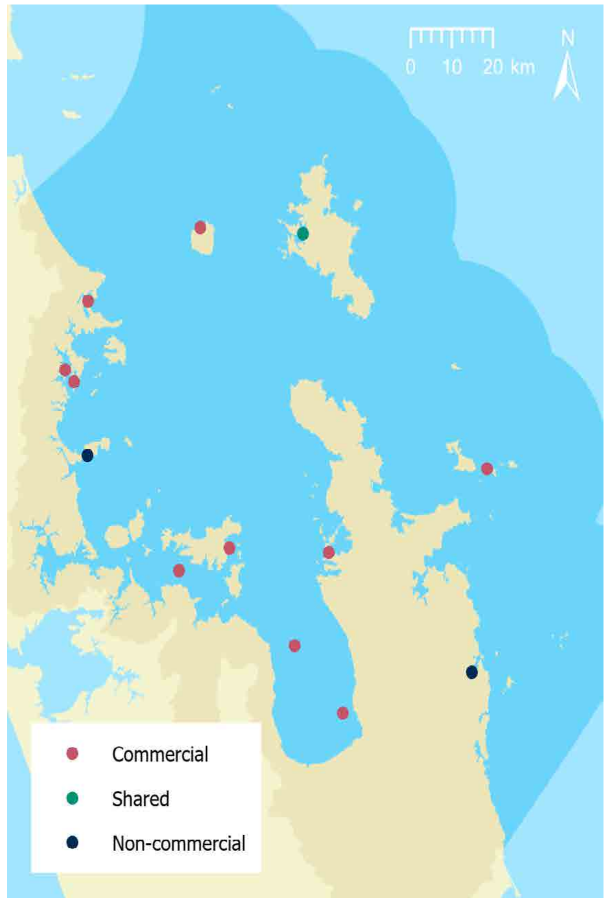


Figure 14: Sites in the Marine Park that are routinely monitored for harmful algae. Commercial sites are paid for by the aquaculture industry, non-commercial sites are paid for by the government, and shared sites are split between industry and government.

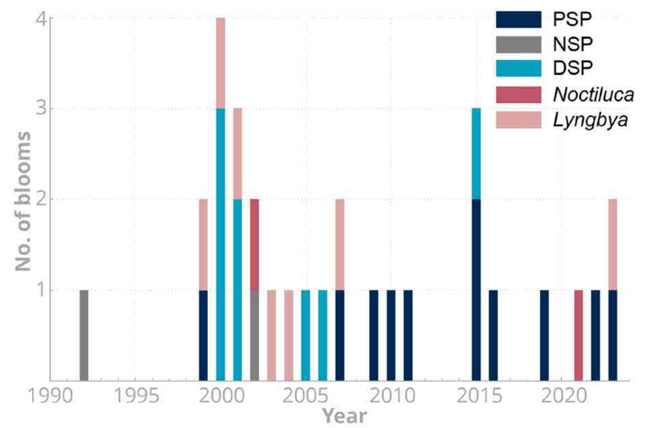
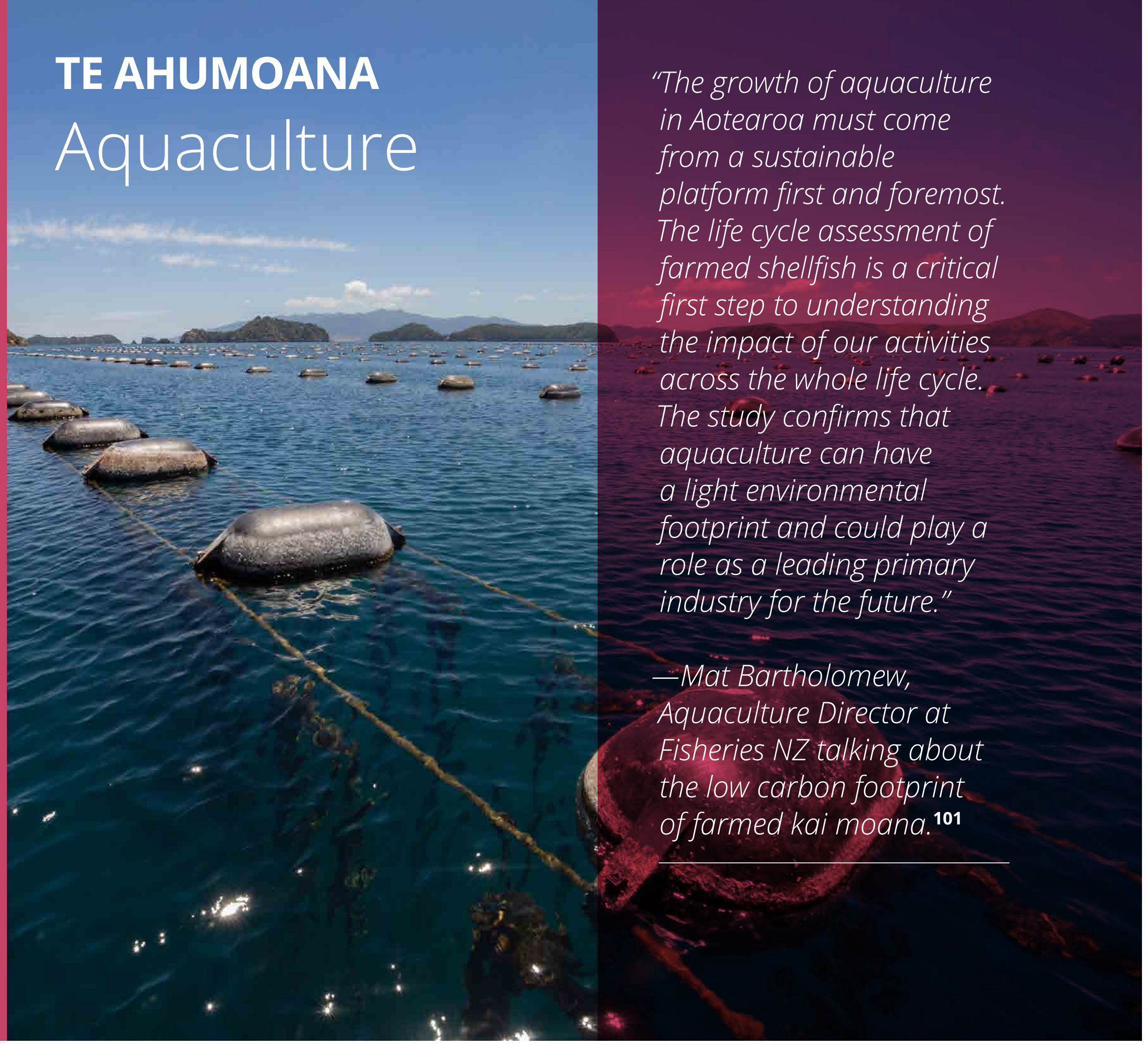


Figure 15: Number of harmful and nuisance algal blooms recorded in the Marine Park since 1992 (PSP = paralytic shellfish poison, NSP = neurotoxic shellfish poison, DSP = diarrhetic shellfish poison, *Noctiluca* and *Lyngbya* are nuisance algae). Data provided by the Coromandel Marine Farmers Association, MPI and available literature.[75,92,95,99,100]

TOHU (Indicator)

TE AHUMOANA
Aquaculture



Kūtai (mussel) farm off Moturua Island © Shaun Lee

"The growth of aquaculture in Aotearoa must come from a sustainable platform first and foremost. The life cycle assessment of farmed shellfish is a critical first step to understanding the impact of our activities across the whole life cycle. The study confirms that aquaculture can have a light environmental footprint and could play a role as a leading primary industry for the future."

—Mat Bartholomew, Aquaculture Director at Fisheries NZ talking about the low carbon footprint of farmed kai moana.[101]

Aquaculture in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf has grown from small experimental mussel rafts in the 1960s to a major industry that currently occupies around 3000 ha in the Marine Park. Kūtai (green-lipped mussels) and Pacific oysters are the main species grown, with approximately 30% of New Zealand's kūtai and 60% New Zealand's Pacific oysters produced in the Marine Park and wider Auckland Region. Recently, experimental rimurimu (seaweed) farming has started, which has potential to occupy significant farm space if successful.

The ecosystem effects of culturing filter-feeding kai moana such as kūtai and oysters are generally well understood, and largely depend on the location and scale of farm activities. The main effects of kai moana farms are benthic effects caused by the deposition of living and waste material on the seabed, and the hosting and spread of marine pests. Changes to seabed communities may be positive or negative, depending on the level of organic deposition. Low levels of enrichment, and kai moana and shell drop off can greatly increase the abundance and diversity of marine life living on and under the farms, which provides food and shelter for a range of invertebrates, fish and birds. However, at high levels of enrichment the abundance and diversity of seabed communities can be greatly reduced.

Ecological effects of kai moana farms, both positive and negative, are generally confined to the areas near the farms. The scale of kai moana farms is therefore an indicator of the likely scale of effects. However, effects vary depending on farm location, and broader-scale or cumulative effects are more likely as the scale of marine farming increases.

Currently there are no finfish farms in the Marine Park, but 390 ha in the Firth of Thames/Coromandel area has been zoned for this activity, and a resource consent application for a 300 ha multitrophic farm (haku (kingfish), kūtai (mussels), pūngorungoru (sponges), rimurimu (seaweed) and sea cucumber) has been recently approved.

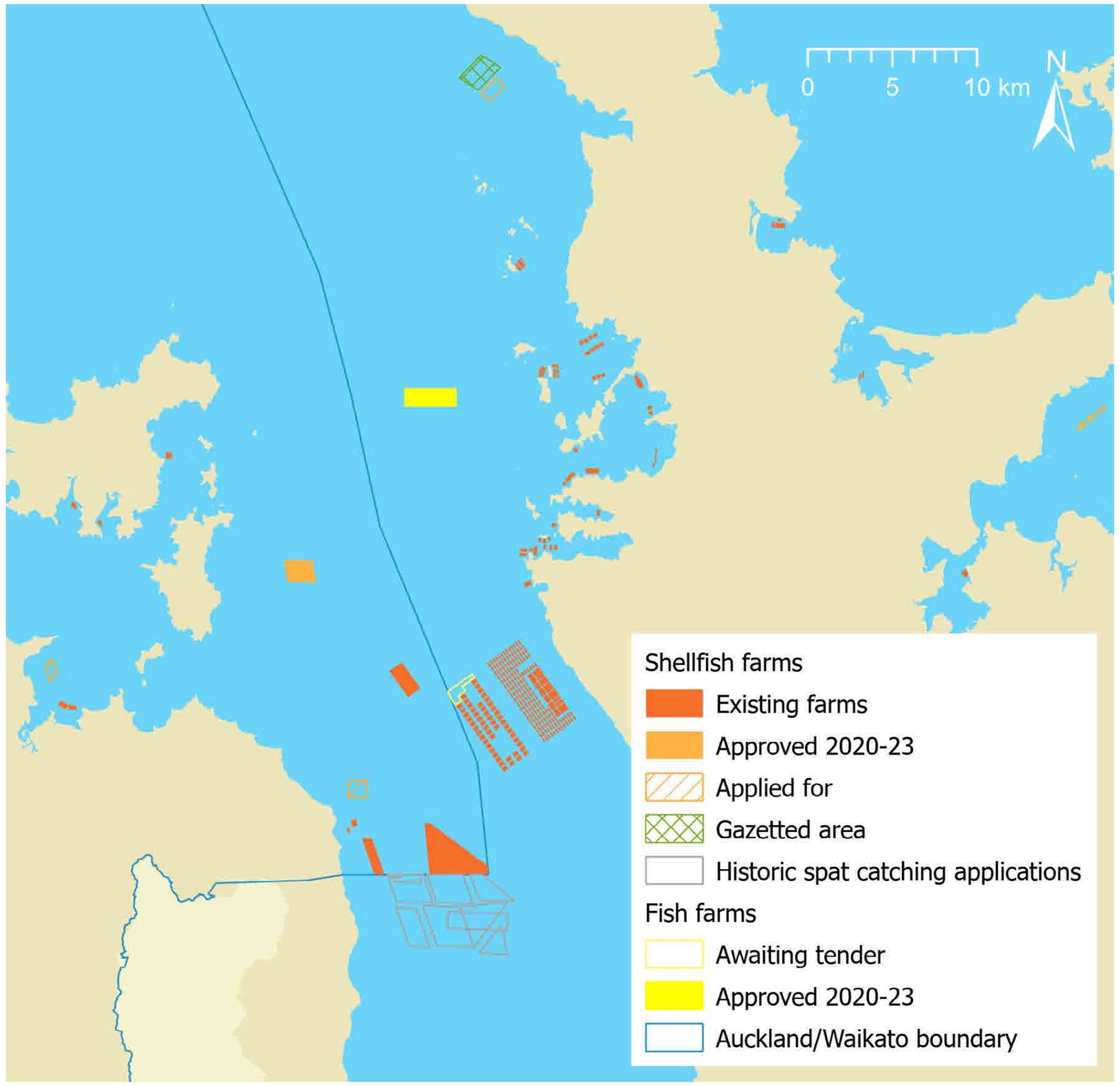


Figure 15: Current and potential aquaculture areas in the Firth of Thames and inner Marine Park.

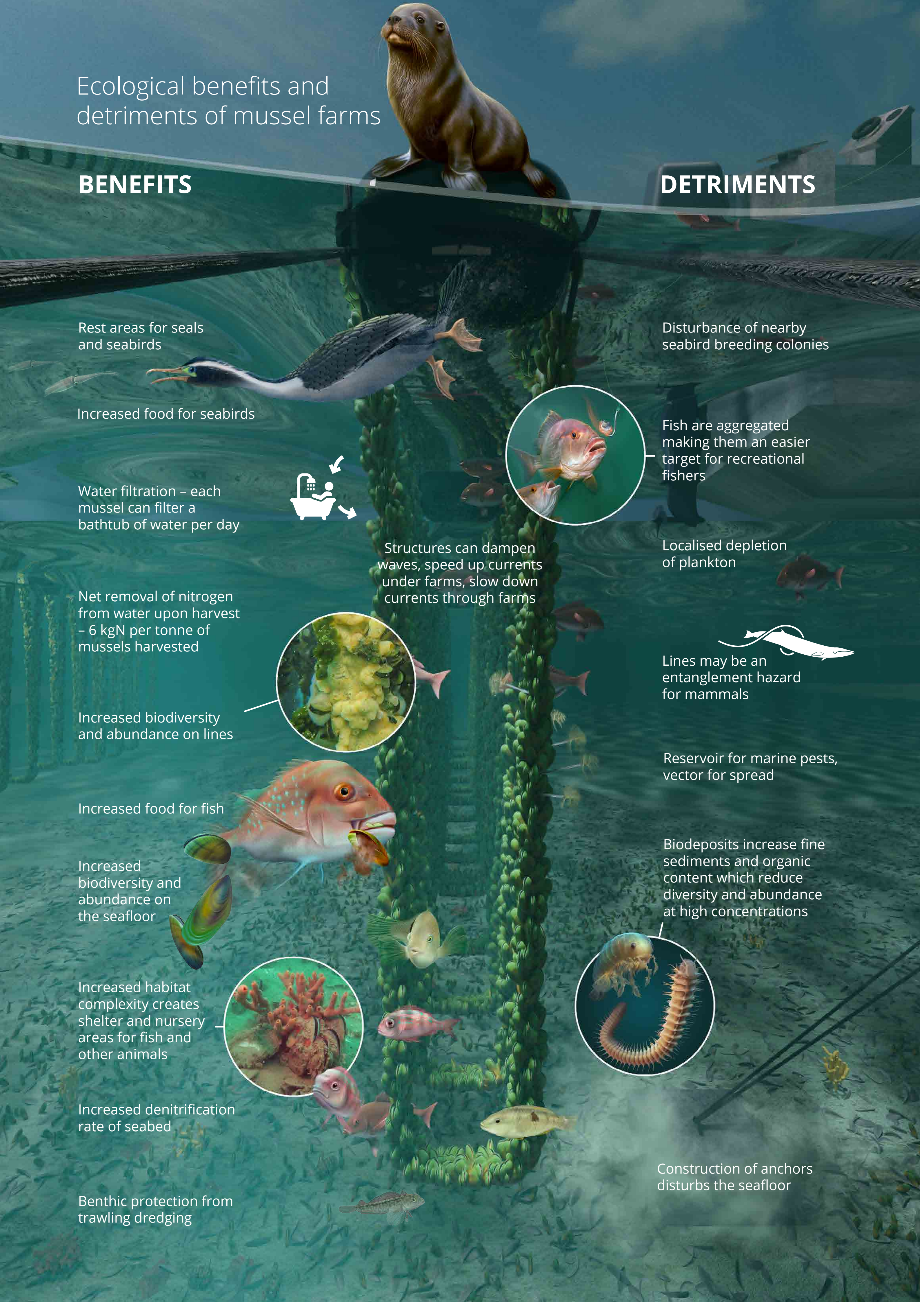
On a per hectare basis, the ecological effects of any future farming of finfish are expected to be more significant than kai moana farming. Of particular note are the:

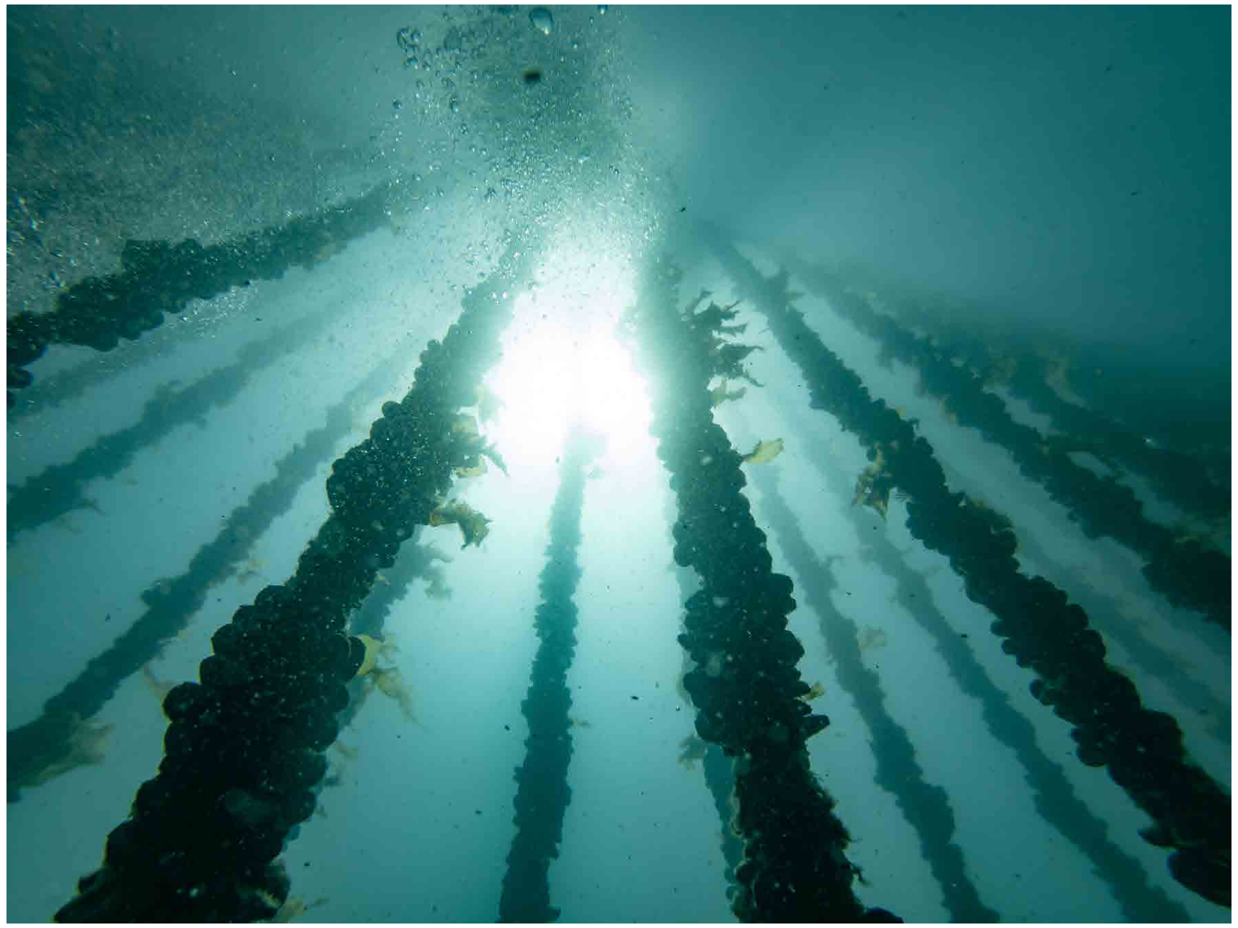
- Greater magnitude of potential detrimental ecological effects.
- Potential for high nitrogen loads from fish farms to compound the effects of land-based nutrient run-off. The Waikato Regional Coastal Plan provides allowances for a combined nitrogen discharge of 1,100 t per year from future finfish farms in the region.
- Overlap of the finfish farm zone west of Coromandel with an area that is regularly used by several marine mammals, including Bryde's whales, maki (orca), popokanua (common dolphins), terehu (bottlenose dolphins) and kekeno (NZ fur seals), though the farm zone is not considered to provide critical habitat for any of these species.[102]

Marine farms also have the potential to diminish natural character and landscape values, create navigational hazards, and limit how others can use the water space.

Major shifts in aquaculture regulatory frameworks have occurred over the last two decades. These changes have largely been in response to three competing factors: 1) a desire by industry, central government and some councils to increase aquaculture production; 2) competition among users of marine space; and, 3) concerns about the environmental impacts of large-scale aquaculture development.

During the 1990s demand for aquaculture space increased five-fold, and it became apparent that regulatory tools and





Kūtai (mussel) farm 📷 Shaun Lee

authorities were unable to cope with the 'goldrush' demand for space. In 2002, Central Government attempted to resolve these issues by limiting marine farming to Aquaculture Management Areas (AMA), yet it did not require Councils or marine farmers to establish any AMAs. The task of balancing competing demands eventually proved too difficult and the initiative failed.

Further regulatory changes in 2011 and the adoption of the Auckland Unitary Plan in 2016 opened up aquaculture development in the Auckland Region, which is now occurring on a largely piecemeal basis. Regulatory changes also provided for fish farming in the Waikato Region and the limited expansion of existing kai moana farming. However, a prohibition under the Waikato Coastal Plan still prevents marine farms (apart from spat catching areas) from being developed outside of prescribed areas.

Additional aquaculture development is likely, as Central Government seeks to grow the industry from one that produces $670+ million in annual sales nationally, to $3 billion in sales by 2035.[103,104] The Government's Aquaculture Strategy is seeking to do this through sustainable, productive, resilient and inclusive development.

Given that aquaculture effects are largely location and scale dependent, this indicator looks at changes in the scale of marine farming in the Marine Park and where growth is occurring (*Figure 16*).

Consented kai moana farms in the Waikato Region cover around 1428 ha (2556 ha if Wilson Bay farm zones A and B are used instead of farm footprints), and applications are being processed for 116 ha of spat catching area.

Consented kai moana farms in the Auckland Region cover around 1241 ha, recent approvals allow for new farms in another 334 ha, and applications are being processed for 46 ha of new space.

An application for a 300 ha multitrophic farm (including finfish) in the Coromandel Marine Farming Zone has recently been approved.

Historic spat catching applications for around 3,000 ha that were made prior to the 2001 moratorium remain on hold and may be processed in the future.

KEY EVENTS

1960s: Farming of tio (rock oysters) and kūtai began in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf.

1964: Rock Oyster Farming Act 1964 comes into effect.

1968: Marine Farming Act 1968 comes into effect.

1971: Marine Farming Act 1971 replaces the previous act.

1984: First mussel farming licences in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf granted.[105]

1991: Resource Management Act 1991 comes into effect, regulating the allocation of marine farming space.

1990s: The aquaculture industry goes through a boom period, and demand for farming space increases fivefold.[106]

2001: Resource consents were granted for kūtai farming in Area A of the Wilson Bay Marine Farming Zone.

A moratorium on new aquaculture applications is put in place, delaying the development of Area B in Wilson Bay.

2002: Central Government formalises a 2-year moratorium to allow a new framework for managing aquaculture to be developed.

2004: New rules introduced that restrict marine farming to AMAs.

Māori Commercial Aquaculture Claims Settlement Act 2004 comes into effect, providing cash and/or farm space entitlements to iwi.

2008: AMA status granted to Area B of Wilson Bay, allowing development to begin.

2011: Regulatory changes remove requirements for AMAs, provide for fish farming in the Firth of Thames/Coromandel area, and for the limited expansion of existing marine farms.

2016: Auckland Unitary Plan becomes operative, easing requirements for new aquaculture development in the Auckland Region.

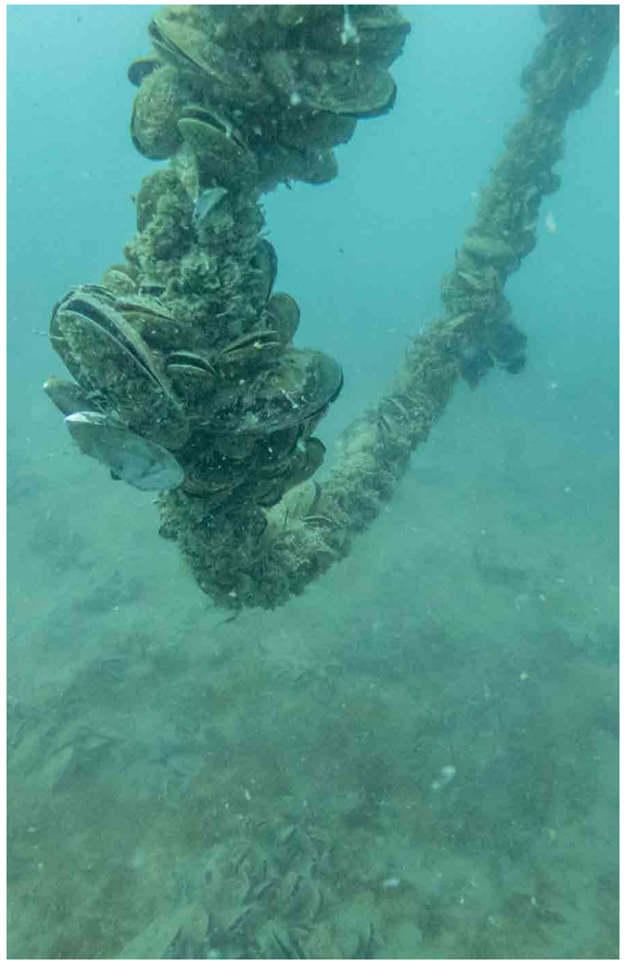
2019: Release of NZ Aquaculture Strategy.

2020–23

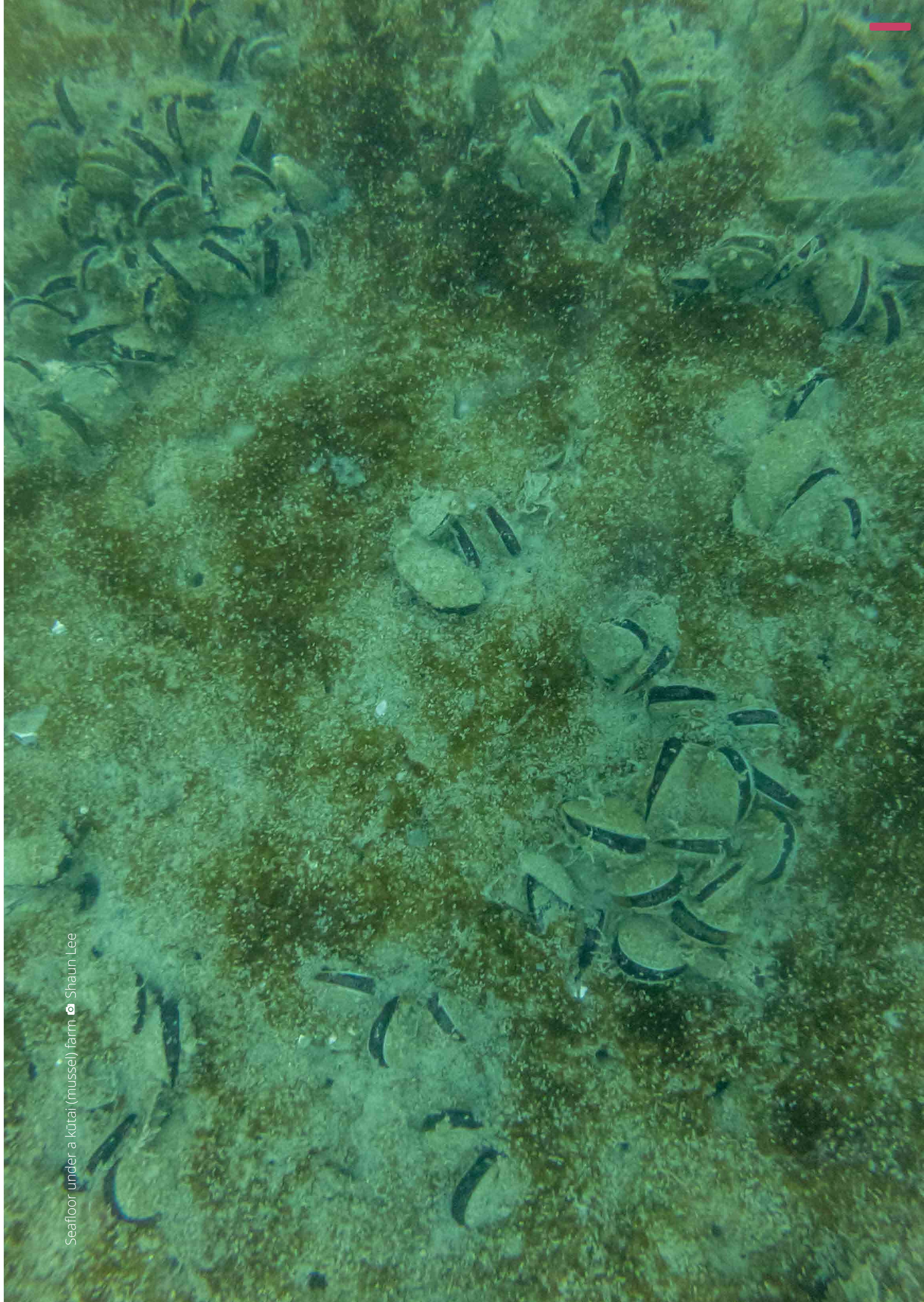
2020: National Environmental Standards for Marine Aquaculture came into force, establishing a consistent framework for reconsenting existing marine farms.

2021: Consent was granted for a new 221 ha kūtai farm east of Ponui Island.

2023: Consent was granted for a new 300 ha multitrophic farm (including finfish) in the Coromandel Marine Farming Zone.



Seafloor under a kūtai (mussel) farm Shaun Lee



Seafloor under a kūtai (mussel) farm Shaun Lee

Pae Uta ki Pae Tai

Mountains to sea

Post cyclone mud in Whangamatā © -Micheal Townend & Kit Squires

Pae Uta ki Pae Tai is a concept in Te Ao Māori that characterises kaitiakitanga starting from mountains and other inland geographic features down rivers and valleys to the sea. It is a total catchment management approach that is not alien to western science, though they are defined through different cultural lenses.

Te Ao Māori recognises that all things animate and inanimate derive from Ranginui (sky father) and Papatūānuku (earth mother). The natural world was divided into realms ruled over by gods who were the offspring of Rangi and Papatūānuku. Tangaroa was the God of the Sea and Fishes, Tāne Māhuta the God of Forests and Birds, Haumietiketike the God of Uncultivated Food, Rongomātāne the God of Cultivated Foods, and Tāwhirimātea the God of Weather, to name a few of those most relevant to this section.

Here, we look at relationships between the whenua and moana and other waterways such as awa (rivers), roto (lakes), hāpua (lagoons) and wahapū (estuaries) in and around the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf rohe. Those relationships have changed markedly since the distant tūpuna of tangata whenua first inhabited this takiwā (region). They continue to change during our reshaping of the natural world. Some of those relationships, such as plumes of sediment flowing from our rivers, are obvious. Others, like the accumulation of heavy metals, nutrients and disease-causing pathogens in our water are hidden from our sight, or they occur over such imperceptibly slow timeframes that if we are not vigilant, they can catch us unaware.

The key indicators covered in this section include coastal and ocean sprawl, paihana (toxic chemicals), toiora (nutrients), the suitability of water for swimming, sediment and benthic health, and mānawa (mangroves).

TOHU (Indicator)

TE WHAKAWHĀNUITANGA ATU KI TE MOANA

Coastal urban and ocean sprawl

"It is no longer acceptable for a port to reclaim more land every time it needs capacity."

— Liz Coutts, Ports of Auckland Chairperson [2015–2021].[107]

Ports of Auckland expansion (2017) Shaun Lee

The concept of 'urban sprawl' is well-understood and relates to the global trend of villages, towns and cities growing and sprawling out across the surrounding landscape. The term 'ocean sprawl' is used to describe coastal engineering works and structures that are increasingly sprawling out into our estuaries, harbours and oceans. These include marinas, wharves, structures for coastal protection and flood defence, roads and bridges, pipes, cables, dredging and disposal areas, shipwrecks, aquaculture structures, and 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.

Urban and ocean sprawl go together, as many of our main centres were built beside the sea. Ports and wharves are needed to move people and goods. Facilities are required to launch, store, maintain and refuel vessels. Important land transport corridors traverse coastal sections, and groynes are used to protect seaside homes from coastal erosion. Expansion and protection of this infrastructure is commonly accommodated through progressive reclamation. Stormwater, wastewater and industrial discharges often occur through coastal or ocean outfalls. Navigational aids are needed to safely guide vessels into ports and harbours. Marine farming is an important source of income and employment. As a result, many parts of the Marine Park and its shores have been highly modified.

Councils do not routinely collate information on coastal urban and ocean sprawl, but this indicator provides a snapshot of information on major development, structures and associated activities in the Marine Park and along its shores since 2020. Details of the situation in 2020 are provided in the previous State of Our Gulf report. Also note that marine farms make up a large proportion of coastal structures but have already been covered in this report *(see Section on Aquaculture)*.

Council decisions on consent applications for substantial coastal activities over the past three years have included:

A 2020 Auckland Council decision to grant consent to establish a 15 km shared (pedestrian and cycle) path linking the Waitematā and Manukau Harbours. The path includes around 7.1 km of 4.3 m wide boardwalk and bridge structures through Te Whau River. Those structures are expected to cover approximately 3.06 ha.[108,109]

A 2020 Auckland Council decision to grant Ports of Auckland a capital dredging consent for Rangitoto Channel and the Fergusson approaches with a combined dredging volume of around 2.25 million m^3; and a 35 year consent for maintenance dredging to preserve depths in the dredged channels, remove slumped material from the channels, and remove accreted material from undredged accessways.[110]

2022 Auckland Council decisions to decline two applications (inshore and offshore areas) and grant one application (mid-shore area) for sand extraction off Pakiri Beach. The applicant's sought:

- Inshore area: consent to extract up to 76,000 m^3 of sand over any consecutive 12-month period, with the extraction volume being limited to a maximum of 15,000 m^3 over any consecutive 30-day period[n, 111]
- Midshore area: consent to extract an annual average of up to 125,000 m^3 per year over any consecutive 5-year period with a maximum rate of 150,000 m^3 over any 12-month period, with extraction volume being limited to a maximum of 15,000 m^3 over any consecutive 30-day period.[112]
- Offshore area: consent to extract up to 2,000,000 m^3 of sand from between the 25 m and the 40 m isobaths over an approximate area of 44 km^2, with no more than 150,000 m^3 per any 12-month period between the 25 m and 30 m isobaths.[113]

Decisions on all three of those hearings were subsequently appealed to the Environment Court and were yet to be heard at the time of writing.

Hururoa (Horse mussel) bed off Pakiri Beach in 1996 NIWA

Several projects have also been consented through the COVID-19 Recovery (Fast-track Consenting) Act 2020. The Act came into effect on 9 July 2020 and provides a fast-track consenting process. It will be repealed on 8 July 2023. Key projects consented under the Act among others, have included:

Te Ariki Tahi Sugarloaf Wharf upgrade in Coromandel Harbour, to provide for the upgrade, operation and maintenance of Ariki Tahi for commercial and recreational purposes. The consent enabled dredging to provide an all-tide approach channel to the wharf, the reclamation of approximately 6,900 m^2 of seabed, the establishment of a commercial facility with 5 berths and a separate recreational facility with dual boat ramps, and improved access to the facilities.[114]

Redevelopment of the Kōpū Marine Precinct, including construction of a commercial wharf for loading and unloading marine farming vessels, an upgrade to the current commercial slipway to provide for the haul out of vessels of up to 150 tonnes, upgrades to access roads and the area used to manoeuvre and carry vessels once they are hauled out, provision of a boat ramp and parking for recreational vessels, and construction of a rock armoured revetment to provide structural stability along the river bank.[115]

In the Auckland Region, 3,029 building consents were issued for new residential buildings within 200 m of the coast between January 2020 and December 2022 . Most of these were within existing or developing urban areas, with over 95% of consents in areas zoned for residential, business or general land use (the latter mainly applies to consents for building on Gulf islands). Around 3% were issued for rural properties, with the remaining 2% (44 consents) issued for land zoned for other purposes.

A potentially significant development has also been proposed on land adjoining the Beachlands coastline. The proposal covers more than 300 hectares and would allow over 3000 homes to be built. An application for a private plan change to enable that development, has been lodged with Auckland Council but was yet to be heard at the time of writing.

[n] Note that the extraction volumes sought were amended during the hearing.

KEY EVENTS

2000: Auckland Regional Growth strategy provides a roadmap for the Region's growth and development.

Work on Ports of Auckland's, Fergusson container terminal extension, and Pāuanui. Waterways canal development underway.

2001: Work begins on Whitianga Waterways.

2006: Construction of Orakei Marina provides 179 additional berths.

2008: Construction of the 209-berth, Whangamatā Marina begins.

2009: Coromandel Peninsula Blueprint provides a strategy for future growth and development.

2010: Thames Coromandel District Plan becomes operative.

2011: Consent granted for a 95-berth marina in Tairua.

2013: Application lodged to build and operate a marina in Matiatia, Waiheke Island (subsequently declined).

2016: Construction of a 131-berth marina at Sandspit complete.

Waikato Regional Policy Statement becomes operative, formally recognising the Coromandel Peninsula Blueprint.

Decision version of updated Thames-Coromandel District Plan notified (subsequently appealed).

Auckland Unitary Plan (operative in part) adopted, including Future Development Strategy.

2017: Consent granted for a 186-berth marina in Pūtiki Bay, Waiheke.

New 307m Fergusson North Wharf completed.

2018: A 35-year consent to dump sediment from sources in the Northland, Auckland and Waikato Regions at a site 25 km east of Aotea is granted. The decision was successfully appealed to the High Court who referred it back to the Environment Protection Authority for reconsideration. The application was subsequently withdrawn.

2019: Moorings cleared from Ōkahu Bay, Auckland.

Ports of Auckland granted a 35-year consent to dump sediment from capital and maintenance dredging of berths and the Rangitoto Access Channel at a site 27 nm east of Cuvier Island.

Pāuanui waterways development nearing completion.

Work begins on America's Cup Base on the Auckland waterfront.

2020–23

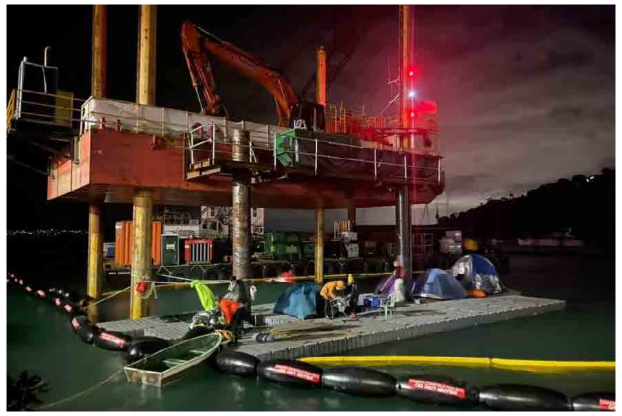
2020: National Policy Statement on Urban Development, providing direction to Councils on urban growth and development, released.

2022: Two of three applications to continue dredging sand off Pakiri Beach declined, and subsequently appealed.

Consent granted for redevelopment of the Kōpū Marine Precinct.

Consent granted for the upgrade of Te Ariki Tahi Sugarloaf Wharf.

Application for a private plan change to provide for the development of 300 ha of coastal land at Beachlands lodged.



Kennedy Point Marina - Waiheke Island
Bianca Ranson / Protect Pūtiki

Save Our Sands Andy Bruce / Elevated Media

Ōkahu Bay Shaun Lee

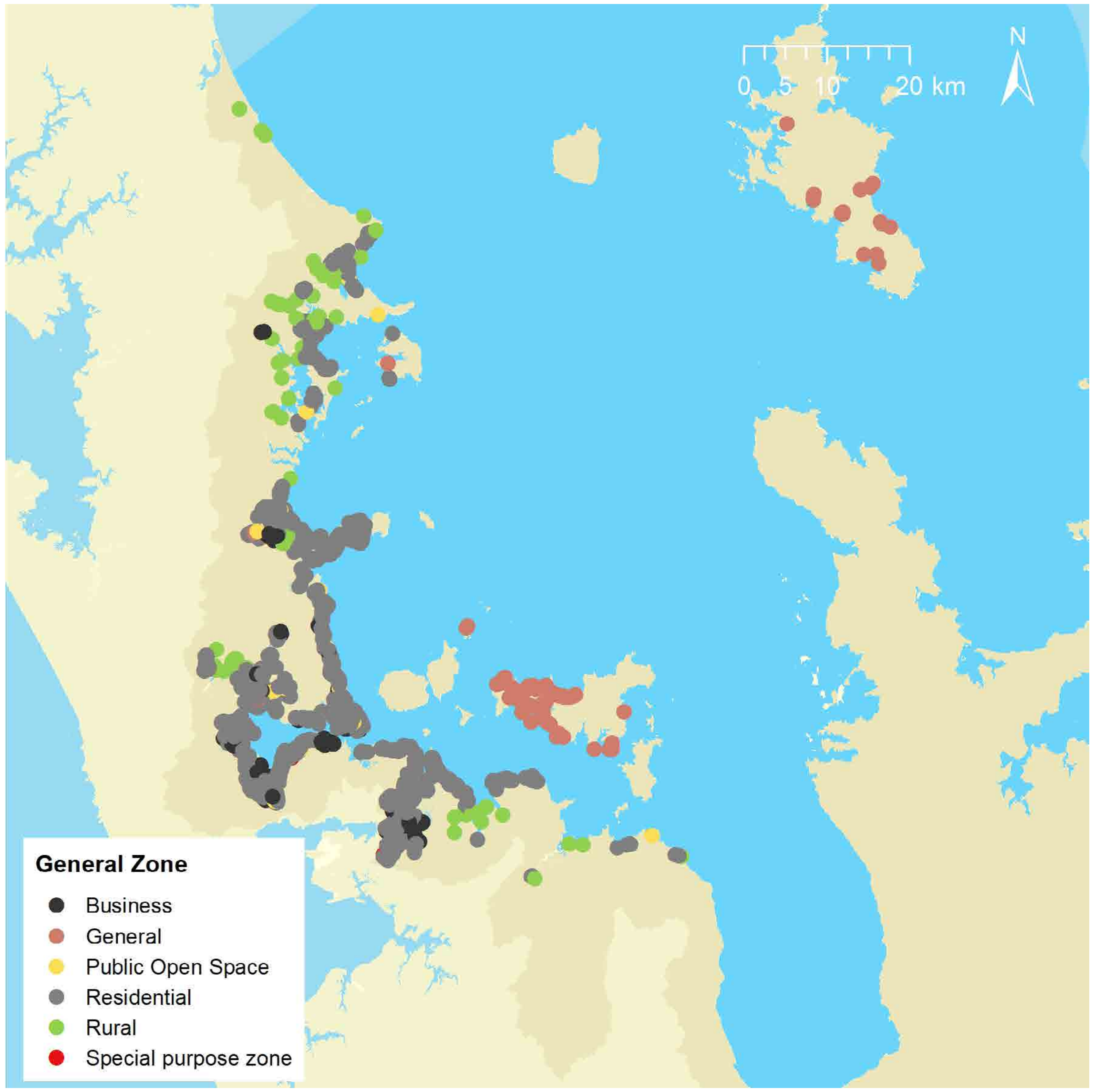


Figure 16: General zones where Auckland building consents were issued for new residential buildings within 200 m of the coast between January 2020 and December 2022.[a]

Highway development in Whangaparāoa (O Mahurangi / Penlink) on the Weiti River Geoff Reid

[a] Data provided by Auckland Council and does not include consents for extensions, alterations, removals or relocations.

HE RANGAHAU WHAKAPŪAHO (Case study)

TE HARURU O TE MOANA

The roar of the sea

Mangawhai Estuary © Shaun Lee

We live emersed in the sounds we create. We talk, whisper, yell, whoop, and holler. Our sounds induce wonder, comfort, and joy. They wake us up and send us to sleep. But not all our sounds are pleasant – some are just noise. Noise can scare, stress, anger and injure us. It also masks the important sounds we listen for. So we create rules about the amount of noise we can make, and when we can make it. We protect our ears, muffle our vehicles, and wear headphones to block out background noise and listen to the sounds we like.

Sea creatures also live emersed in sound. Underwater noise is naturally produced by waves, wind, rain, and hail. Shifting rocks and gas bubbles. Occasionally the sounds of earthquakes and undersea volcanoes spread across entire oceans. Urchins scrape, shrimp snap, fish grunt, bark, pop and click, dolphins whistle. The natural sounds of the sea are diverse. They vary over daily, monthly, and seasonal timescales. Reefs become noisier during the dawn and dusk chorus of fish and urchins. Noise waxes during the new moon and wanes over the full moon, increases in summer, and drops off in winter.[116]

Primitive marine life evolved the ability to sense the natural vibrations of ocean sound and to use it to sense their surroundings. Even jellyfish use sound to help them avoid hazards that could cause them to strand.[117] Sophisticated sound production and hearing abilities evolved over millions of years. Sensory cell and anatomical adaptations emerged, allowing sound to be produced, detected, and used in a myriad of ways. For navigation and foraging, to display aggression, and to defend territory. Sound is used to attract mates, as a display during courtship, and to coordinate spawning activities. It maintains group cohesion, and ultimately, has allowed a few special species to 'see' the world using echolocation.[118]

Underwater noise travels fast and far. We generate it through a myriad of activities—boating, shipping, construction, port work, bridge traffic, use of sonar equipment (sidescan, multibeam, and fish finders), seismic surveys, dredging, and fishing.

Studies suggest ships and small boats are key sources of anthropogenic noise in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf.[116,119] The sound of vessels affects marine animals of all shapes and sizes. It alarms them. Injures and stresses them. It changes how they behave.

Bigeyes are a small reef-dwelling fish that are common in the Tīkapa Moana / Te Moananui-ā-Toi. They hide in dark holes, cracks and caves formed beneath and between reef boulders and other formations during the day, and emerge at night forming loose shoals and feeding on small planktonic animals before returning to their shelters around dawn. Many fish use vision or water movement to coordinate their schooling behaviour, but a different approach is needed when feeding in the dark. The solution bigeyes have developed is for members of the shoal to maintain contact by producing popping sounds and listening for the pops of others.[120,121]

Researchers from the University of Auckland have found that bigeyes produce the loudest of all nocturnal fish sounds on the Leigh coast, and that their calls are used to maintain the cohesion of their schools. However, those calls can be drowned out by background noise. Like people talking in a noisy bar, bigeyes are forced to moving closer together to hear their neighbour's pops. Under natural, background conditions bigeyes can maintain contact over tens of metres.[121,122] Communication distances decease to mere metres, when their calls become obscured by other noise, such as that created by passing ships. Tīkapa Moana / Te Moananui-ā-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.[123] Over nine months of monitoring in Tīkapa Moana / Te Moananui-ā-Toi, ship noise exceeded natural background noise levels between 3.9 to 18.9% of the time, and was estimated to have reduced the communication distances of bigeyes by up to 61.5% when they were within 10 km of passing ships.[121]

At the other end of the scale are tohorā (whales). Artificial noise has been linked to the disruption of travel by marine mammals, increased stress, and impacts on foraging, socialising, communicating, resting, and other behaviours. Bryde's whales are one of the most frequently observed marine mammals in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. Bryde's whales aren't big on korero, or as the scientists say, they vocalise infrequently.

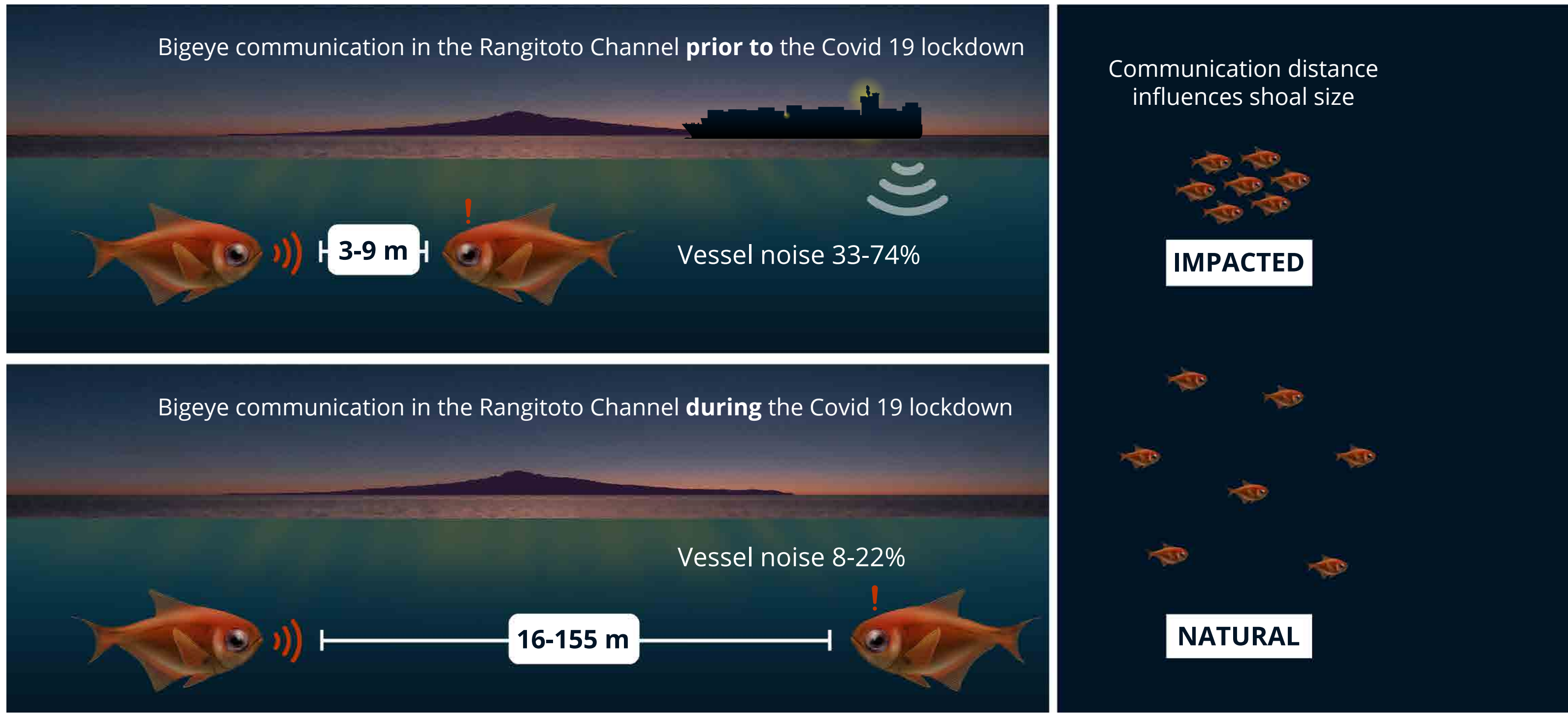


Figure 18: Effects of noise on bigeye communication distance and shoal size.

Whanganui A Hei / Cathedral Cove Marine Reserve Shaun Lee

Research carried out by scientists from the University of Auckland indicates that passing ships can drown out their calls, reducing communication distances from around 8 km to a few hundred metres.[121] This could lead to missed breeding opportunities and affect the social cohesion of Bryde's whales. Other effects of ship noise on other whale species include heightened levels of physiological stress, increased volume of whale calls, and changes to their foraging behaviour.[124]

Underwater acoustics has been an important and active topic of research and development since the early 20th century,[125] yet we still have a lot to learn about the ecological importance and impacts of underwater noise. Nevertheless, our understanding of the importance and impacts of sound to marine animals is increasing.[118] For example, there was a large difference in communication distances of fish and mammals when New Zealand went into COVID-19 lockdown. Small vessel activity was severely restricted for seven weeks and shipping was heavily reduced.

The amount of vessel noise plummeted and the sea became quiet. Dolphins could suddenly communicate at distances of several kilometres, rather than hundreds of metres pre-lockdown, and fish could communicate across hundreds rather than tens of metres.[126]

Like us, marine animals make and listen to sounds for all sorts of reasons. Like us, they are affected by unusual and loud noises. But unlike us, marine animals have little, to no, control over background noise. The adverse effects of underwater noise are now accepted. It is increasingly common for noise to be considered during major coastal resource consent applications in Aotearoa, and noise monitoring is also commonplace overseas (e.g., it is mandated in the European Union).[118] However, the underwater soundscape within Tīkapa Moana / Te Moananui-ā-Toi is not regularly monitored. That means we are limited in our ability to detect, assess, and respond to noise impacts on marine life in the Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf.

Terehu (Bottlenose dolphin) Tiia Cooke / Project Kahurangi

TOHU (Indicator)

NGĀ MATŪ TĀOKE
Toxic chemicals

Tyre in Opanuku Stream © Shaun Lee

"Great to see the next phase of the road map. These types of trucks work in stop/start conditions and city traffic where the benefits of electric vehicles should be outstanding with respect to reduced emissions and reduced heavy metals (by using regen braking versus brake pads)"

—tweet by Kristian Jensen, Technical Director at WSP in response to Auckland Transport's announcement that they were welcoming New Zealand's first trial of a 100% electric truck.

Human activities generate a variety of toxic heavy metals and other 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. The main causes of contamination in the Marine Park are urbanisation, historical mine activity, and agriculture. Major spills sometimes have immediate and catastrophic effects. These tend to be obvious and localised. Contaminant loads from individual sources such as ports, industries, mines, marinas and landfills can also be very high and persistent, causing localised impacts. But many contaminants come from small sources scattered throughout catchments, which combine to produce large loads that affect broad areas in harbours and estuaries.

For example, a huge mass of waste has been generated since the arrival of Europeans in the 1840s. As a result, Auckland's mainland catchment of the Gulf, Waitematā Harbour, is thought to contain around 150 closed landfills, with 106 of those located within the Waitematā catchment. Until the 1980s, most New Zealand landfills were simply unlined pits, which were often poorly sited, designed and managed. There were also few controls on the acceptance of hazardous wastes.[127] Older landfills are therefore prone to seeping contaminated leachate through their base, sides and surface. Environmental risks are increased when landfills adjoin sensitive receiving environments such as streams or sheltered coastal areas, or if they are located in permeable ground conditions. Many of the closed landfills in the Waitematā catchment are located in higher risk locations (*Figure 19*). Examples include:

- Meola landfill which is located on the toe of a fractured basalt lava flow with emergent groundwater springs;
- Chelsea landfill which was formed in the headwaters of an historic inlet and has two piped streams running beneath it;
- landfills that directly adjoin the headwaters and/or stream tributaries of Whau Inlet, Henderson Creek, Oakley Creek and others.

Primary contaminants of concern are copper and zinc, with lead and mercury of secondary concern. Other contaminants may also accumulate, including new contaminants that are constantly emerging. Environmental scientists are struggling to keep pace with the rapidly increasing list.

This indicator looks at concentrations and trends in the primary contaminants of concern, copper, zinc, lead, and mercury in the marine environment. The status of the 163 sites sampled between 2007 and 2020 is presented, with 41 Auckland sites[P] and 4 Waikato sites having updated data in this report. Copper, lead and zinc concentrations are presented against Auckland Council's Environmental Response Criteria (ERC), while mercury concentrations are presented against Threshold (TEL) and Probable (PEL) Effects Level guidelines (*Figure 20*).[128]

The latest results show:

- Rural coastal sites and sites outside Auckland's central harbours and estuaries mostly have metal concentrations in the green category. The exceptions are some sites around Thames, Coromandel and Whitianga that were subject to historic mining activity. At those sites, copper, lead, mercury and/or zinc concentrations are elevated.
- Multiple sites in the southern and upper Waitematā Harbour and upper Tāmaki Estuary are amber for copper and mercury. Whau Wairau in the upper Waitematā is red for copper.
- A few sites in the southern Waitematā Harbour are amber for lead. Whau Wairau and Inner Meola Creek are red for lead.
- Multiple sites in the southern Waitematā Harbour and upper Tāmaki Estuary are red for zinc.
- Changes in the status of six of the 41 Auckland sites with new data since the 2020 report include:
  - copper at the Upper Lucas Creek (upper Waitematā) site worsened, changing from green to amber;
  - lead at the Inner Meola Creek (central Waitematā) and Middlemore (upper Tāmaki) sites worsened, changing from amber to red, and green to amber, respectively;
  - zinc at the Henderson Lower (central Waitematā) site worsened, changing from amber to red;
  - zinc at the Oakley Creek (central Waitematā) and Central Main Channel (upper Waitematā) sites improved, changing from red to amber, and amber to green, respectively.

[P] Only one year's data was available for the four Coromandel sites monitored in 2019.

Initiatives to reduce the amount of metal pollutants entering our waterways include switching to copper-free brake pads, and installing on-site proprietary devices, wetlands or rain gardens that filter contaminants out of the stormwater before they reach our waterways.[129-131]

KEY EVENTS

2000: The main source of lead had already been removed, by banning its use as a petrol additive.

Interim sediment quality guidelines published for Australia and Aotearoa (ANZECC guidelines).[132]

2001: Regional Discharges Project (RDP) established.

2002: ARC develops more conservative sediment quality guidelines (ERC) and a blueprint for monitoring urban estuaries.

Variations to regional plans proposed to improve their alignment, incorporate the ERC, and clarify the outcomes that discharges are expected to meet.

2003: ARC manual for designing stormwater management devices released.[133]

2004: Major stormwater funding shortfalls identified; ARC approves a 10-year Stormwater Action Plan to improve environmental outcomes; Auckland Regional Coastal Plan becomes operative in part.

2007: Ministry for the Environment announces funding to remediate Tui Mine, which was leaching heavy metals into creeks that flow to Waihōu River.

2013: Variation to Auckland Regional Coastal Plan in relation to managing network discharges adopted; notification of the Proposed Auckland Unitary Plan.

Tui mine remediation complete.

2015: Auckland Stormwater Bylaw comes into effect.

2016: Auckland Unitary Plan becomes operative in part.

2019: Auckland Council granted a region-wide stormwater network discharge consent.

2019: Waikato Regional Council add Coromandel Harbour to their Regional Estuary Monitoring Programme.

Figure 19: Closed landfills around the Waitematā Harbour and Tāmaki River, with predicted river courses from the NIWA River Environment Classification (REC) overlaid.

Paint washed down stormwater drain, Maungarei Springs Wetlands 📷 Shaun Lee

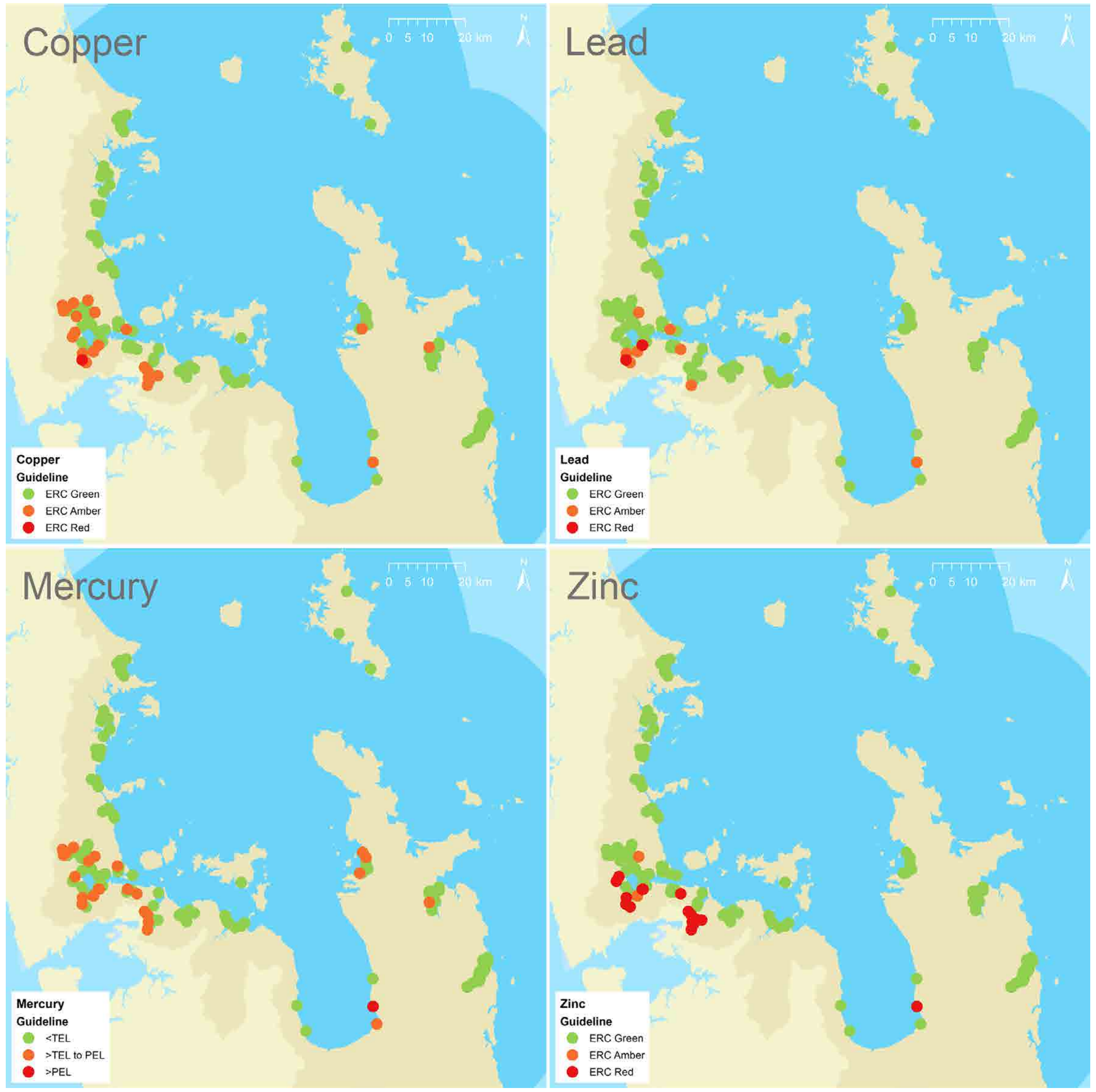


Figure 20: Most recent monitoring results available for each site in the Marine Park showing the ERC status of sites for copper, lead and zinc; and Effects Level status for mercury (unlikely (green), threshold effects level (amber, TEL=0.13 mg/kg) and probable effects level (red, PEL=0.71 mg/kg)). For four sites the most recent data was obtained between 2007 and 2009. For the other 156 sites, the most recent data was obtained since 2010. Note that monitoring of some sites has been discontinued.

HE RANGAHAU WHAKAPŪAHO (Case study)

TE KAIPUKE RMS *NIAGARA*—HE AITUĀ TE WHAI AKE NEI?

The RMS *Niagara*—a disaster waiting to happen?

RMS *NIAGARA* Australian National Maritime Museum 00041723 / Frederick Garner Wilkinson

Over one hundred and twenty metres below the ocean's surface, halfway between the Mokohinau Islands and the Hen and Chickens Islands lies the RMS *Niagara*. A casualty of World War II, she sank in June 1940 after hitting a contact mine laid by the Germans in a bid to blockade Auckland. Fortunately, no lives were lost, but half of New Zealand's entire stock of small arms ammunition and 590 gold bars went down with the ship—a severe setback for the Allies. An ambitious and highly dangerous salvage operation for the gold, which was estimated to be worth £2.5 million, started shortly after, and the bulk of the gold was retrieved by the end of 1941.[134]

Today, more than 80 years later, the *Niagara* is largely forgotten. Abundant reef life, including rare black corals and deep-sea sponges, now cover the wreck, and huge schools of haku (kingfish) circle above.[135] But beneath this thriving marine ecological community is a potential ecological disaster that is waiting to happen.

The *Niagara* had a heavy fuel oil capacity of several thousand tonnes, and had refuelled in Auckland prior to setting sail. A large quantity of that oil escaped in the immediate aftermath of the sinking, coating the surrounding coastline and wildlife with thick oil. Plumes of leaking oil have occurred ever since, but no one knows how much remains on the wreck. What is known, is that the wreck is gradually deteriorating, and oil leaks continue to be observed. Concerned environmentalists, salvage experts, and local politicians fear a major catastrophe could occur and have spent years lobbying Maritime NZ to extract the oil before that happens. They believe that the question of a major oil spill is not 'if' but 'when'.

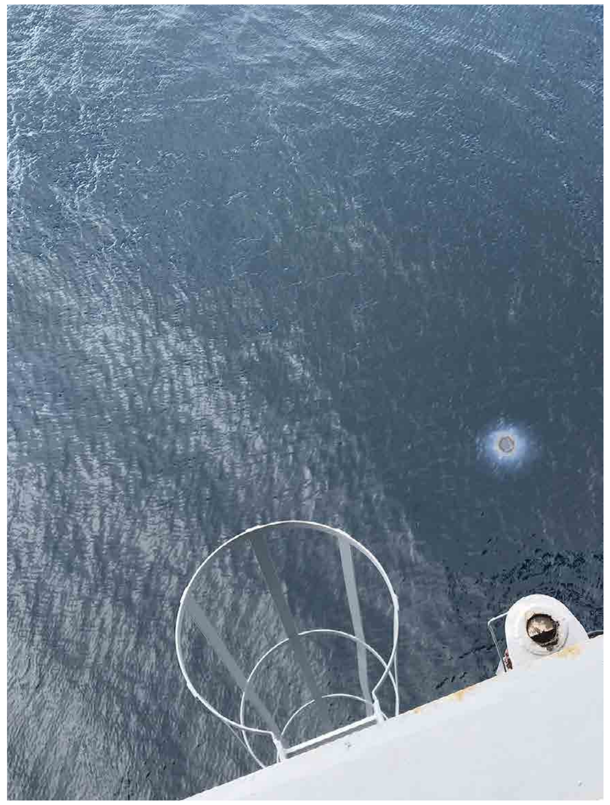
Maritime NZ (MNZ) is the lead agency in a national-level maritime incident, which includes oil spills. Their resources include: the National Maritime Response Team, oil spill equipment, contracted vessels and aerial assets, and contracted wildlife response. In addition to personnel/equipment capacity and capability, MNZ have well-developed systems and processes for maritime incident responses. They also have agreements with international support agencies and work with the network of New Zealand government agencies.

MNZ agrees that the risks associated with the RMS *Niagara* remain unclear. What is certain is that there were significant releases of oil when the vessel was sunk and again when the salvage operation to recover the gold bullion took place (the strong-room was blasted open). In addition, the vessel has been leaking small amounts of oil fairly constantly since its sinking. Given this, it is possible that relatively little oil may remain in the wreck after some 80 years, but it is acknowledged that even a small release of oil can have significant adverse effects on the environment.

Maritime NZ has already gone through a comprehensive process that considered undertaking a survey and risk assessment of the vessel. Their work highlighted that, given the way the wreck lies on the seabed, access to a some of the vessel's fuel tanks is highly problematic and that, for the wreck overall, any invasive survey work poses a risk of triggering a release of oil if it is present. Alternatively, a non-invasive survey may not provide sufficient information to support a detailed risk assessment. To date, MNZ has not been successful in securing funding to conduct a detailed risk assessment and survey of the vessel.

Not everyone is happy with the lack of pre-emptive action. Tim Moon, an archaeological project director, is hoping enough money can be raised to conduct a largely, privately funded survey of the *Niagara* to determine how much oil remains onboard, and whether there is a risk of a major spillage within the next couple of decades. The hope is that the results of the survey will convince the government to fund the oil extraction from the wreck before it is too late.[136] However, such a survey is not without risk. Accidentally, triggering a release of oil during a privately funded survey could also have serious environmental and personal liability outcomes.

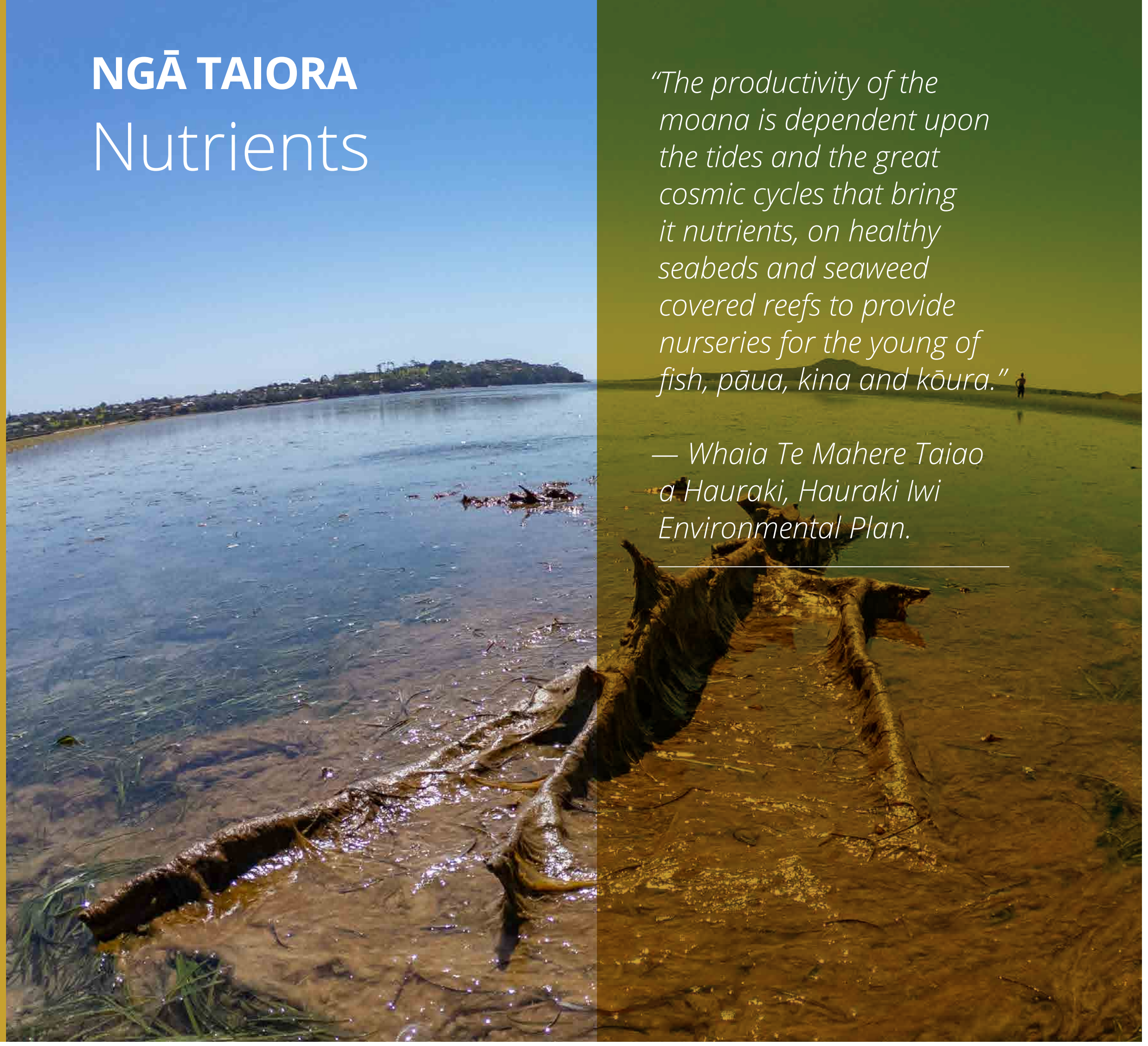
One way or the other, the final legacy of the mine that struck the *Niagara* will be revealed with time. The best we can hope for is that little oil remains and the leaks gradually dissipate. But as the saying goes—the worst possibility doesn't bare thinking about. The wreck has been described as an environmental time bomb[136] and after 80+ years, the question still remains—will it ever explode?



Oil leaking from the wreck in 2021
Clive Sharp / Subsee

Inspecting the disintegrating interior Keith Gordon

NGĀ TAIORA
Nutrients



"The productivity of the moana is dependent upon the tides and the great cosmic cycles that bring it nutrients, on healthy seabeds and seaweed covered reefs to provide nurseries for the young of fish, pāua, kina and kōura."

— Whaia Te Mahere Taiao a Hauraki, Hauraki Iwi Environmental Plan.

Algae smothering seagrass in the Tāmaki Estuary 📷 Shaun Lee

Nutrients sustain the growth of microscopic algae, rimurimu (seaweeds) and the other marine plants that form the base of the ocean food chain. In Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf, nutrients come from the surrounding ocean, are recycled from the seabed, and are washed in from the land. We increase nutrient loads to the Marine Park through our wastewater discharges, use of fertilisers, and the effluent produced by our livestock. Fish farming may be a significant source of nutrients in the future.

Slight increases in nutrients can promote healthy algal growth. The extra energy and matter produced flows up the food chain, supporting greater numbers of fish, birds and other sea creatures. But problems can arise if nutrient levels get too high. Then, microalgae and nuisance rimurimu blooms can occur. Microalgae blooms reduce water clarity and light levels, which can stunt the growth of rimurimu and karepō (seagrass). When the microalgae or rimurimu dies, decomposing bacteria can reduce oxygen levels in the water to harmful levels and produce large amounts of carbon dioxide, which lowers the pH of water making it more acidic. On the shore, rotting rimurimu can also create an unsightly, smelly mess.

Nitrogen is generally considered to have the greatest effect on marine water quality, but phosphorus is also a key nutrient of concern.[p] By far, the largest source of nutrients produced through our activities are the rivers draining the Hauraki Plains.

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

Synthetic nitrogen fertiliser application near the Piako River 📷 Shaun Lee

The latest results show:

The Waikato, including the Hauraki Plains, remains a key centre of intensive dairy farming, but Livestock Improvement Corporation and DairyNZ statistics indicate that dairy stock numbers on the plains have been relatively stable since 2000. In contrast, stock numbers in Auckland have declined substantially since 2000.[137]

Between 2011 and 2020, rivers draining the Hauraki Plains carried at least 3,730 t per year of nitrogen and 207 t per year of phosphorus to the Firth of Thames. The majority of the combined loads came from the Waihou River (60–61%) and the Piako/Waitoa River (36–38%).[138]

Estimates of nutrient loads indicate that the combined load of nitrogen during 2011–20 was about 10% higher than the preceding 10-year period (2000–09), while the load of phosphorus was about 27% lower.[138]

During 2011–20, the combined load of nitrogen from point sources was about 18% lower than that discharged during the preceding 10-year period; while the load of phosphorus was about 30% lower. This indicates that the overall increase in nitrogen load was due to increases in diffuse agricultural sources.[139]

By comparison, the combined average annual discharge load from Auckland's two largest east coast wastewater treatment plants (Rosedale and Army Bay) is around 245 t per year (minor loads are also discharged from other plants), while Auckland's largest river has been estimated to discharge around 120 t per year. Loads from other Auckland rivers were much lower.[140]

An application to establish and operate a marine farm in the Coromandel Marine Farming Zone for finfish and other marine species has been recently approved with consent to discharge up to 800 t of nitrogen per year.

Auckland Council has been monitoring coastal surface water quality since the early 1990s. Recent analytical anomalies arising from a switch in laboratories, means that nutrient trends in some parameters from Auckland coastal could not be assessed. However, spatial patterns show nutrient concentrations tend to be highest in the Waitematā Harbour, Tāmaki Estuary, and Wairoa Bay (***Figure 22***).

Waikato Regional Council has recently established a regular long-term monitoring programme for surface water quality, but data has not been collected for long enough to determine temporal trends. However, spatial patterns show elevated nitrate-nitrite-N and ammoniacal-N concentrations in Tairua Harbour, but relatively low concentrations in the Firth of Thames. The opposite pattern is apparent for concentrations of total nitrogen, phosphorus and chlorophyll *a*. Concentrations of all nutrient indicators are exceptionally high in the lower reaches of Piako and Waihou Rivers (***Figure 22***).

Recent research has found that the rate that nitrogen in the Firth of Thames is being recycled back to the atmosphere (denitrification) has decreased, leading to higher nitrogen concentrations in the Firth's bottom waters.[141] This is thought to be a response to high levels of organic matter generated within the Firth, driven by the high nutrient loading it receives from its rivers. The seasonal breakdown of this organic matter is promoting acidification and depleting oxygen levels throughout the Firth, especially in summer and autumn.[142] The organic matter deposition and low oxygen can further decrease denitrification, leading to a feedback effect that further increases nitrogen concentration. Globally, such effects have been shown to affect the capacity of sensitive coastal environments like the Firth to sustain ecological functions and values.

Sources of Nitrogen to the Firth of Thames

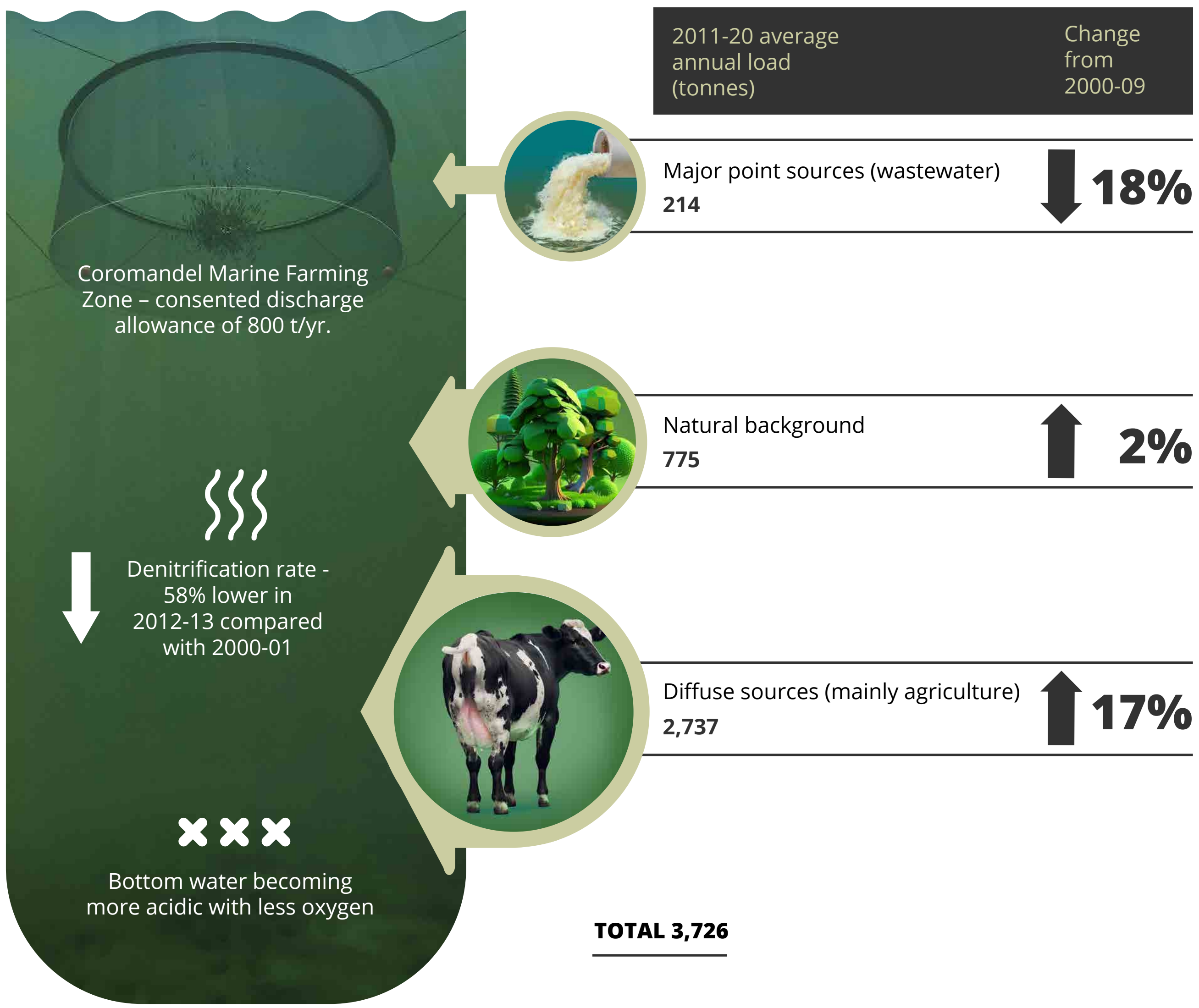


Figure 21: Sources of nitrogen changes in nitrogen loads from major rivers draining to the southern Firth of Thames and consented discharge allowance for the Coromandel Marine Farming Zone, along with nitrogen related environmental changes observed in the Firth of Thames. [138,139,141-144]

KEY EVENTS

2000: Dairy intensification on the Hauraki Plains had plateaued.

2011: Waikato Regional Coastal Plan amended to provide for fish farming included a combined allowance for the discharge of up to 1,100 t of nitrogen per annum (800 t for the Coromandel Marine Farming Zone and 300 t for the Wilson Bay Marine Farming Zone).

2011: National Policy Statement for Freshwater Management introduced.

2013: Sustainable dairying water accord launched.

2020–23

2020: Waikato Regional Council begins routine monitoring of water quality in the Firth of Thames, and the lower Waihou and Piako Rivers.

An application from a Waharoa dairy factory to discharge to water was declined largely because of nutrient effects on the Firth of Thames. The discharge was subsequently approved on appeal, subject to a revised proposal that included irrigation to land over summer and discharges to water being largely limited to winter/spring.

2022: Application to farm fish in the Coromandel Marine Farming Zone recently consented.

2023: Development of a new model by Auckland Council's Healthy Waters team, which estimates nutrient and sediment loads and identifies their sources, is nearing completion.

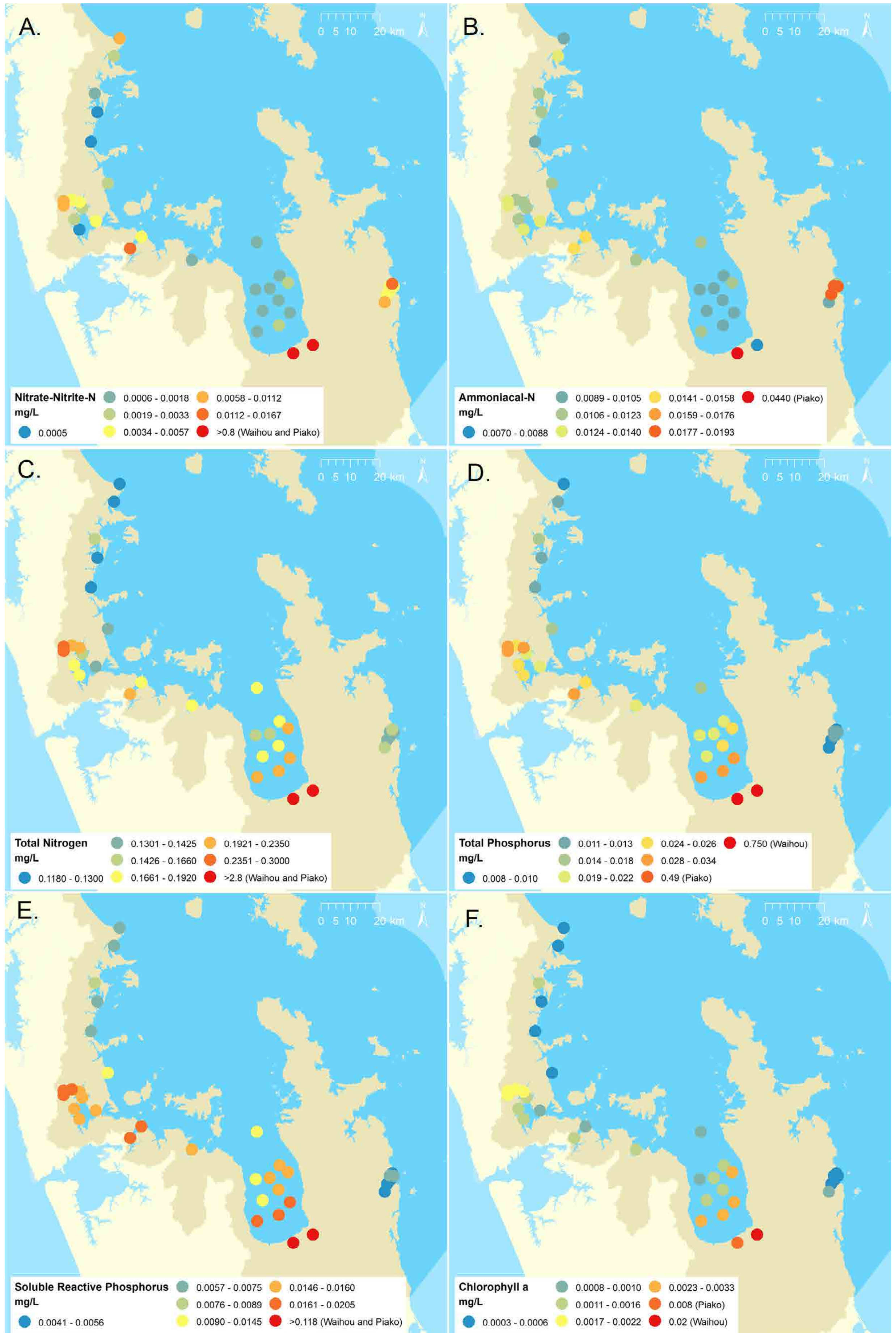
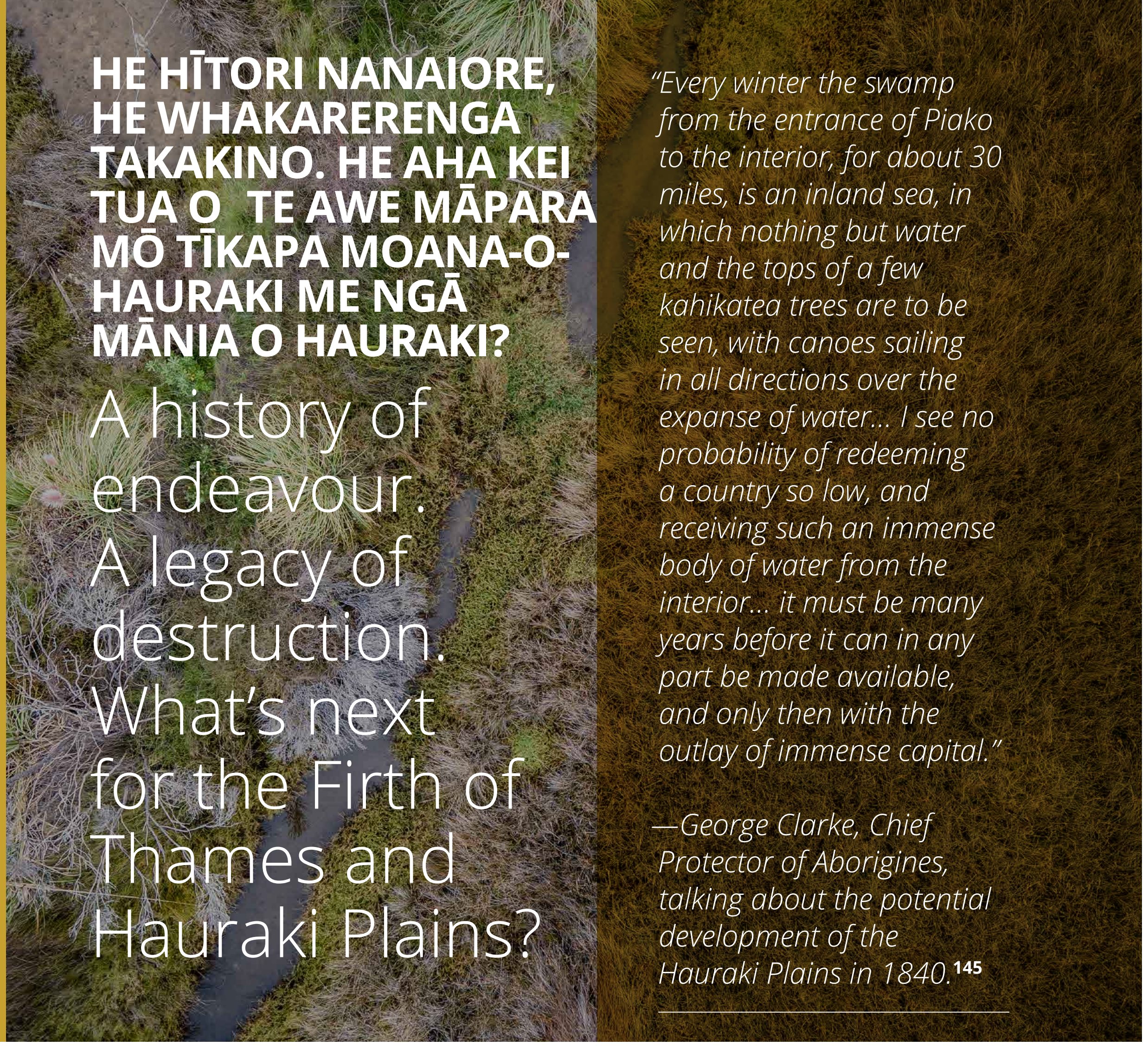


Figure 22: Median concentrations of: A) nitrate-nitrite-nitrogen; B) ammoniacal nitrogen; C) total nitrogen; D) total phosphorus; E) soluble reactive phosphorus; and, F) chlorophyll *a* from monthly monitoring data obtained by Auckland Council and Waikato Regional Council between July 2019 and June 2022.



HE HĪTORI NANAIORE, HE WHAKARERENGA TAKAKINO. HE AHA KEI TUA O TE AWE MĀPARA MŌ TĪKAPA MOANA-O-HAURAKI ME NGĀ MĀNIA O HAURAKI?

A history of endeavour. A legacy of destruction. What's next for the Firth of Thames and Hauraki Plains?

"Every winter the swamp from the entrance of Piako to the interior, for about 30 miles, is an inland sea, in which nothing but water and the tops of a few kahikatea trees are to be seen, with canoes sailing in all directions over the expanse of water... I see no probability of redeeming a country so low, and receiving such an immense body of water from the interior... it must be many years before it can in any part be made available, and only then with the outlay of immense capital."

—George Clarke, Chief Protector of Aborigines, talking about the potential development of the Hauraki Plains in 1840.[145]

Wetland in the Tairua Estuary © Gareth Cooke / Project Kahurangi

The story of the Hauraki Gulf over the past 250 years is etched into the Firth of Thames and the land that surrounds it. It's a remarkable story of a whenua and moana that have given so much. A story of human endeavour, tenacity, hard living and back breaking work. It's a story of boom and bust, serial depletion, and progressively shifting from one resource to the next. Of a whenua stripped, reshaped, and repurposed. Of a moana, whose taonga have been dragged from its waters or buried beneath a blanket of mud. But at what cost?

When Captain Cook and his party rowed up the Waihou in 1769, he never knew he had entered one of the largest wetlands in Aotearoa. A wetland that had formed over thousands of years and was an important food basket for Māori, providing waterfowl, fish and edible plants.[146,147] What Cook did notice, was the kahikatea (white pine) trees lining the river. He calculated the amount of timber that could be extracted.

It took another three decades for ships seeking timber for spars to arrive. However, the kahikatea timber was not durable enough for spars and attention shifted to kauri.[148] Slowly at first, but before long the trickle of loggers became a flood.

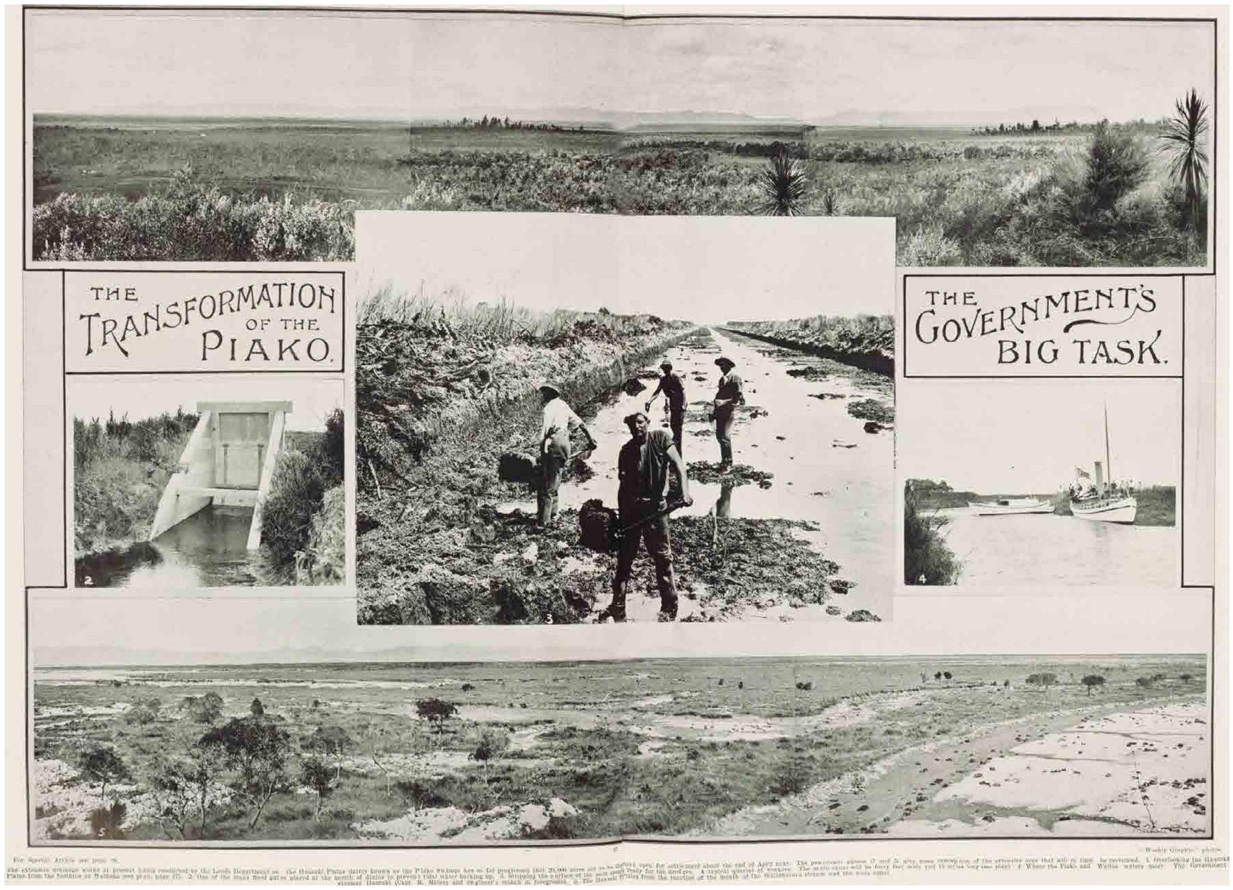
Easily accessible kauri trees were the first to be harvested. Loggers then devised methods for getting remote logs down to the coast. From the early 1860s logs were amassed behind dams, then spewed out in a crushing torrent of water and wood when tripped. Tearing at beds and banks, ripping sediments from river channels, and carrying everything down to the sea. The right to float logs down rivers was enshrined through the Timber Floating Act 1873. The Act provided for compensation to be sought for damages to riverbanks, eel traps and from silting, but no effective action was taken against timber companies.[149] Kauri logging peaked in the late 1800s, but harvesting dwindled as fewer and fewer trees remained. Harvestable trees were in short supply by 1900, and virtually all gone by the 1920s.

Gold mining batteries, Moanataiari Valley, Thames. Sherring, W W: Photographs of gold mining near Thames and view of the Wairarapa Plains. Ref: PAColl-7395-1. Alexander Turnbull Library, Wellington, New Zealand. /records/23203728

The landscape of the Hauraki Plains was also being transformed. Dairy farming was becoming increasingly important from the late 1880s thanks to the advent of refrigeration, which made bulk dairy sales to British markets a lucrative New Zealand trade. Forests of giant kahikatea, which once thrived in the wetlands, were felled and used for butter boxes, rabbit crates and packing cases to support trade between New Zealand, Australia and Britain. In 1908 the Hauraki Plains Act was passed, which aimed at turning 90,000 acres of swamp into productive dairy farms. The Act ***"authorised Department of Lands and Survey to drain and develop the land, construct roads and stop banks, with the intention of subdividing it for sale to prospective Pākehā farmers"***.[149] Labourers were sent out into the wetlands to turn ***"useless swamp into rich farmland"*** by stumping and burning, building stopbanks ***"to prevent the tide backing up over the flats"*** and scattering grass seed.[150]

Gold mining had also taken off after a gold-bearing quartz reef was discovered near Thames in 1867. Similar reefs were found in surrounding areas including Coromandel, Waihi, Karangahake, and Te Aroha. Gold extraction was a particularly difficult and destructive business involving processes that included, sluicing, coastal dredging, deforestation to obtain firewood for boilers, and the use of toxic chemicals. Silt produced by the crushing of ore with stamper batteries and other tailings were deposited into waterways with devastating impact. In 1895, Ohinemuri and Waihou Rivers were declared sludge channels under the Mining Act 1891, into which ***"tailings, mining debris, and waste waters of every kind used in, upon, or discharged from any claim or licensed holding"*** could be discharged, legalised the use of those rivers for toxic waste disposal.

Massive river silting ensued, contributing to major floods, washing finely ground slimes over surrounding pasture and impeding river navigation. In response, the Government established a Silting Commission to examine the issue. That led to the Waihou and Ohinemuri Improvement Act being passed into law in 1910.[149] The purpose of the Act was to remedy

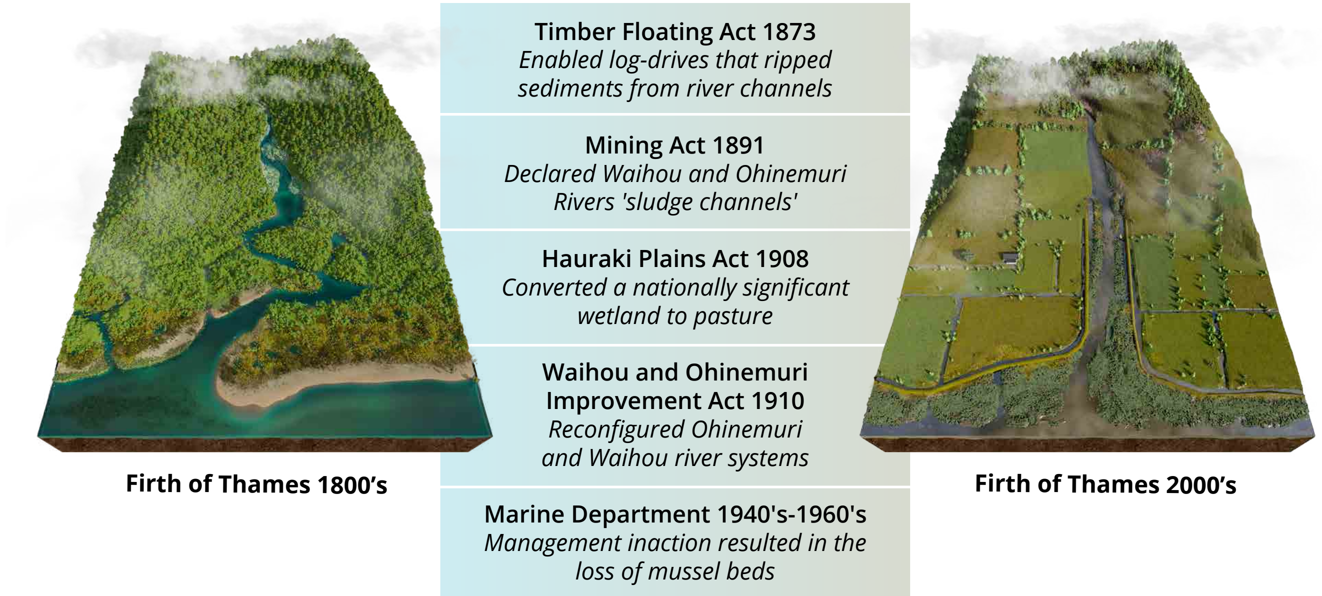


Series of photographs showing scenes during the work to reclaim land from the Piako Swamp. (1.) Overlooking the Hauraki Plains from the foothills at Waikaka. (2.) One of the many flood gates placed at the mouth of drains to prevent tidal water backing up. (3.) Stripping the surface of the main canal ready for the dredges. A typical quartet of workers. (4.) Where the Piako and Waitoa rivers meet. The Government steamer Hauraki and engineer's launch in foreground. (5). The Hauraki Plains from the junction of the mouth of the Waitakaruru stream and the main canal. Auckland Libraries Heritage Collections NZG-19100209-0020-01

or prevent the silting up of the rivers from mining or draining operations, prevent or mitigate flooding, and improve navigation. It gave the Minister of Works the power to ***"Straighten, shorten, divert, deepen, widen, or diminish the width of or alter the course of any river, stream, watercourse, or drain; deposit dredgings and other materials on the banks so as to form stop-banks, reclamations, and other works; construct levees, groynes, drains, floodgates, protective or other works in, upon, or under the bed or bank of any river, stream, watercourse, and lands in the river district; remove any trees in or adjacent to such river, or close up or alter any outlet from or inlet to the same, either wholly or partially; and remove, alter, or construct such walls, breastworks, wharves, shipping-places, and all other necessary erections, with road approaches and other convenient adjuncts thereto, in or upon the bed or banks of any river or on lands within the river district, as he thinks fit, without payment of any compensation for severance or loss of riparian or other rights in any such case, save only for the value of the land taken"***. The Ministry of Works, quickly set about doing that.

Consequently, most of the Hauraki flood plain was eventually logged, drained, and transformed into a geometric grid of dairy farms and embanked rivers. The conversion of wetlands on the Hauraki Plains to intensive dairy farms provided employment and made a substantial, and ongoing, contribution to the economy. However, it also led to the loss of important taonga for Māori and the destruction of an extremely valuable terrestrial ecosystem. It exacerbated sediment and nutrient loads, and at the same time greatly reduce the ability of the natural drainage system to filter those contaminants from the water, allowing them to flow into the moana.

Government Acts and departmental actions that enabled environmentally devastating outcomes



Sediment runoff radically altered the Firth of Thames. Around 44 million m^3 of sediment was deposited within the lower Waihou River and in the Southern Firth in the 40 years prior to 1918. This equates to around 300 years of today's suspended sediment loads from the Waihou and Piako Rivers.[151]

The impacts of these, and other, activities on the Firth of Thames have been dramatic. Until the mid-1940s, tidal flats in the southern Firth of Thames were composed of gently-sloping, muddy-sand flats that were largely free of mangroves. Thereafter, there was a marked shift in sediment texture from sand to mud, and by the mid-1960s the former muddy-sand flat had been replaced by mudflat.[151]

Mangroves began to colonise the upper mudflat in the mid-1950s and rapidly expanded seawards, trapping sediment with their aerial roots. By the mid-1970s, the surface elevation within the mangrove forest was one metre above the adjacent mudflat. Large quantities of sediment were still being trapped and deposited along the seaward margin of the mangroves. Sedimentation rates in this area increased two to ten-fold, and by the mid-1980s, a wide mud platform of several hundred metres had formed along the margin of the old mangrove forest. This platform was raised 0.8 to 0.9 m above mean sea level and gradually became colonised by mangroves until the early 1990s, when a period of rapid mangrove expansion and infilling occurred. Overall, mangroves have expanded by about 900 to 1,000 m into the southern Firth of Thames since this process began.[151]

There is little doubt that the expansion of mangroves led to the loss of ecologically diverse and productive open intertidal sand and mudflats. Although empirical data is not available, it is inevitable that the extent and abundance of mud-sensitive benthic species (such as tuangi (cockles) and hanikura (wedge shells)) would have been reduced. The spread of mangroves has also altered the distributions of roosting shorebirds, with previously popular roosting areas being abandoned and some species declining in number. Displacement has been particularly noticeable for ngutu parore (wrybill), kuriri (golden plover), and huahou (lesser knots).[152] However, mangrove expansion has increased available habitat for birds that feed, roost or breed within them, such as moho pererū (banded rail).

Scientists are also warning about the effects of nitrogen runoff. The ability of the seabed to process nitrogen (denitrify it) has been declining and nitrogen loads from land-based activities are causing bottom waters of the inner Firth to become more acidic, with depleted oxygen levels in summer and autumn.[141,142] Recorded pH and oxygen levels in that area are approaching, or within ranges, known to negatively affect a variety of urchin, shellfish and fish species.

Resources within the Firth of Thames have also been affected by overharvesting. Commercial kūtai (mussel) harvesting began around the turn of the 20th century. Kūtai were initially picked by hand, then harvested by a small dredge pulled by a small motorboat. Methods soon shifted towards larger vessels and dredges, and annual landings rapidly increased from an estimated 100–500 t over the 1920s, to 1,200 t by the end of the 1930s. Concerns about the sustainability of the fishery grew in the 1940s, leading to a 3-year closure of beds around Coromandel, and fishers were encouraged to prospect for new beds in other areas of the Firth and inner Gulf. Declines in the quantity and quality of kūtai were also being noted. Explanations for this included increasing silt and overcrowding within beds. Despite these concerns two companies were licenced in the late 1940s to dredge kūtai and shell for fertiliser and shell lime.[153] Landings rose sharply in the 1950s to 2,500 t annually. By the end of that decade, very serious declines were being reported in many, once productive beds. Landings increased again in the first two years of the 1960s, then completely crashed to zero by 1969. On this, Paul[153] notes ***"Despite the clear warnings in Reid's 1958 study, the Marine Department made little effort to bring the fishery under sustainable management, and its Reports on Fisheries simply recorded its decline"***. There has been no natural recovery of kūtai beds in the Firth in the 50+ years since dredging ceased.

More recently, government and industry dissatisfaction with the lack of progress on diversifying and expanding aquaculture development, led to reforms to the Resource Management Act (RMA) in 2011. Among other things, the reforms amended the Waikato Regional Coastal Plan and established a new 300 ha zone for finfish aquaculture west of Coromandel, and a 90 ha fish farming zone in Wilsons Bay.[154] The effects of that decision are yet to play out, but if consents are granted, some impact will be inevitable. Of particular concern, is the potential for nitrogen discharges from fish farms to exacerbate the effects of nitrogen from land-based sources.[142]

The recent changes to the RMA echo a common thread throughout this story. That is, the role of Central Government in enabling commercial activities known to have deleterious impact on the environment. It includes activities that have led to the demise of irreplaceable environmental taonga. The Waitangi Tribunal's Hauraki Report[149] summarises the consequences of that history:

"From our twenty-first century viewpoint, we may feel appalled, as many claimants have told us, at the wanton destruction of land, forests and waterways. Hauraki Māori have certainly suffered the loss of resources. Pākehā settlers, too, found their interests were secondary to the interests of gold-mining and timber companies. But, by the 1920s, these industries were fading fast, to be replaced by dairy farming and farm-related economic activities. But farming too has contributed a share toward the pollution of rivers from fertiliser runoff into streams, effluent from cow sheds and dairy company wastes and spills. There have been pressures from growing towns and seaside subdivisions. The forests have been ravaged by introduced deer, goats, and possums. Blackberry and gorse have flourished on the land. The native birds have been killed off by rats, stoats, feral cats, and possums. Māori in Hauraki have suffered a loss of traditional resources. Eel weirs were destroyed in timber drives, the ecology of waterways was polluted by mining waste dumped in rivers renamed sludge channels. The hills, denuded by timbermen and miners, have eroded and sediments filled the watercourses. The legacy of all this is continuing, expensive flood-control schemes on the rivers of the Hauraki Plains. We acknowledge and welcome the Crown's concessions on these subjects."

Kūtai (Green-lipped mussel) dug up from the mud by diver Shaun Lee

Many lessons can be taken from the history of the Firth of Thames, including:

- Industries built around finite resources can generate tremendous short-term profits. But they also come and go, leaving a tremendous impact.
- People are incredibly industrious and given time, opportunity, and resources, can achieve remarkable feats of engineering and development. The ability of people to modify the environment has never been greater than it is today.
- Impacts and opportunities that directly affected people's living or livelihoods elicit rapid and costly responses that transform the landscape.
- Solutions to a problem often have unforeseen environmental consequences (or people may simply be indifferent to the consequences). The same applies to technological advances.
- Important intrinsic values of natural resources like giant forests of ancient kauri and kaihikatea, vast kūtai beds, and the expansive Hauraki wetlands are only fully appreciated decades after they disappeared.
- Some effects are rapid and obvious. Others, such as the serial depletion of kūtai and nutrient effects are hidden and arise slowly.
- Environmental decline has largely been a one-way process.
- Government decisions commonly enabled, or are directly responsible, for the loss of significant natural values and threaten the long-term sustainability of resources for future generations.

Those lessons can help shape future actions, but what should we do about legacy issues? Those costs to the environment remain unaccounted for, while new threats continue to emerge. Nutrient effects, climate change, and increasing numbers of marine and aquatic pests, to name but a few.

History suggests that the Firth of Thames and Hauraki Plains were 'ground zero' for the explosion of activity and impacts that followed Pākehā settlement of the lands surrounding Tīkapa Moana / Te Moananui-ā-Toi. Remedying legacy impacts appears to be well beyond the capacity of local and regional councils, or central government to address alone. In reality, the impacts of past actions are simply too big to be completely reversed. Yet actions could be taken to avoid further loss and improve specific outcomes in the Firth and surrounding plains. But that requires coordination, commitment, and a plan. The Government has set an example with the development of a plan for Revitalising the Gulf. Perhaps it's time for central, local, and regional government to also produce and implement a bespoke plan for the Firth of Thames and Hauraki Plains, that not only manages the impacts of current activities, but also allows the environmental clock to be wound back a little.

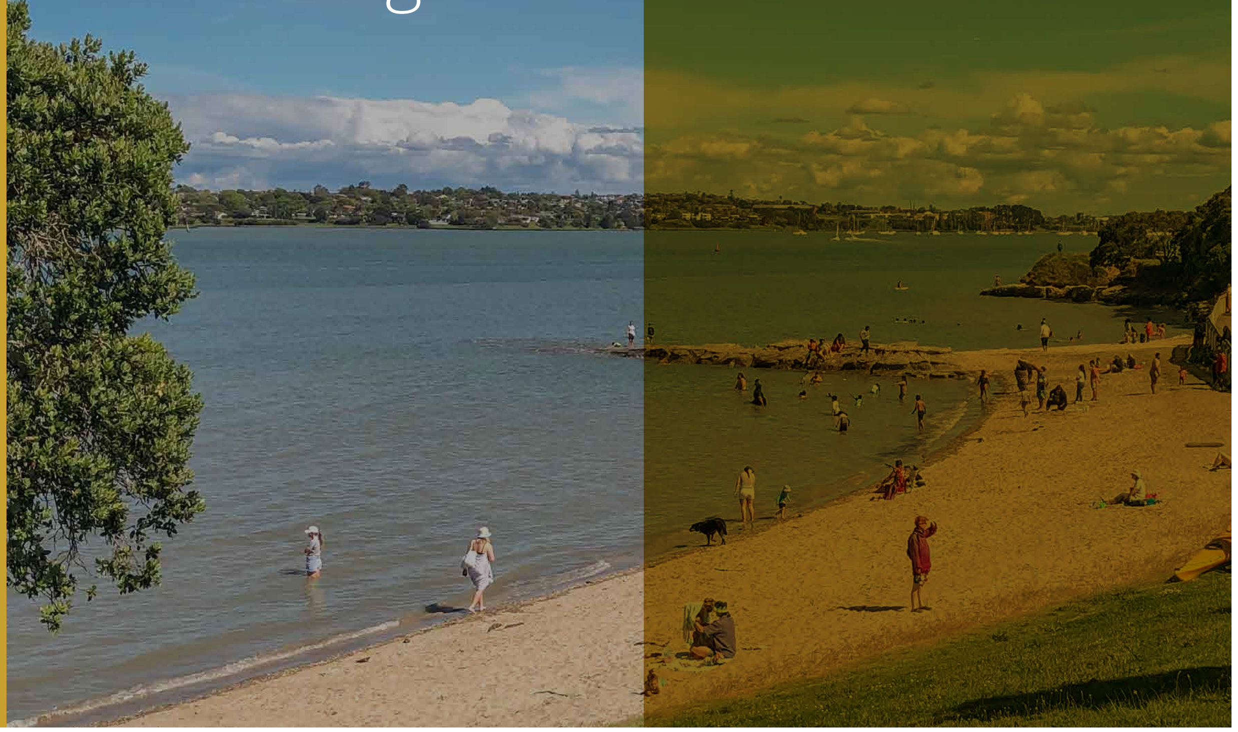
TOHU (Indicator)

TE TOITŪTANGA O TE WAI HEI WAI KAUKAU

Suitability of water for swimming

"Nearly every beach in Auckland unsafe to swim at after another deluge"

—Newshub headline 25 February 2023.[155]



Tāmaki Estuary Shaun Lee

Human and animal faeces contain bacteria, viruses and other disease-causing organisms that can make swimmers, or other people, who come into contact with contaminated water sick. 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.

Treated and untreated wastewater are major sources of disease-causing organisms. Wastewater enters the sea through discharges from wastewater treatment plants, sewer overflows, seepage from septic tanks, discharges from boats, and through contaminated stormwater.

Auckland has a vast reticulated wastewater system that includes 18 wastewater treatment plants, around 8,000 km of pipe and about 420,000 wastewater connections. Smaller networks are found in towns and villages throughout the Marine Park catchment.

While only 15% of the 34 wastewater treatment plants in the Marine Park catchment discharge directly to the sea, those that do include the largest plants (Rosedale and Army Bay). Greater numbers of (typically smaller) treatment plants often discharge to rivers (47%) or land (35%, including 9 of the 13 plants on Coromandel Peninsula) (***Figure 23***).

Population growth and new development has strained local wastewater facilities. Over the past decade or so, new or significantly upgraded treatment plants have been built at Kawakawa Bay, Whitianga, Coromandel, Thames and Matarangi. New ocean outfalls have been built at the Army Bay (Whangapāroa Passage) and Snells Beach (Martins Bay) treatment plants. Progress has also been made on a new regional wastewater treatment plant at Snells Beach that will accommodate growth in Snells-Algies and Warkworth district and replace the Mahurangi River discharge from the old Warkworth treatment plant. Despite this, spikes in the populations of beach settlements over holiday periods can still be problematic, due to 'shock loads' on sewage treatment systems.

Meanwhile, many coastal communities still rely on septic tanks whose performance varies widely. Auckland Council are trying to reduce leakages from septic tanks, and in 2022 they introduced a compliance scheme that requires owners to provide evidence that they have their septic tanks serviced every 3 years.[156]

All wastewater networks are 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 can occur to land, streams and the coast.

This indicator uses measured, modelled and assumed data on the concentrations of the gut bacteria, enteroccoci, at beaches in the Marine Park. Enterococci are present in faeces and are used as a proxy for other disease-causing organisms that can make people sick. Beaches should be closed when repeat samples have concentrations greater than 280 enteroccoci most probable number (MPN)/100 ml (the 'Action' level).

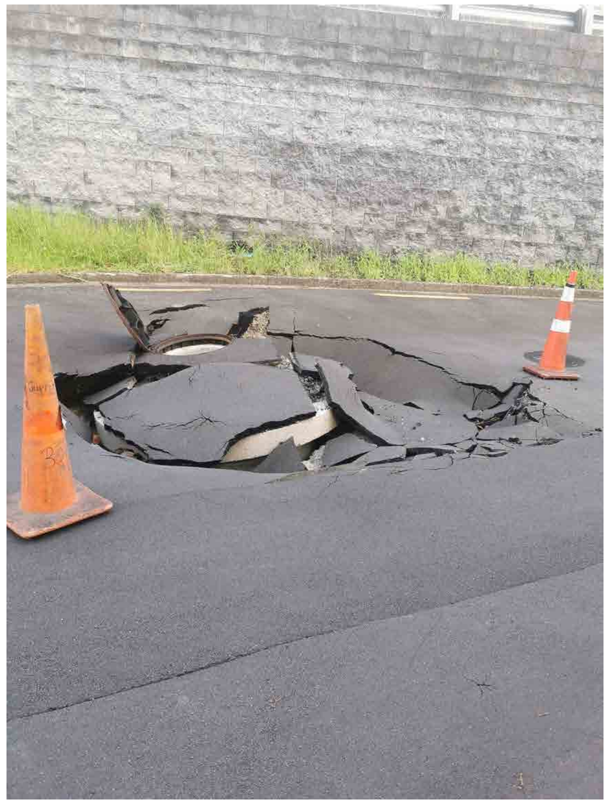
Safeswim (www.safeswim.org.nz) has provided a technological step-change for the assessment and reporting of health risks for Auckland's beach goers and is cited as a good example of communication in the World Health Organization guidelines on recreational water quality.[157] Safeswim uses real-time data from Auckland's wastewater networks and rainfall to model forecasts of water quality and provide up-to-the-minute advice on swimming conditions. Safeswim provides better transparency about water quality by informing recreational users in real-time of the public health risk at major beaches.

The number of beaches assessed in the Safeswim programme has increased over time, but the original 59 east coast sites are

Stormwater and sewage in the Tāmaki Estuary catchment (2020–2022) Shaun Lee still used for standard reporting purposes. The Safeswim reporting statistics are based on daytime, hourly predictions of beach status over the summer period.[r] The indicator for Auckland beaches is the averaged percentage of predictions that exceed the Action threshold over the three summers from 2019–20 to 2021–22. Seven sites had not been modelled due to: consistently good water quality at five of them; and, permanent beach closures at Cox's Bay and Meola Reef. Of the modelled sites, 48% were predicted to exceed the enterococci trigger more than 5% of the time; 25% were predicted to exceed the trigger more than 10% of the time; and 4% were predicted to exceed the trigger more than 20% of the time (*Figure 24*). The worst beaches Auckland were mainly located along the shore between Tāmaki River and the Upper Waitematā Harbour, but Action levels were also regularly exceeded at Little Manly on Whangaparāoa Peninsula. These exceedances show that there is some way to go to reduce wastewater effects on our beaches.

In the Waikato Region, health risks are still managed using weekly beach water monitoring over the summer period, with results being reported through the Land Air Water Aotearoa (LAWA) website.[s] Waikato Regional Council conducted monitoring of 10 Coromandel Peninsula sites between the summers of 2019–20 to 2021–22. Water quality at their seven open-coast beach sites, and at the Whangamata Harbour estuary site was good, with less than 5% of samples from four of those sites exceeding the Action level trigger, and the remaining four sites never exceeding it (*Figure 24*). Two estuarine sites (Grahams Stream and the Pepe Stream Bridge) in Tairua Harbour had the worst water quality, with 16–22% of samples exceeding the Action level trigger. Exceedances at the Grahams Stream site have been largely attributed to faecal contamination by birds.

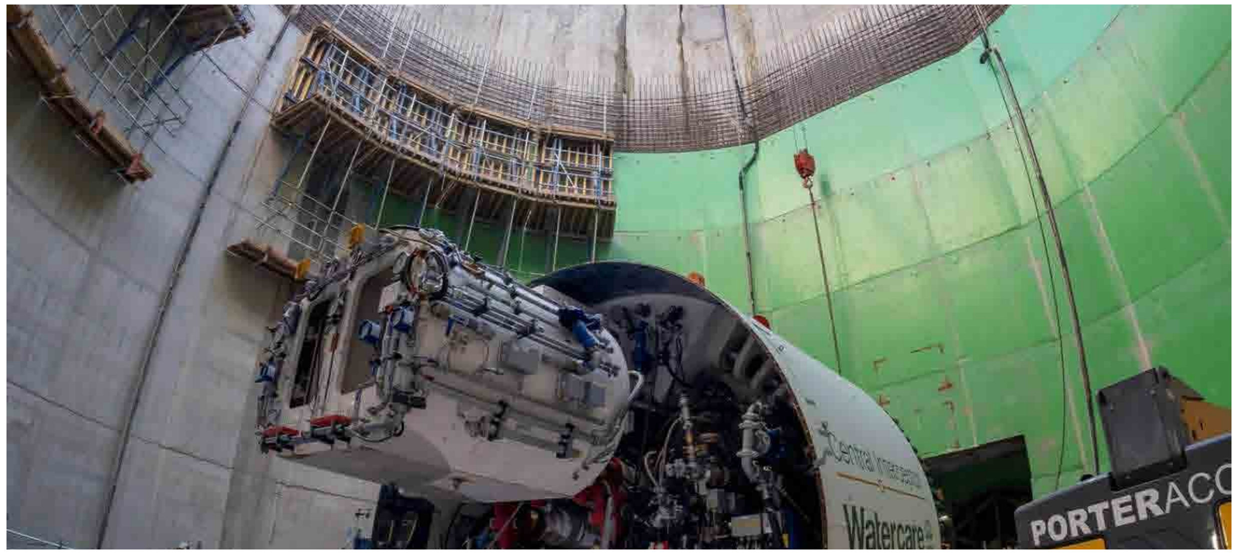
Note that the data provided in this report does not cover the effects of recent storm events in early 2023. In late January–February 2023, wastewater networks across and beyond the Marine Park catchment were sorely tested by a record-breaking rainfall event followed in quick succession by Cyclone Gabrielle. Floodwaters overwhelmed pipe networks and poured through a number of wastewater pump stations, damaging pipes, pumps and associated electrical systems. Numerous overflows resulted, with untreated wastewater pouring into waterways and out to the coast, causing beaches to be closed for extended periods to protect public health. At the time of writing, the overall effects of those events were yet to be quantified.



Manhole in Parnell after Cyclone Hale (2023)
NZ Flood Pics

Waiwera Estuary May (2023) Ed Chignell

[r] 6 am to 9 pm between 1 November to 30 April.
[s] https://www.lawa.org.nz/explore-data/swimming/



Watercare's Hiwa-i-te-Rangi tunnel boring machine at the bottom of the launch shaft in Māngere Watercare

Auckland Central Interceptor

The central Auckland isthmus is a particularly problematic area for wastewater discharges to the Gulf. Much of that area is serviced by older components of Watercare's wastewater network, which were originally constructed for the Ōrākei outfall in the earlier part of the 20th century and are now up to 100 years old. Around 20% of the connections in Auckland's Western Isthmus (Central Interceptor) catchment go to the old, combined stormwater and wastewater pipe system (*Figure 23*). The combined system conveys wastewater to Mangere Wastewater Treatment Plant in dry weather. However, when it rains, stormwater runoff enters the pipe network, which quickly reaches capacity and discharges into waterways. While only 20% of Watercare's engineered overflows are within the combined system area, it contains 68% of the overflows that discharge most frequently, with approximately 50 overflowing every time it rains. Outfalls in the Western Isthmus catchment are estimated to discharge around 2.2 million m^3 of diluted wastewater on an average annual basis.

The construction of the Central Interceptor should be a game-changer for central Auckland beaches. This $1 billion initiative is New Zealand's largest wastewater project. It involves boring a 4.5 m high, 14.7 km long wastewater tunnel between Grey Lynn and the Māngere Wastewater Treatment Plant, connected to surrounding areas by two linking tunnels.

In addition to transporting wastewater, the tunnel will provide 226,000 m^3 of storage.

The project is designed to reduce average annual overflow volumes in the Central Interceptor catchment by 80%, cater for Auckland's ongoing population growth, and to provide resilience to at-risk sections of the sewer system. The project involved over five years of initial planning prior to it being consented in 2013, with construction starting in 2019 and completion expected by 2026.

State-of-the-art tunnel boring machines have been brought from Germany to build the tunnel, which will have a gradual slope that allows wastewater to flow downhill towards the treatment plant. The main tunnel boring machine has a massive 5.4 m diameter cutter head that will grind its way through a variety of soils and rocks. Spoil is transported back in skips, lifted out of the tunnel and trucked to Puketutu Island in Māngere where is being used to help recreate the original volcanic cone. The tunnel is being lined with 9,000 precast concrete segment rings, with a durable lining that will protect the concrete from corrosion over the tunnels expected 100-year lifespan. Sixteen construction sites are located along the tunnel route. Larger ones are expected to operate for three to five years, with smaller sites open for around 18–30 months.

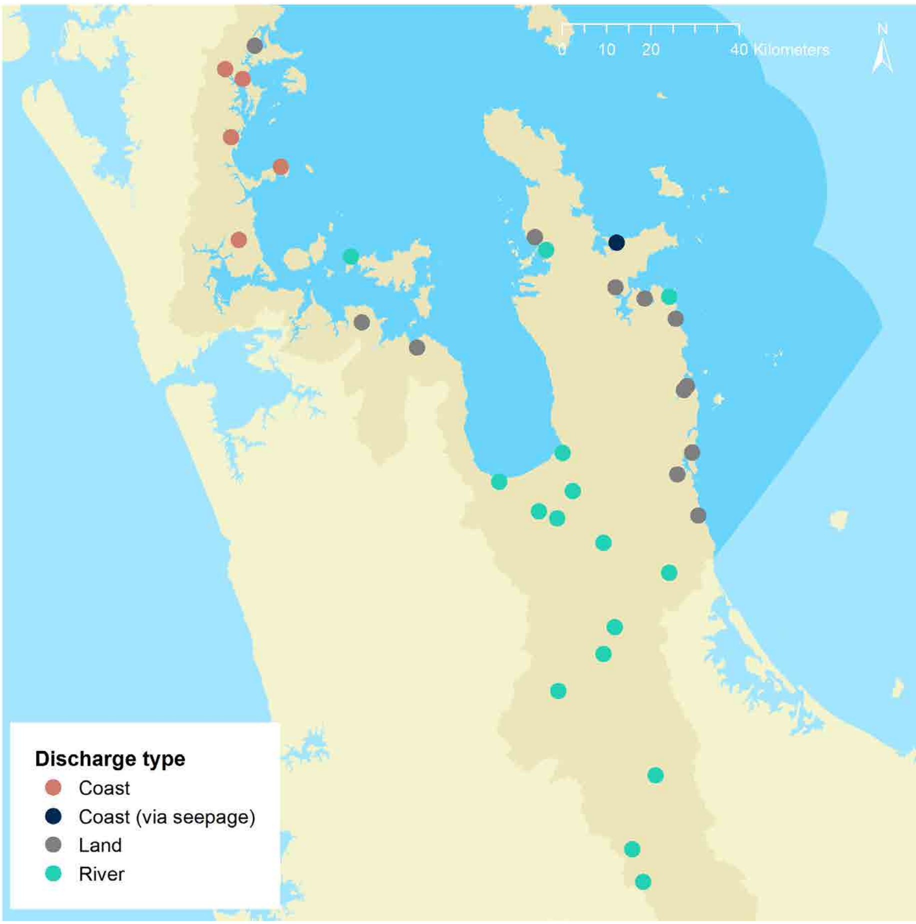


Figure 23: Environments that wastewater treatment plants in the Marine Park catchment discharge to.

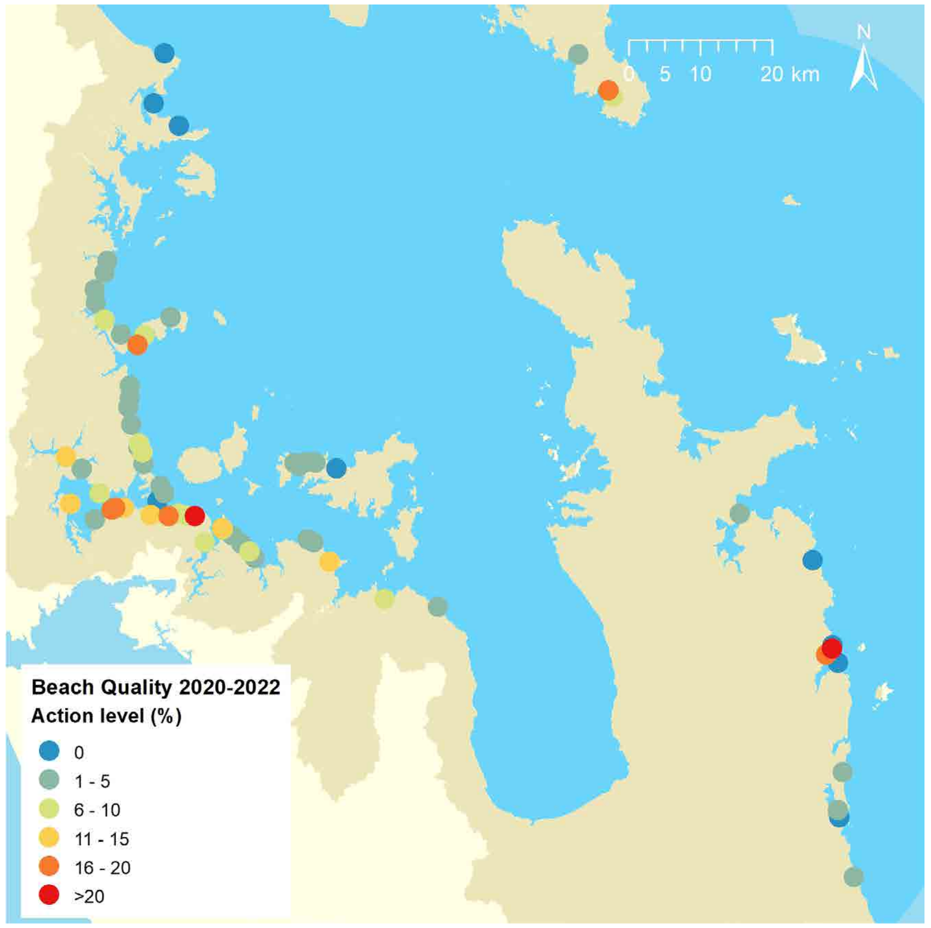


Figure 24: Percentage of model results (Auckland) or coastal samples (Waikato) that exceeded the 'Action' level Enterococci concentrations between 2019–20 and 2021–22 summers.

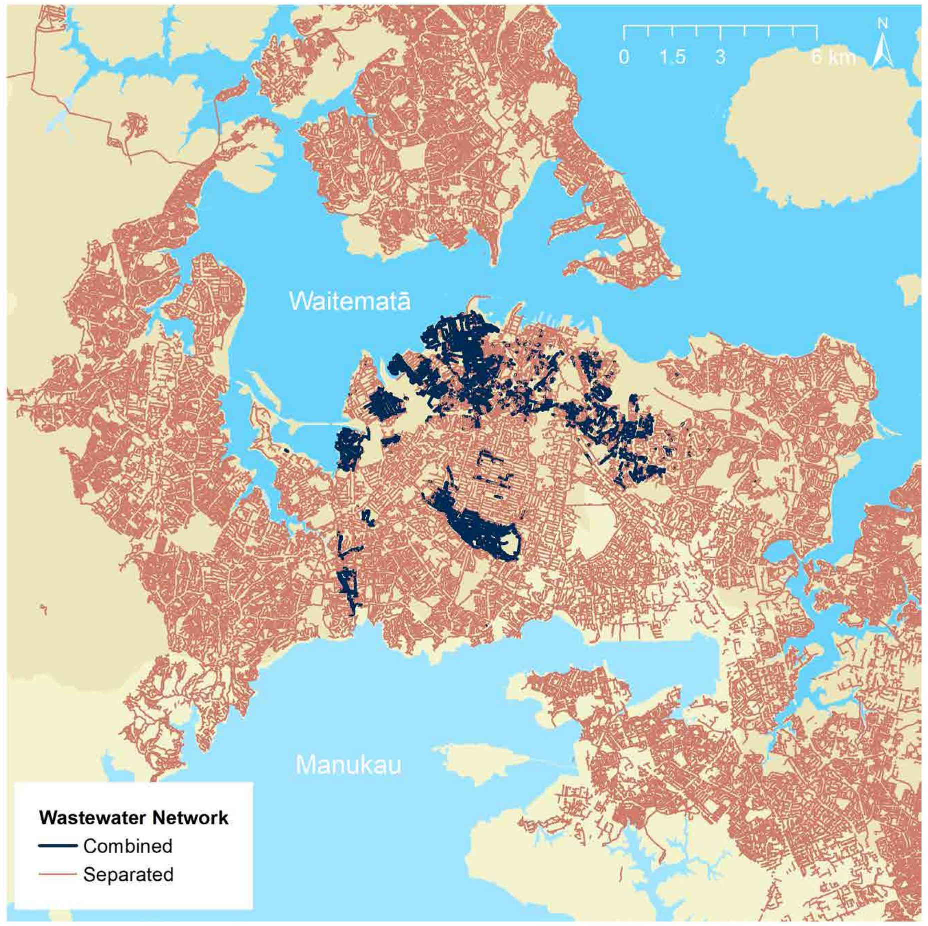


Figure 25: Central Auckland areas that have a combined wastewater and stormwater system, and areas that have a separated system.

KEY EVENTS

2000: Local and regional councils monitored 75 Marine Park beaches for summer water quality.

Regulations introduced that prohibit the discharge of untreated sewage from vessels, including recreational boats, in waters less than 5 m deep or within 500 m of the shore or a marine farm.

2003: New microbiological water quality guidelines released by the Ministry of Health and Ministry for the Environment.

2008: Auckland Three Waters Strategic Plan identifies the provision of a new Central Interceptor as a matter of urgency for the Auckland's sewer system.

2013: Consent granted for Auckland's Central Interceptor project.

2014: Watercare Services granted an Auckland-wide, 35-year discharge consent for discharging wastewater from existing and specified future networks.

2017: Auckland Council begins reporting 'real-time' health risk information through their Safeswim web portal.

2019: Construction of Auckland's Central Interceptor begins.

2020–23

2021: Watercare's tunnel boring machine begins its 5-year journey from Māngere to Grey Lynn.

Work begins on the new Warkworth-Snells Algies wastewater scheme including a new modern wastewater treatment facility at Snells Beach, new transmission infrastructure to convey wastewater from Warkworth to the new plant. The scheme is expected to be finished in late 2024.

2022: Watercare defers its planned St Mary's and Herne Bay wastewater separation programme on the southern side of the Waitematā harbour bridge, due to an unaffordable cost escalation. A new plan is announced to extend the Central Interceptor to St Mary's Bay, with a smaller Herne Bay wastewater pipe, and a revised programme of sewer separation to be completed by late 2028.

2023: Planning progresses for the Newmarket wastewater storage and conveyance tunnel to be built later in the decade. The tunnel will convey and store wet weather overflows from Newmarket gully, helping to reduce wet weather wastewater discharges to Hobson Bay and the Waitematā.

Auckland Anniversary Day floods and cyclone Gabrielle cause extensive damage to localised parts of Watercare's wastewater network. The recovery phase is expected to take up to two years to complete.

TOHU (Indicator)

TE ORANGA O TE PARAKIWAI ME TE PAPAMOANA

Sediment and benthic health

"Aotearoa New Zealand has some of the highest sediment run-off of any country in the world, contributing an estimated 1% of worldwide sediment input into the marine environment from our coastlines."

—Office of the Prime Minister's Chief Science Advisor[159]

Sediment smothering kelp near Motukorea / Browns Island Shaun Lee

Sediment is ranked the 3rd highest threat[t] to Aotearoa's marine habitats (after ocean acidification and global warming).[13] It is a serious pollutant that degrades our coastal habitats and smothers marine life. Land activities, such as forestry, farming, mining, draining of wetlands and urban development have greatly increased the amount of sediment that enters our waterways and harbours. Sedimentation rates in the Waikato over the past 100 years were around 100 times those of pre-human times.[160]

This has led to major changes in our coastal marine ecological communities. High levels of suspended sediments prevent life-supporting light from reaching rimurimu (seaweed) and karepō (seagrass), damages the gills of fish, and stops filter-feeders such as kai moana and pūngorungoru (sponges) from feeding efficiently. This sediment eventually settles on the seafloor, where it smothers marine life, resulting in the loss of mud-sensitive species such as tuangi and pipi, and the increase in mud-tolerant worms.[63]

Councils monitor suspended sediment (total suspended solids or TSS) in our waters, the muddiness of our estuaries, and the health of intertidal animal communities (Benthic Health Modelmud) around the Marine Park. Site health is graded from 'extremely good' to 'unhealthy with low resilience' depending on the number and type of animals present, as different communities are present on sandy shores versus muddy shores. The monitoring shows that:

High sediment inputs are still occurring in some estuaries, which is reflected in the increasing proportion of mud in many of the monitored sites over the last decade (*Figure 26*).

Of the 93 sites monitored in the Marine Park, only 38% have good or extremely good benthic health (*Figure 27* & *Figure 28*). The healthiest sites are in the outer areas of Waiwera, Pūhoi, Ōrewa and Okura estuaries, while the poorest sites are in the inner areas of the Waitematā Harbour, Tāmaki Estuary, Mangemangeroa Estuary and Weiti River.

[t] Equal with bottom trawling.

The most recent available data provided by WRC (2018–20) and Auckland Council (2019–21) shows benthic health scores improved at 16 sites and declined at 7 sites over those periods. The largest estuary-wide changes have occurred in Tairua Harbour and Waiwera Estuary (3 sites each have improved), and Turanga Estuary (2 sites have improved). Pūhoi and Okura estuaries had a mixed response (2 sites improved but 1 site declined in each). However, considerable year-to-year variation can occur in the benthic health scores. Examination of longer term data over the last 10–20 years show that two Tairua Harbour sites have improved (Oturu Stream and Pepe Inlet), and four sites (Miranda, Manaia Rd in Tairua Harbour, and Shoal Bay and Herald Island in Waitematā Harbour) have declined (*Figure 29*). Most sites show no consistent trend over the past decade.

Ecological communities at some sites in Mahurangi Harbour have not recovered from major stepwise changes caused by sedimentation in the 1990s, such as large reductions in tuangi, hanikura (wedge shells) and polydorid polychaetes.[161]

TSS concentrations typically show a gradient of decreasing concentration from the inner reaches of estuaries and the Firth of Thames out towards the outer Gulf. In some areas such as the Waihou and Piako Rivers, recently-started[u] water quality monitoring shows that TSS concentrations are extremely high, with levels around 25–80 times higher than those in the inner Firth (*Figure 30*).

New, environmental DNA (eDNA) techniques for monitoring benthic communities are currently being developed that have potential to provide for faster, less costly monitoring of benthic communities. Genetic material such as skin cells and faeces that are present in water samples can be matched to the DNA database of marine species (if the species is present in the database) to identify the animals present in the area. Unlike traditional macrofaunal monitoring, which is largely based on the abundance of different species, eDNA cannot measure population size, only the presence or absence of an animal. eDNA samples are currently being collected around the Marine Park alongside traditional ecological monitoring samples, with the aim of developing new alternative or complementary techniques for monitoring our coastal environment.[162]

Concern about the effects of sedimentation in our estuaries led to Council-funded research on sedimentation in high risk areas, including the Firth of Thames, Waitematā Harbour, Whitford embayment, and Okura and Mahurangi estuaries.[160,163-166] This has increased our understanding of the sources of sediment, historic and future accumulation rates, and the effects of sedimentation on marine ecological communities. The main source of sediment accumulating in the Firth of Thames in recent times (2005–2015) is from catchment subsoil (around 50%), but around 45% is from resuspended marine sediments that originated from deforestation and erosion that occurred over 100 years ago. Forestry and pasture top soils were only found to contribute a minor portion of more recent sediment in the Firth.[163]

Volunteer sampling eDNA in the Tāmaki Estuary
Shaun Lee / Tāmaki Estuary Protection Society

Catchment management plans have been developed for numerous estuaries around the Marine Park to try and reduce sedimentation rates and restore native coastal vegetation communities.[167] Work includes fencing off waterways to protect them from stock, planting steep hillsides and riparian areas, wetland restoration, and weed removal.

[u] Monthly sampling beginning in August 2020.

Much of this work is jointly funded by private landowners and Councils. Progress towards management plan goals is often slow and disjointed because it is generally reliant on obtaining sufficient ongoing funding and strong community support and participation.[168]

Implementation of a National Environmental Standard for Plantation Forestry (NES-PF) in 2018, and a National Environmental Standard for Freshwater in 2020 aimed to reduce erosion and sediment generated from forestry and activities that pose a risk to freshwater systems. Regulations include: protection of natural wetlands from clearance, earthworks or alteration of natural water flows; fencing wetlands from stock; stormwater and sediment control measures for forestry activities; and, required setback areas when planting next to rivers, lakes, wetlands, and coastal areas. However, there are concerns that the NES-PF doesn't adequately address the environmental impacts of plantation forestry.[169] Proposed changes to the NES-PF were submitted for public consultation in late 2022, but no decision had been released at the time of this report writing. Better methods for managing sediment in land run-off on construction sites have also been implemented.[170]

However, there is still a long way to go in managing sediment runoff. Higher intensity rainfall events and greater extremes in river flows due to climate change will further exacerbate this issue. The huge quantity of sediment deposited on flooded plains during Cyclone Gabrielle is a grim illustration of the quantity of sediment that is entering our moana. The effects of these major flood events on marine ecosystems are yet to be determined, but initial observations by scientists from WRC suggest they could be significant and will compound the legacy effects of sediment accumulation *(see Case Study: A history of endeavour. A legacy of destruction. What's next for the Firth of Thames and Hauraki Plains?)*.

Diver showing how visibility declines with depth over mud substrate 📷 Shaun Lee

KEY EVENTS

1994: Monitoring of Mahurangi starts.

2000: Monitoring of Okura starts.

2001: Monitoring of the Firth of Thames starts.

2002: Monitoring of Pūhoi, Waiwera, Ōrewa and Mangemangeroa starts.

2004: Monitoring of Turanga and Waikopua starts.

2009: Monitoring of Whangateau starts.

2013: Monitoring of Tairua starts.

2018: Implementation of a National Environmental Standard for Plantation Forestry.

2019: Monitoring of Coromandel Harbour starts.

2020–23

2020: Implementation of a National Environmental Standard for Freshwater

2023: Flooded rivers during extreme weather events carried huge loads of sediment into the Marine Park.

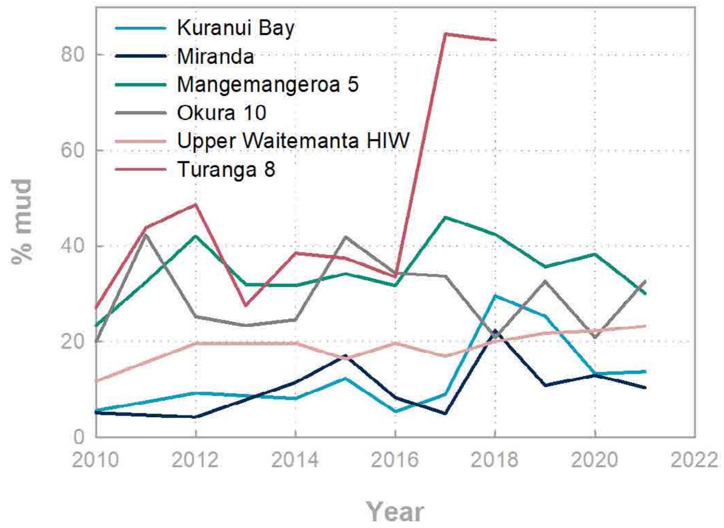


Figure 26: Sites that have shown the greatest increase in mud content over the last decade (data provided by Auckland Council and Waikato Regional Council). Grainsize methodology has been consistent since 2008.[171,172]

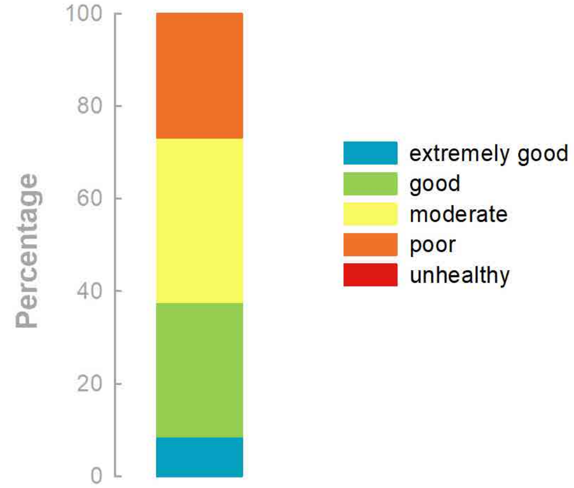


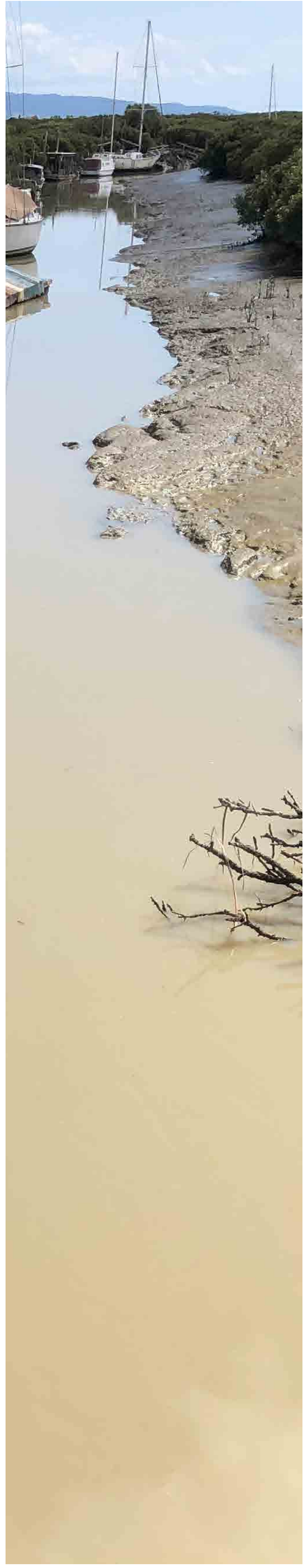
Figure 28: Percentage of sites ranked from extremely good to poor in the Marine Park between 2018–21.

Post cyclone mud in Whangamatā
📷 Micheal Townend & Kit Squires

Figure 27: Benthic Health mud scores[v] for monitored sites in the Marine Park between 2018–21. The most recent score for each site is shown (data from Auckland Council and WRC).

Figure 30: Median total suspended solid concentrations at monitored sites between 2019–22. Note the extremely high TSS concentrations in the Piako and Waihou Rivers that feed into the Firth of Thames (data from Auckland Council and Waikato Regional Council).

[v] Auckland model

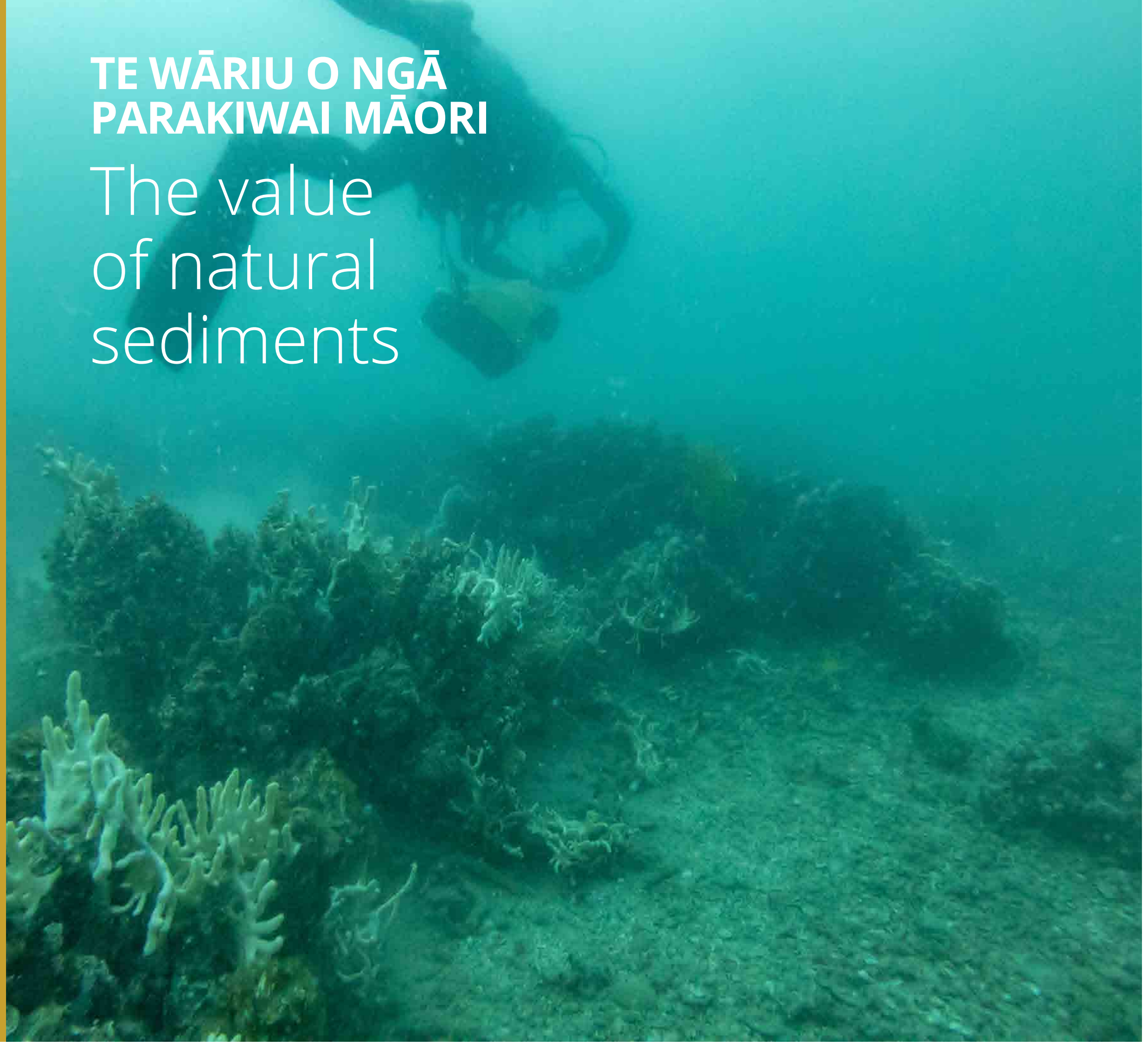


Piako River 📷 Shaun Lee

Figure 29. Monitored sites in Auckland and Waikato that show long-term trends in BHM_{mud} scores. Scores range from 1 (extremely good) to 5 (unhealthy).

TE WĀRIU O NGĀ PARAKIWAI MĀORI

The value of natural sediments



Diver swimming over scarlet tube worm mounds near Moturua Island Shaun Lee

Not all sediments are bad. In fact, most of the seafloor in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf is covered in sediment. It forms some of the most important and productive habitats in the Gulf.

Many of us have searched intertidal and subtidal sandflats for the kai moana such as tipa (scallops), tuangi (cockles), pipi and tuatua. We may have watched shorebirds probe in the sand for their next treat, or been fascinated by crabs shooting back into their burrows when we approach. What we may not realise is that there is an amazing range of species that grow in and on sediments that we don't normally notice, and many of us never get to see.

The characteristics of sediment vary widely. Muddy sediments have a high proportion of small particle (or grain) sizes, which are slow to settle and can therefore, be dispersed long distances before they settle. They are typically found in shallow, sheltered areas such as the upper sections of estuaries and tidal creeks, or in still deeper waters beyond the influence of waves. In energetic environments, fine sediments are quickly remobilised and dispersed, leaving the heavier sandy and shelly sediments behind. These are harder to suspend by waves or currents, and quickly resettle. Consequently, sandy and shelly sediments remain in energetic areas where fine sediments are quickly swept away.

Marine animals that live in and on sediments commonly display a preference for particular sediment types. Sandy and shelly habitats tend to contain communities that are more diverse, have a greater biomass, and with more large species, than those generally found in muddy habitats. karepō (seagrass), rimurimu (seaweeds), hururoa (horse mussels) and a variety of other, relatively large animals commonly grow on sandy and shelly sediments. In high current areas, colourful gardens of intricate sponges, along with reef-forming species such as the scarlet tube worm[w] may occur.

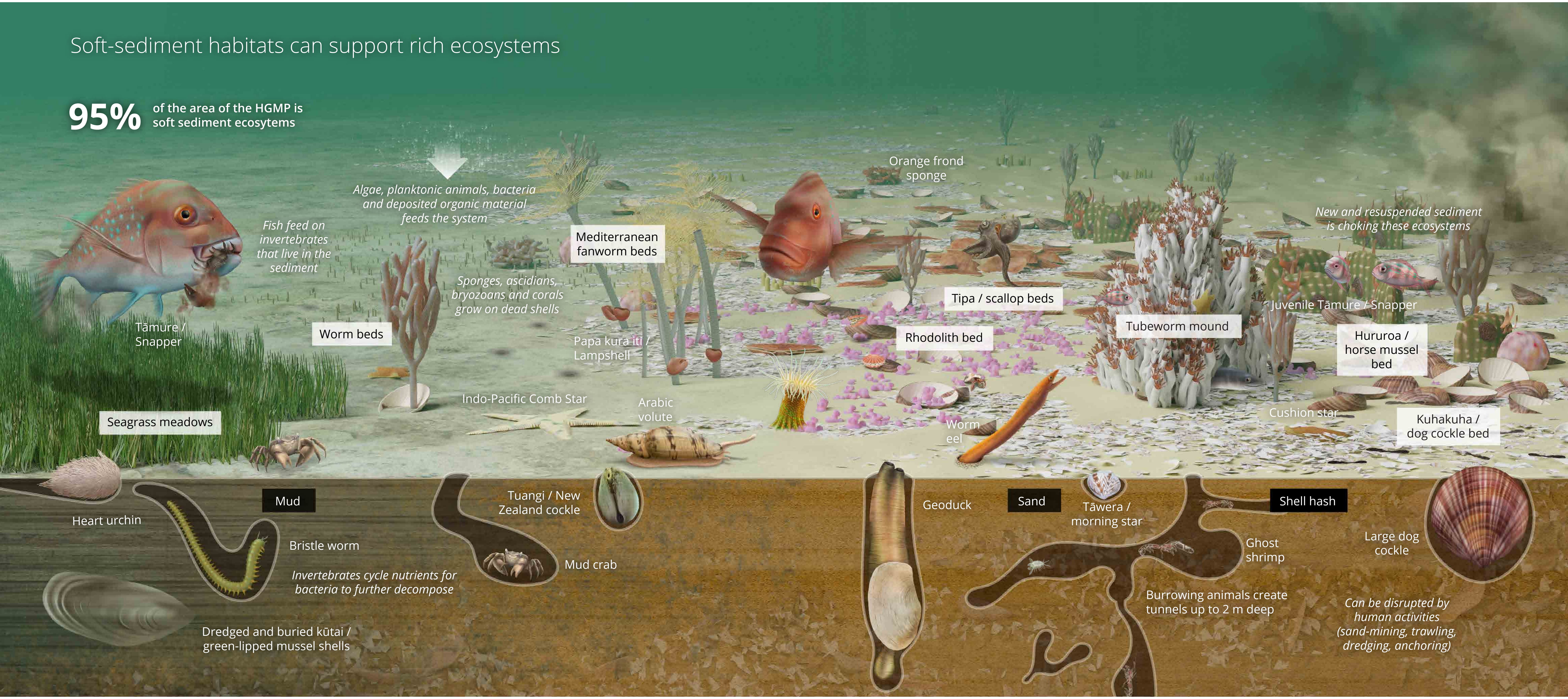
[w] *Galeolaria hystrix*

Sponge Garden at Cape Rodney-Okakari Point Marine Reserve / Goat Island Shaun Lee

Scarlet tube worm mounds near Moturua Island Shane Kelly

Horse mussel in a rhodolith bed off Maria Island, The Noises Shaun Lee

Wheke (octopus) in a kuhakuha (dog cockle) bed off Waiheke Island Shaun Lee



Beneath the surface masses of filter feeding kai moana such as tuangi, pipi, kuhakuha (dog cockles), and tāwera (morning star shell) form dense beds. Other kai moana such as the hanikura (wedge shells) and geoduck burrow deep into the sediments and feed by extending long siphons that vacuum up material growing or deposited on the sediment surface. Other burrowers, such as secretive snake eels, worms, crabs, shrimps and other crustaceans also live in sediments. Female wheke (octopus) also build underground dens, where they lay and protect their eggs, only to die soon after they hatch.

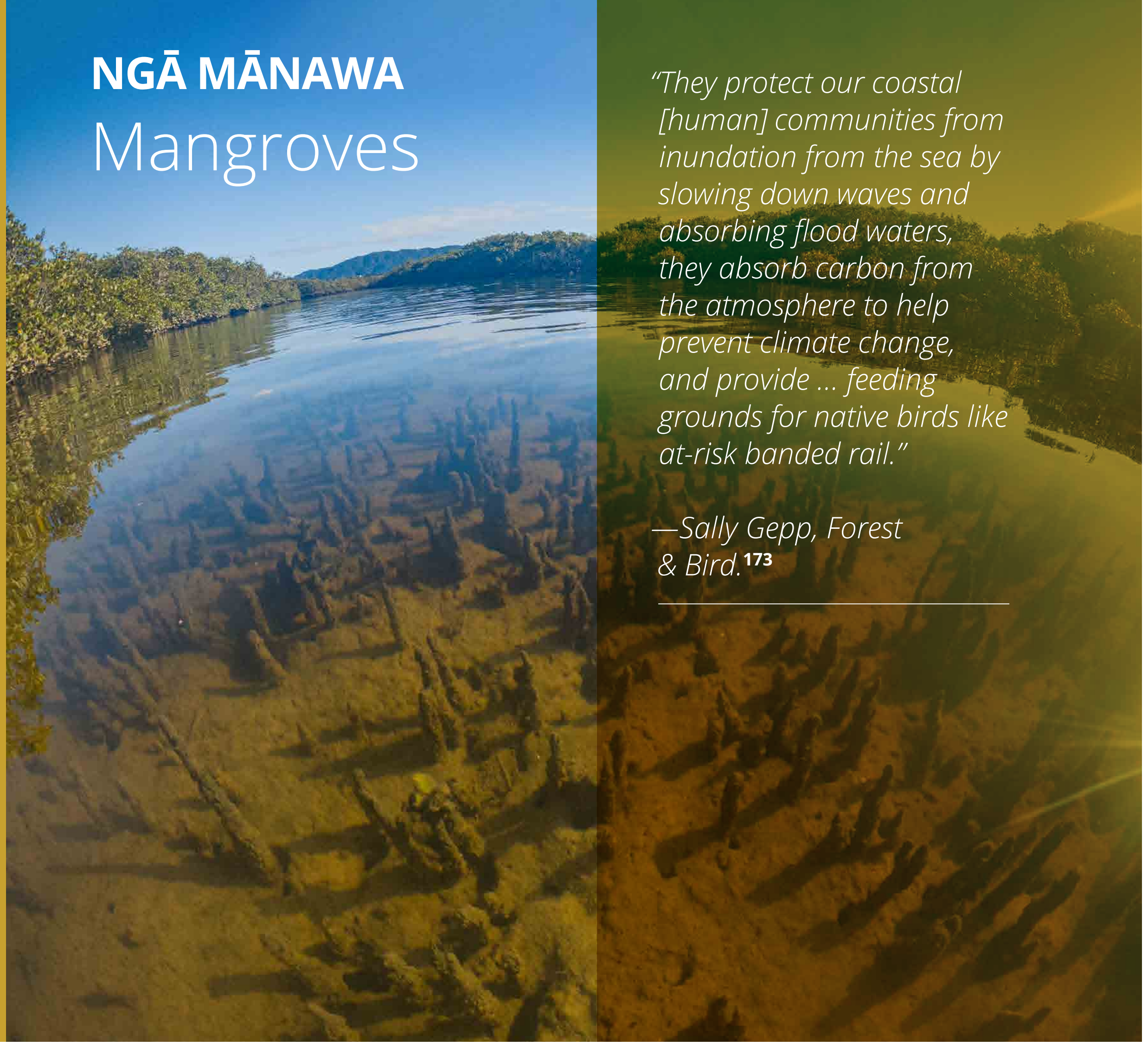
The physical complexity created above and beneath the sediment supports a suite of fixed creatures—sponges, ascidians, hydroids, anemones, molluscs and corals—creating living 'biogenic' habitat that is used by a myriad of other more mobile species that hide amongst, forage within, and grow upon it.

Fish such as whai (rays) and pātiki (flounder) have evolved to detect and feed on animals living within sediments—while camouflaging themselves from predators that may show an interest in them. Others such as stargazers lie partially buried, waiting invisibly to pounce on any unsuspecting prey that swims by.

However, the habitats and communities that form on and in sediments are easily destroyed. They are susceptible to smothering by fine terrestrial sediments that are washed into the sea. To being ripped from the seabed by dredges and trawlers. To being lost beneath reclamations or degraded by contaminants.

History has provided us with important lessons about their sensitivity. The loss of kūtai (mussel) beds, the reduction in subtidal karepō (seagrass) beds, and siltation of areas that once supported abundant tipa (scallops) shows that if important habitats are lost, they may never recover.

NGĀ MĀNAWA
Mangroves



The snorkel-like "breathing" roots of our native manawa Shaun Lee

"They protect our coastal [human] communities from inundation from the sea by slowing down waves and absorbing flood waters, they absorb carbon from the atmosphere to help prevent climate change, and provide ... feeding grounds for native birds like at-risk banded rail."

—Sally Gepp, Forest & Bird.[173]

Mānawa are found in sheltered coastal and estuarine areas in the upper North Island. They provide a habitat for a range of native animals, including several species of fish, birds, and insects, but are a non-essential habitat for most species. The only species that are dependent on mānawa are two endemic insects (a moth and a mite), whose larvae are only found on mānawa. Mioweka (banded rail), which has an 'At Risk: Declining' conservation status, are also becoming increasingly dependent on mānawa because of the loss of their preferred saltmarsh habitat. Trees that are well-submerged each tide also provide an important habitat for juvenile parore, short-finned eels, and grey mullet.[174,175] Mānawa also store carbon (like all trees) and provide coastal protection from waves.[176,177]

Mānawa thrive in muddy, water-logged conditions that are above the mid-tide level. Rapid expansion of mānawa began around 50 years ago, which coincided with the intensification of agriculture and urban development.[178] Mānawa cover in some estuaries have increased by nearly 100% over the last 2–3 decades (*Figure 31*). On average, mānawa cover in the monitored estuaries has increased by 1.2% per year, which is less than the average increase of around 3–4% per year for the second half of the 20th century. However, large increases have still occurred in Pūhoi (3.5% per year) and Tairua (3% per year[x]). In other estuaries such as Whitianga there has been little change in area covered, but mānawa density has increased greatly.[179,180]

The expansion of mānawa in many of our estuaries is symptomatic of the infilling of estuaries from land erosion—sedimentation increases the intertidal area suitable for mānawa (rather than mānawa causing the increase in muddy habitat).[181,182]

The expansion of mānawa can result in the loss of other habitats, such as karepō (seagrass) and kai moana beds, and can decrease the roosting area available for shorebirds such

[x] Percentage increase would be greater if 23 ha of mānawa had not been cleared from the harbour.

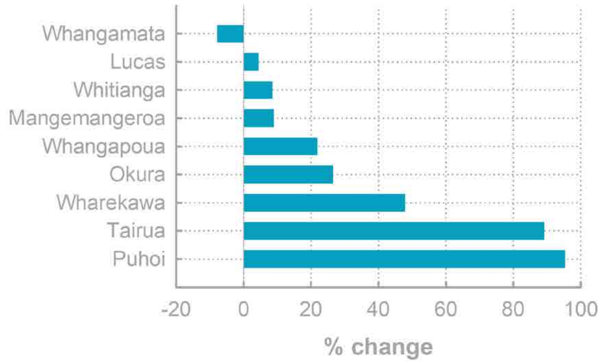


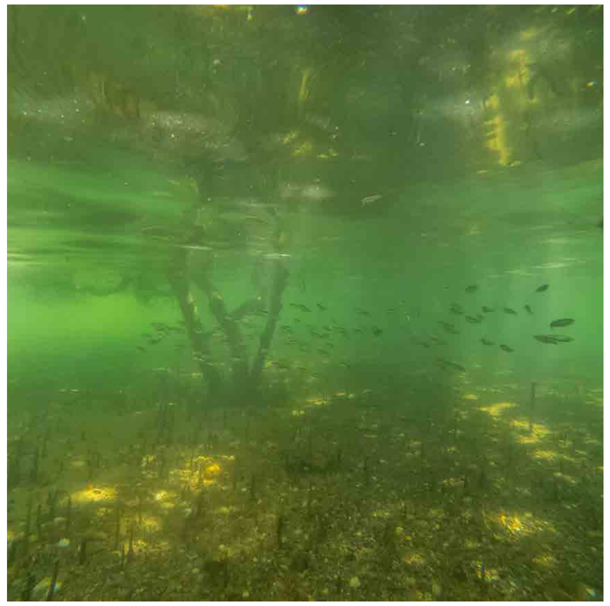
Figure 31: Percentage change in mānawa cover in monitored estuaries in the Marine Park from 1993–2000 to present. Changes include the clearance of over 20 ha of mānawa from Whangamatā and Tairua. Data was directly mapped from aerial photographs or taken from the literature.[175,178,180] Some GIS layers were provided by WRC.

as ngutu parore (wrybill) and kuhikuhiwaka (bar-tailed godwit) that required open sand or mudflats. Increasing temperatures and rising sea level due to climate change will allow the expansion of mānawa further south and more inland. Mānawa expansion can also affect social and cultural values, such as recreational use of the estuary, scenic values, and kai moana harvesting.

Mānawa removal is a contentious issue. Removals (both consented and unconsented) have occurred in many estuaries for a variety of reasons e.g., protection of areas of karepō (seagrass), saltmarsh and sand flats, enhancement of recreational and amenity values, protection of kai moana beds for harvesting, and maintenance of channels for flood control.[183] Currently, clearance of mature mānawa in the Auckland and Waikato regions requires a resource consent. Since 1994, around 200 ha of mānawa have been consented for removal in the Auckland and Waikato Regions (*Figure 32*).[184]

Monitoring of cleared areas indicate that mānawa removal is unlikely to enable muddy estuaries to revert to former sandy conditions, especially in sheltered areas, and/or areas that continue to have high sediment inputs. Three years after large scale mānawa clearances in Whangamatā Harbour, the sediment properties and benthic community composition were more similar to that within uncleared mānawa, than to nearby sandy areas.[185,186]

Ngutu parore Shaun Lee



Mānawa underwater Shaun Lee

Mānawa flowers Shaun Lee

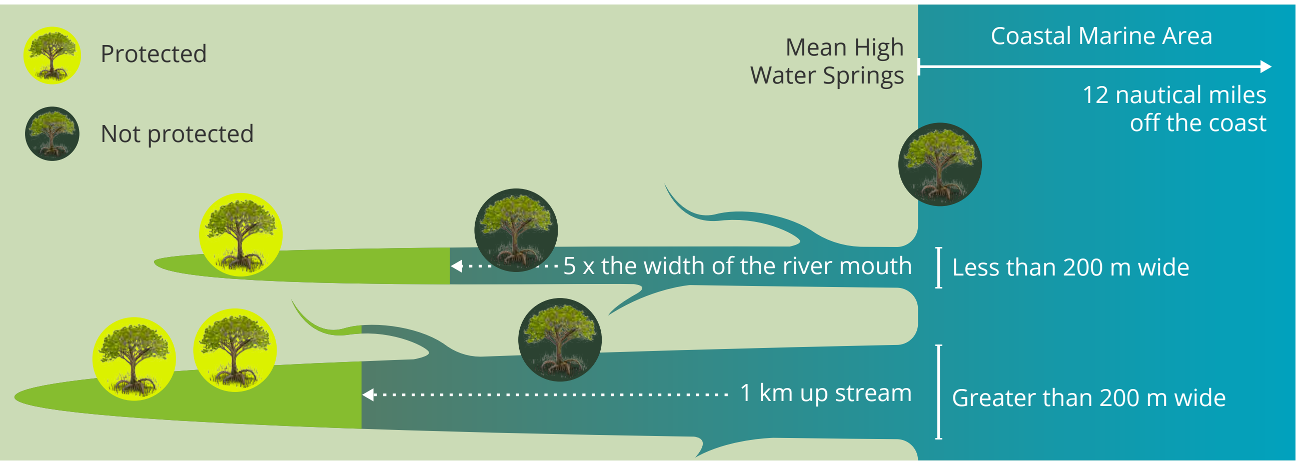


Figure 33. Areas where mānawa are protected by the National Environmental Standards for Freshwater.

In 2020, the National Environmental Standards for Freshwater (NES-FW) was introduced that provides for additional protection of natural wetlands, including mānawa. The standards restrict activities such as mānawa removal, and discharges and earthworks near mānawa forests. In 2022, the NES-FW regulations were updated to clarify that mānawa growing within the Coastal Marine Area (between Mean High Water Springs and 12 nm offshore, and up to 1 km[y] inland of river mouths) were excluded from the NES-FW (*Figure 33*).[187] Instead, mānawa growing within the Coastal Marine Area are managed in accordance with provisions of the New Zealand Coastal Policy Statement. The division of the management of mānawa to areas within and outside of the Coastal Marine Area has little ecological relevance and may have the unintended consequences of pushing more development activities into the Coastal Marine Area where such activities within mānawa forests are not prohibited.

KEY EVENTS

1994: Mānawa protected under the 1994 New Zealand Coastal Policy Statement.

2010: New Zealand Coastal Policy Statement updated. Specific protections for mānawa are removed.

2012: Consent granted to remove 23 ha of mānawa from Whangamatā Harbour using a combination of machinery and hand tools.

2013: Consent granted to remove 22 ha of mānawa from Tairua Harbour using a combination of machinery and hand tools.

2017: Thames–Coromandel District Council proposed a Mangrove Management Bill that would allow for the clearance of mānawa in Whangamatā Harbour in accordance with a mānawa management plan, but without the need for a resource consent.

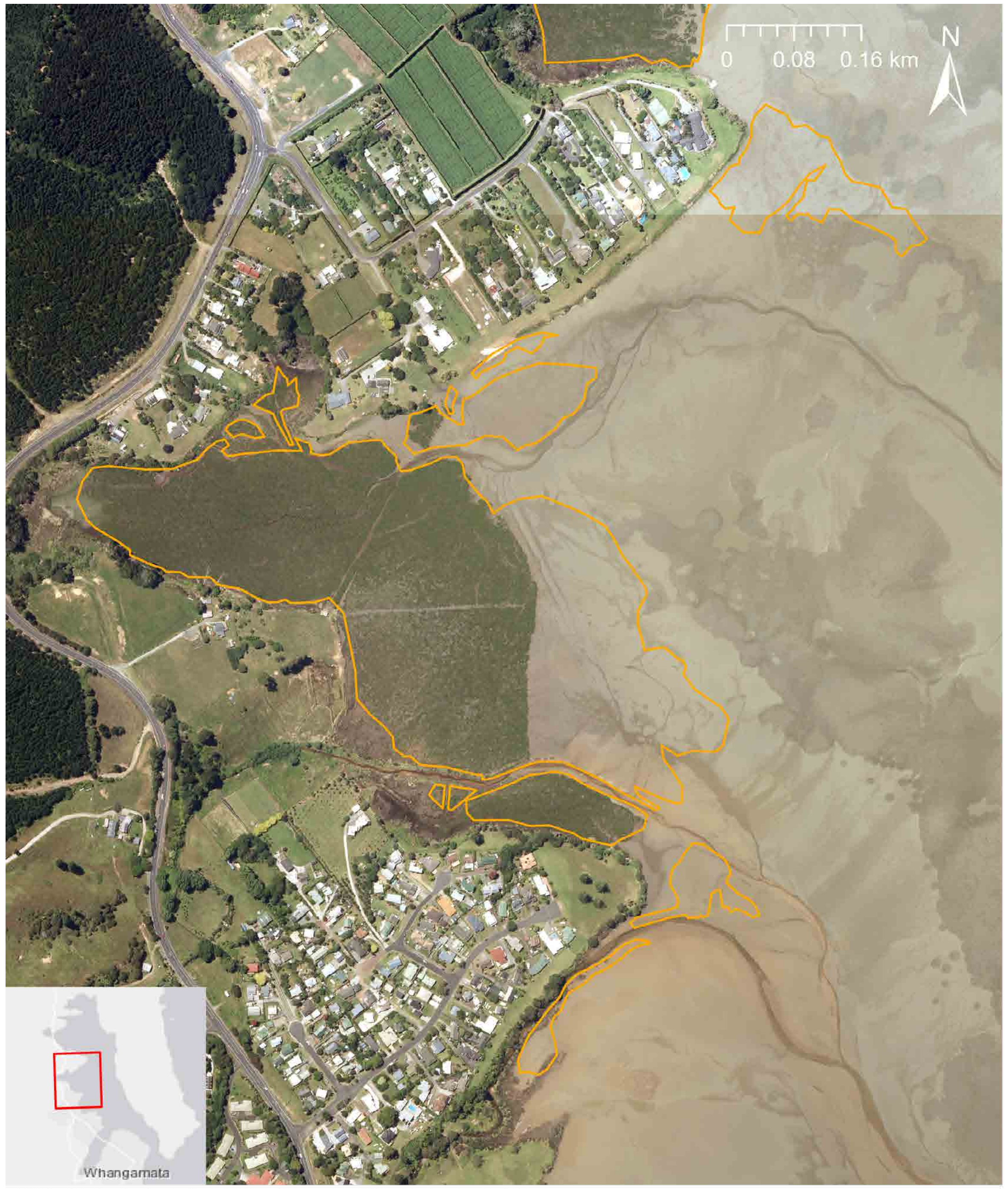
2020–23

2020: Mangrove Management Bill discharged from parliament.

2020: The National Environmental Standards for Freshwater 2020 (NES-FW) is introduced that provides for additional protection of mānawa.

2023: The NES-FW is amended to exclude wetlands (and mānawa) in the Coastal Marine Area.[187]

[y] For small rivers with a width of ≤200 m across the mouth, the CMA covers the distance inland equal to five times the width of the river mouth.



LINZ, Stats NZ, Esri, HERE, Garmin, USGS, Esri, HERE

Figure 32: Example of large-scale mānawa clearance in Whangamatā. Orange outline shows extent of mānawa coverage in 2012 and the aerial basemap was taken in 2021–23.

HE RANGAHAU WHAKAPŪAHO (Case study)

KA PĒHEA TĀ TE ĀHUARANGI HURIHURI WHAKAREREKĒ I TE ĀHUA O TE MOANA

HOW CLIMATE CHANGE WILL AFFECT OUR MOANA

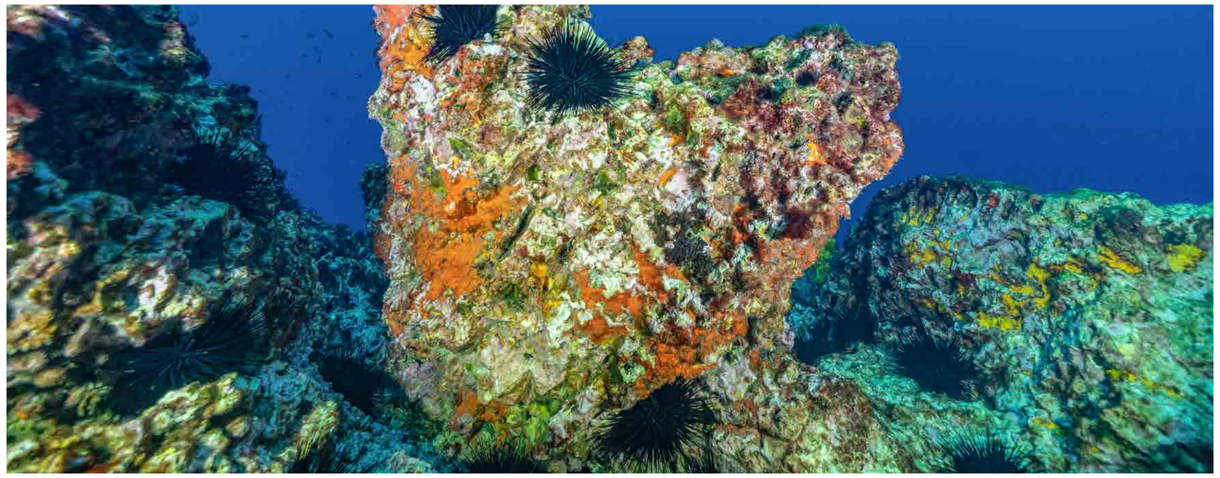
School Strike 4 Climate May 2023 📷 Shaun Lee

Climate change due to global warming is happening. For many people in Aotearoa, the extreme weather events of 2023 have made climate change a devastating reality. 2022 was the warmest year on record for Aotearoa—beating the previous record made in 2021.[188] The longest marine heatwave ever to be recorded in Aotearoa impacted the inner Gulf for an incredible 205 days from late November 2021.[84] Over the last century Auckland's mean annual temperature has increased by 1.6°C (*Figure 34*) and sea levels have risen by an average of 20 cm (*Figure 35*).[189] Extreme weather events such as droughts, flooding and marine heatwaves are becoming increasingly common, and managed retreats of low-lying coastal communities are starting to occur.

Despite these warning signs, global greenhouse gas emissions are still rising. Global atmospheric concentrations of CO_2 in 2021 were the highest on record, and global sea level rise has accelerated to 4.5 mm per year.[190,191]

Aotearoa's greenhouse gas emissions show a similar trend. Between 1990 and 2018, Aotearoa's net emissions increased by 57%.[192]

Drastic action is needed to counteract this trend. It's not sufficient to simply walk to the local shops instead of drive. To limit global warming to 1.5 °C as agreed by Aotearoa in the Paris Agreement,[193] emissions must be reduced by around 55% by 2030, and net CO_2 emissions must be zero by 2050.[194] Otherwise in a couple of generations, temperatures are predicted to increase by up to 3.1 °C, and sea level is predicted to increase by up to 0.9 m (*Figure 34* & *Figure 35*). Family coastal baches will no longer exist, and most of the Hauraki Plains will be flooded. Under current (2020) climate change initiatives, Aotearoa's net emissions are predicted to peak in the mid-2020s before decreasing by around 11% by 2035, which is woefully insufficient to meet our 2030 goal of 30% lower emissions (than 2005 levels) under the Paris Agreement (*Figure 36*).[192]



Long-spined sea urchin barren on Ngaio Rock 📷 Arie Spyksma

Climate change will have significant effects on our moana. Oceans absorb 90% of the excess energy generated by increased greenhouse gases, resulting in rising sea temperatures, the melting of land ice, and sea level rise. In addition, the ocean absorbs around 23% of human-generated CO_2 emissions, which decreases the pH of seawater (ocean acidification).[191] Ocean acidity has already increased by 30% over the last 250 years, and is predicted to increase by around 100% by 2100 under a high emissions scenario. Ocean acidification and rising sea temperatures were assessed as the two largest human-induced threats to Aotearoa's marine environment.[13] These impacts will change the nature of Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf in a variety of ways *(see infographic)*:

1. Waters will get warmer—the warming of the sea will affect the reproduction and survival of numerous marine species, changing the composition of our marine ecological communities:

The distribution of species will change as subtropical animals migrate down to New Zealand, and species that require cooler waters move south. The occurrence and diversity of tropical and subtropical fish in north-eastern New Zealand has increased over the past 50 years, with many species now extending their range into northern New Zealand.[195] Other subtropical species, such as the long-spined sea urchin[z], are becoming increasingly abundant in the Marine Park due to increased reproductive success in warmer waters. A population expansion of these grazing urchins may threaten our native rimurimu (seaweeds), creating more urchin barrens.[196,197]

Marine heatwaves will kill species that cannot move. In the Marine Park, marine heatwaves are thought to cause the widespread death of kōpūpūtai (sponges).[84] In cooler regions of Aotearoa marine heatwaves are thought to have caused the localised extinction of rimurapa (bull kelp) in Lyttelton Harbour, the bleaching of kōpūpūtai (sponges) in Fiordland, and mass mortalities of farmed salmon in Marlborough.[198-200]

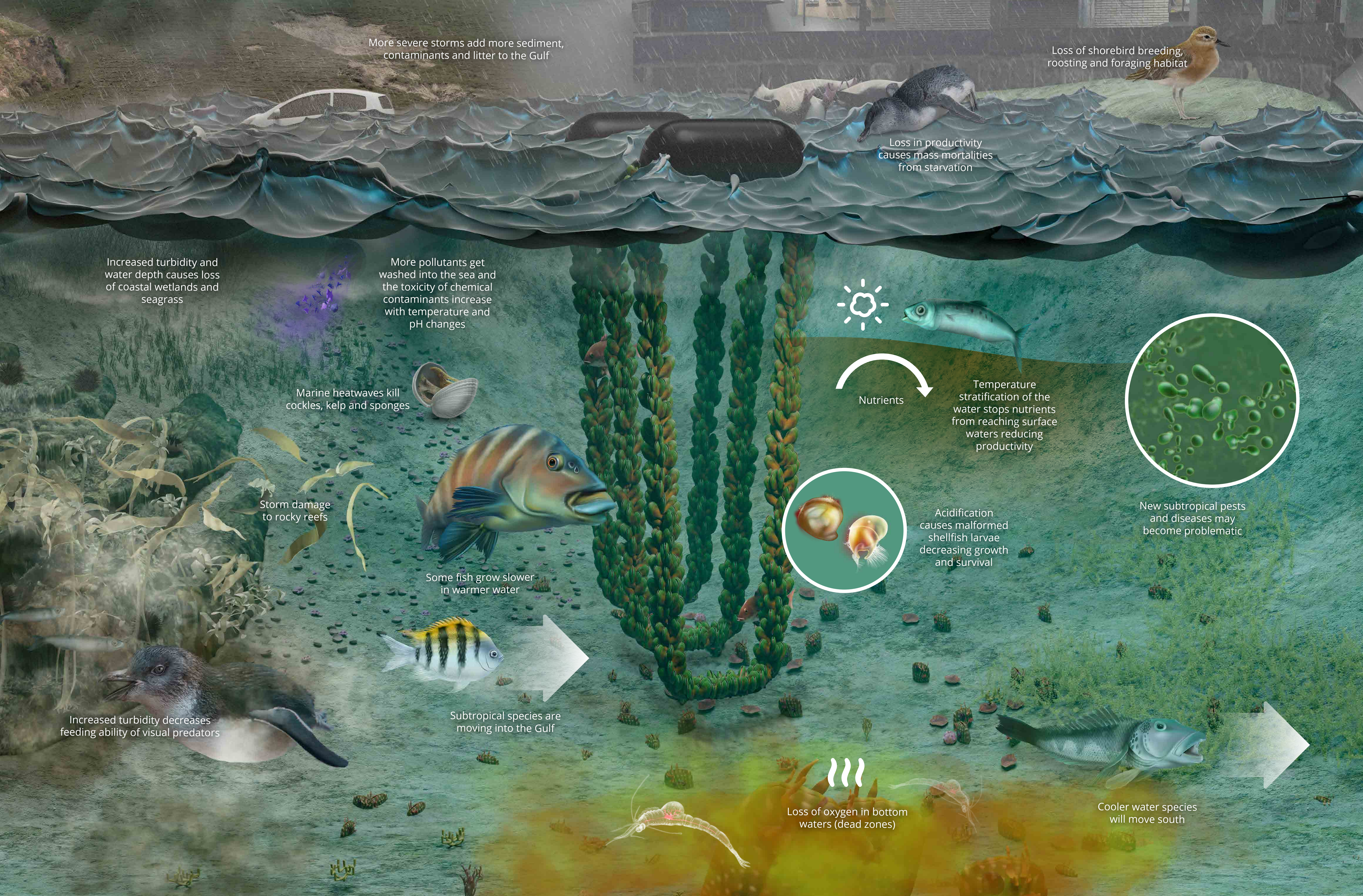
Breeding seasons and the growth and survival of species will change. For example, growth and swimming speed of red moki decreases, while oxygen consumption increases, when mean water temperatures are higher than 17 °C.[201] This indicates that water temperatures[aa] in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf are already near, or over, the optimum limit for red moki, and their growth rate is likely to decrease as temperatures rise. The impact of climate change on other species is more uncertain. For example, the growth and survival of tāmure larvae is higher when water temperatures and CO_2 concentrations are elevated to 2100 predictions.[203,204] However, any increase in recruitment caused by these effects may be offset by reduced larval swimming ability in high CO_2 conditions, and decreased foraging success due to changes in prey availability and increased turbidity.[205,206] Overall, the effects of climate change on the north-eastern tāmure population are highly uncertain, with modelling predicting an impact in fishery yield somewhere between a decrease of 29% and an increase of 44%.[207]

New subtropical pests and diseases are likely to arrive and survive in Aotearoa due to warmer temperatures and changes in ocean currents. For example, the tropical dinoflagellate that causes ciguatera fish poisoning in humans has been found in the Kermadec Islands and may arrive at mainland Aotearoa as ocean waters warm. In addition, infection rates of some diseases increase at higher temperatures, and marine organisms that are stressed by climate change impacts will be more susceptible to diseases.[208,209]

[z] *Centrostephanus rodgersii*

[aa] Average water temperatures in Leigh have been over 17 °C since 2010.[202]

Climate change will change the nature of the Gulf



2. Waters will get more acidic—ocean acidification reduces the concentration of carbonate ions that are the building blocks of the skeletons and shells of many marine creatures including plankton, molluscs (kutai, pipi, tuangi), echinoderms (kina, starfish), and calcifying algae. Under increasingly acidic conditions these shells/skeletons become malformed, decreasing the growth and survival of these species. Very young echinoderm and mollusc larvae appear to be the most vulnerable to acidic conditions.[210] Ocean acidification may have serious negative impacts on our kai moana aquaculture industry, which is heavily reliant on wild-caught larvae.

3. Waters will get more turbid and polluted—increased flooding and storm events will increase the influx of sediment, contaminants, and litter into the sea, and will resuspend buried contaminants.[211,212] Sediment and contaminants have negative impacts on the feeding ability, health and survival of marine species. Visual feeders will find it harder to catch prey[213] and toxic chemicals may decrease the health and survival of animals. For example, liver lesions in flatfish, anchovies and sardines are correlated to higher sediment concentrations of heavy metals and polyaromatic hydrocarbons found in various overseas estuaries.[214,215] Furthermore, the bioaccumulation and toxicity of many contaminants e.g., zinc, copper, arsenic, pesticides, for marine animals are increased under climate change conditions (low pH, low dissolved oxygen and higher temperatures), compounding their impacts on marine life.[211,216] High levels of contaminants in some areas may close swimming beaches and make kaimoana unsafe for human consumption.

4. Waters will get less productive—higher water temperatures increase the stratification[bb] of coastal waters, constricting the supply of nutrients to surface waters. This reduces the growth of phytoplankton, which has flow-on effects of decreased productivity up the food chain.[217] Decreases in prey abundance due to climate change impacts have been implicated in mass mortalities of kororā (little blue penguins) during recent years, with hundreds of extremely underweight, dead kororā found washed ashore in northern Aotearoa.[218,219]

5. Waters will become less oxygenated—warmer, more acidic waters hold less dissolved oxygen and cause higher respiration rates of bacteria and marine animals. Combined with increased stratification, this can cause large decreases in dissolved oxygen concentrations in bottom waters, which will decrease the survival and productivity of seabed communities. In nutrient-enriched coastal waters, oxygen levels may decrease to levels that are lethal to most marine life.[220] Bottom waters in the Firth of Thames are already experiencing decreases in dissolved oxygen down to 40–70% of saturation during summer and autumn due to nutrient enrichment *(see section on Nutrients)*.[221]

6. Waters will encroach the land—animals and plants that live in coastal ecosystems will lose significant habitat due to coastal squeeze from sea level rise. Particularly vulnerable habitats/species include:

Wetlands and karepō (seagrass) beds, which provide important fish nursery habitats. These habitats will become inundated and negatively impacted by increased sediment and contaminant loads. 20–90% of world's current coastal wetlands are at risk of being lost by the end of this century [191,222,223]

Shorebirds that roost and breed on beaches and riverbanks such as tara iti (fairy terns), taranui (Caspian terns) and tūturiwhatu (New Zealand dotterel), will lose breeding grounds, and their nests and chicks will be more vulnerable to being washed away by large waves.[224] For example, shorebirds are now routinely using farmland and stopbanks as high-tide roosts in the southern Firth of Thames, which is probably due to the loss of old beach roosting sites to sea level rise and mangrove encroachment.[225]

Rocky reef intertidal communities, particularly macroalgae and other fragile species. These organisms may be damaged by wave and storm damage.[222]

We are currently perched at the top of a rollercoaster of climate change impacts. Where we end up will depend on our actions today. Climate change will affect the entire marine ecosystem, and may fundamentally change the inherent nature of Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf.

[bb] Separation of the water into distinct horizontal layers

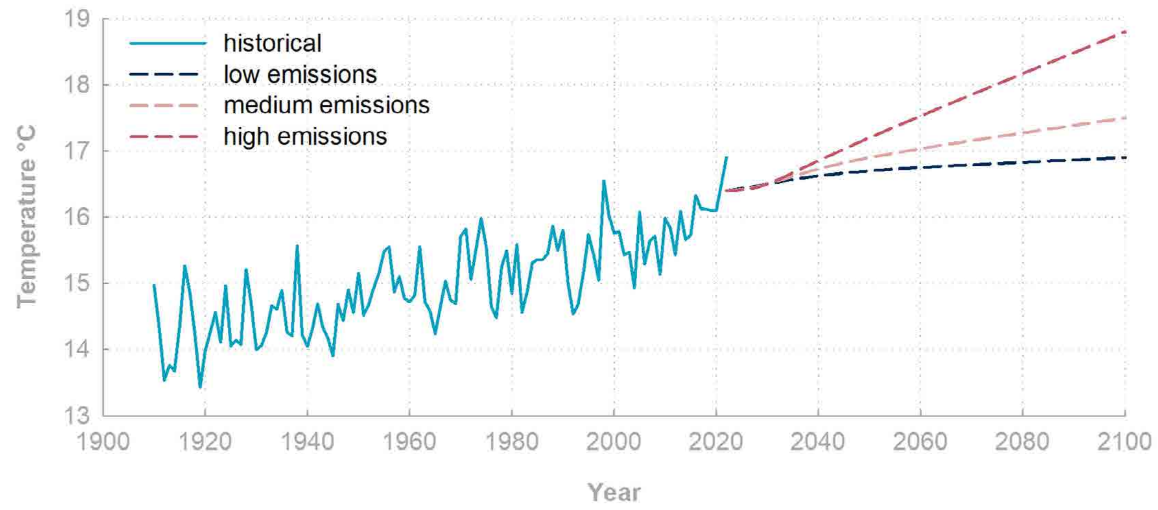


Figure 34: Mean average temperature in Auckland since 1910 and mean predicted temperature to 2100 under low (SSP1–1.9) , medium (SSP2–4.5) and high (SSP5–8.5) emission scenarios (historical data from New Zealand's National Climate Database[226] and predicted data from IPCC WGI Interactive Atlas[227]).

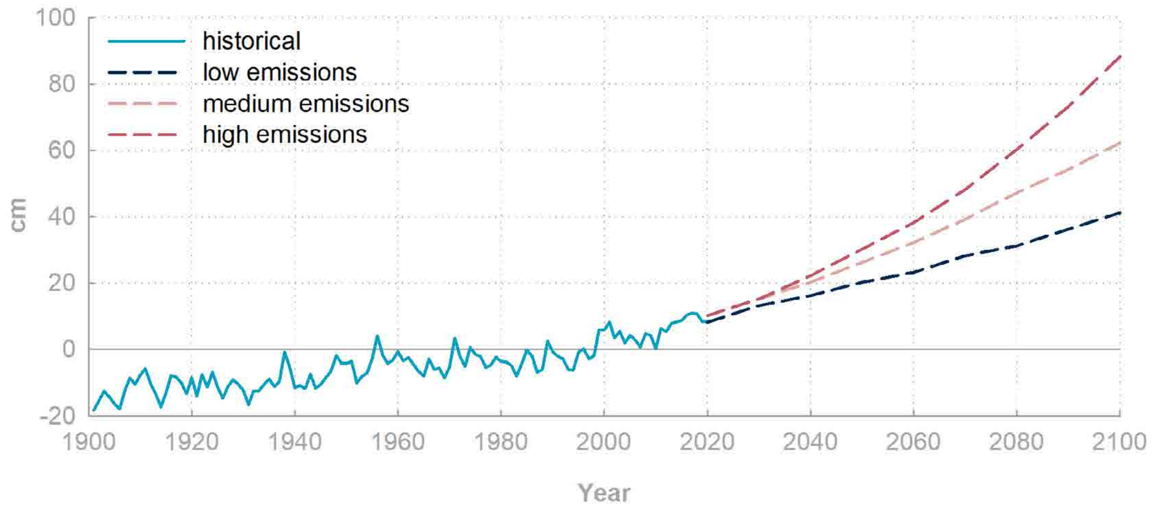


Figure 35. Observed sea level rise in Auckland since 1901 and mean predicted sea level rise to 2100 under low (SSP1–1.9), medium (SSP2–4.5) and high (SSP5–8.5) emission scenarios (historical data from MfE[228] and Stats NZ,[229] predicted data from NZ Sea Rise[230]).

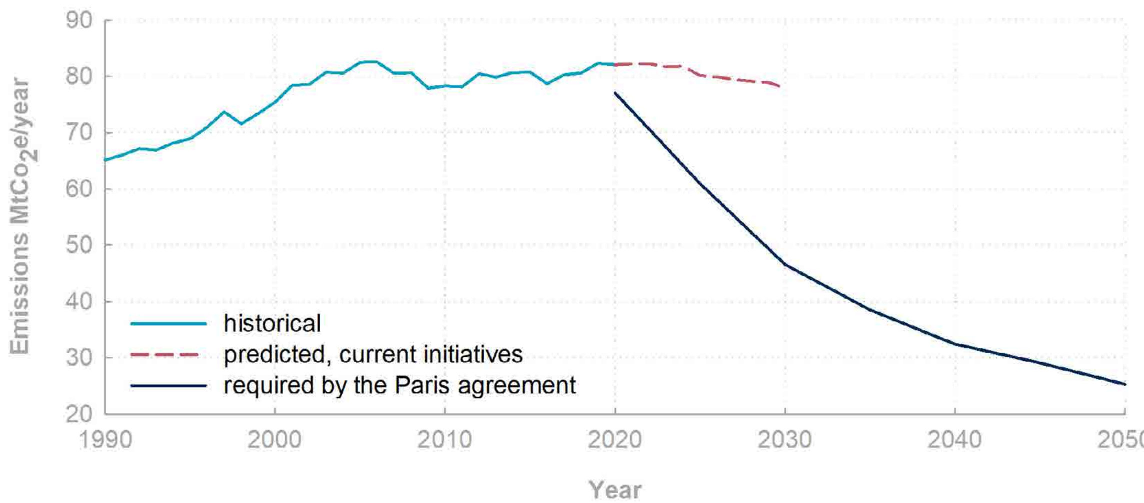


Figure 36: New Zealand's historical CO_2 emissions, predicted $C0_2$ emissions under current (2020) initiatives, and the emission target required by New Zealand under the Paris agreement (data from Climate Action Tracker).[231]

[cc] Shared Socioeconomic Pathways: SSP1–1.9 net CO_2 emissions decrease to zero by 2050; SSP2–4.5 CO_2 emissions remain at current levels until 2050 and the decrease to net zero by 2100; SSP5–8.5 CO_2 emissions triple by 2075.

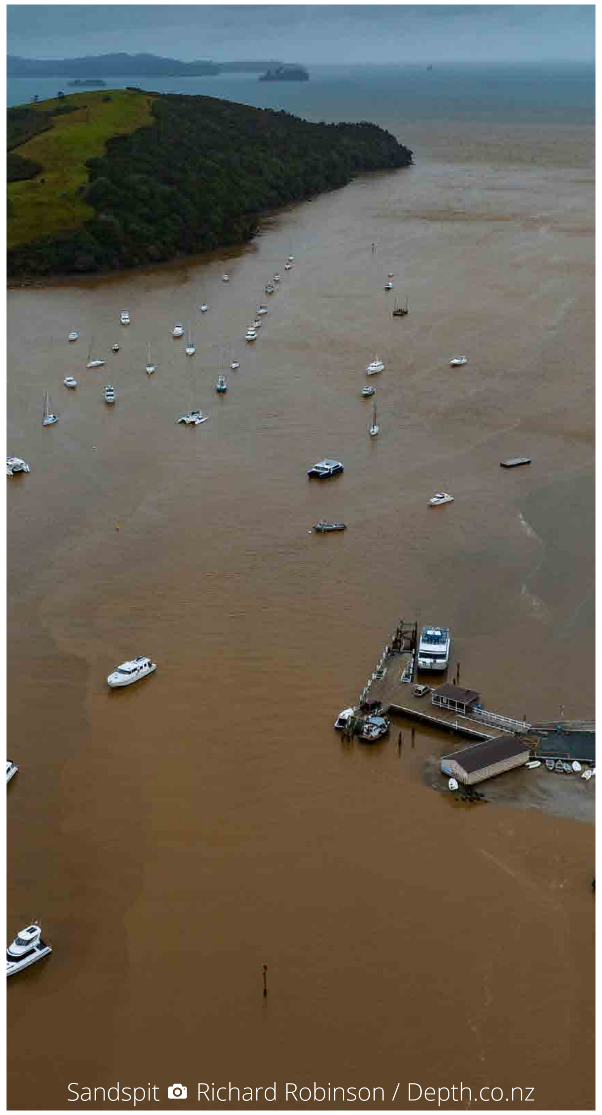
Cyclone Hale January 2023

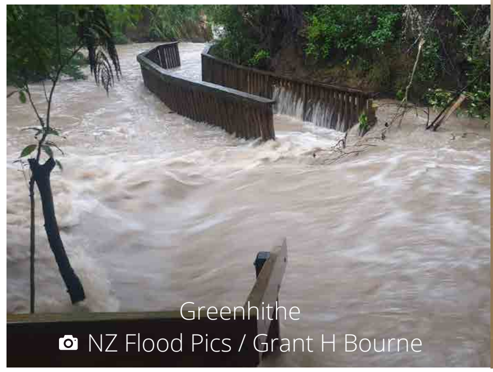

New North Road NZ Flood Pics

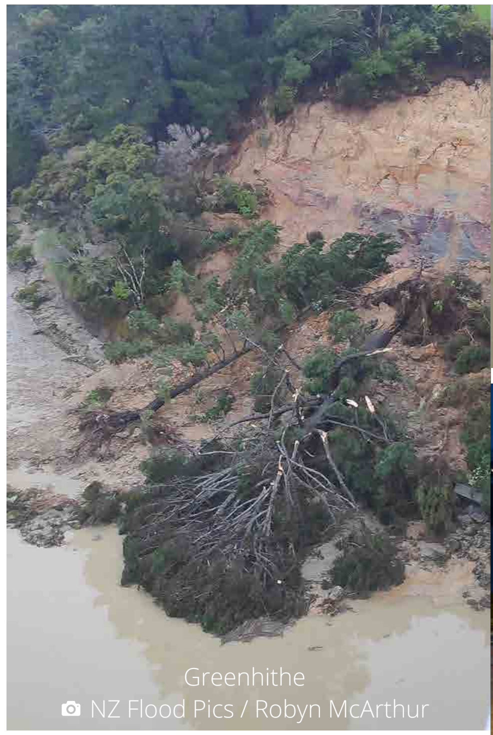

Greenhithe NZ Flood Pics / Barbara Tulloch

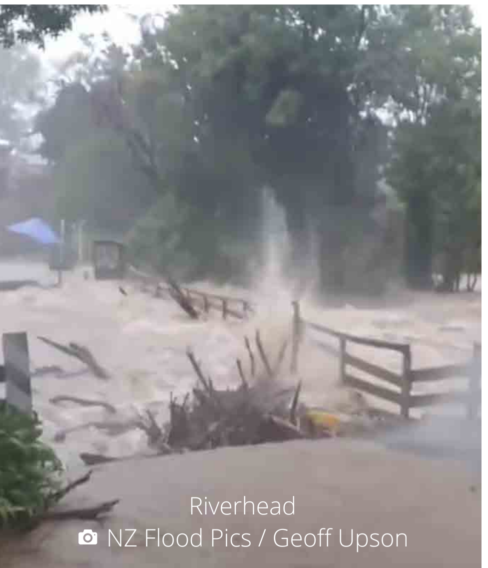

Charcoal Bay
NZ Flood Pics / Craig Stanton

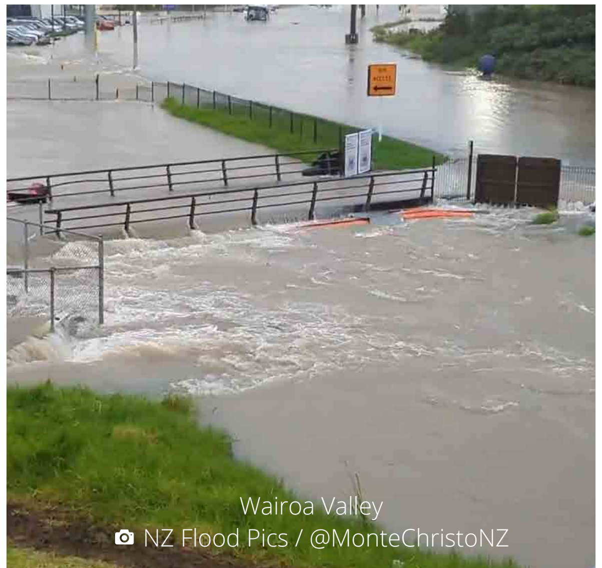

Oakley Creek
NZ Flood Pics / LJ Blackburn


Sandspit Richard Robinson / Depth.co.nz


Greenhithe
NZ Flood Pics / Grant H Bourne


Greenhithe
NZ Flood Pics / Robyn McArthur


Riverhead
NZ Flood Pics / Geoff Upson


Wairoa Valley
NZ Flood Pics / @MonteChristoNZ


Wairoa Valley
NZ Flood Pics / @MonteChristoNZ

Cyclone Gabrielle February 2023

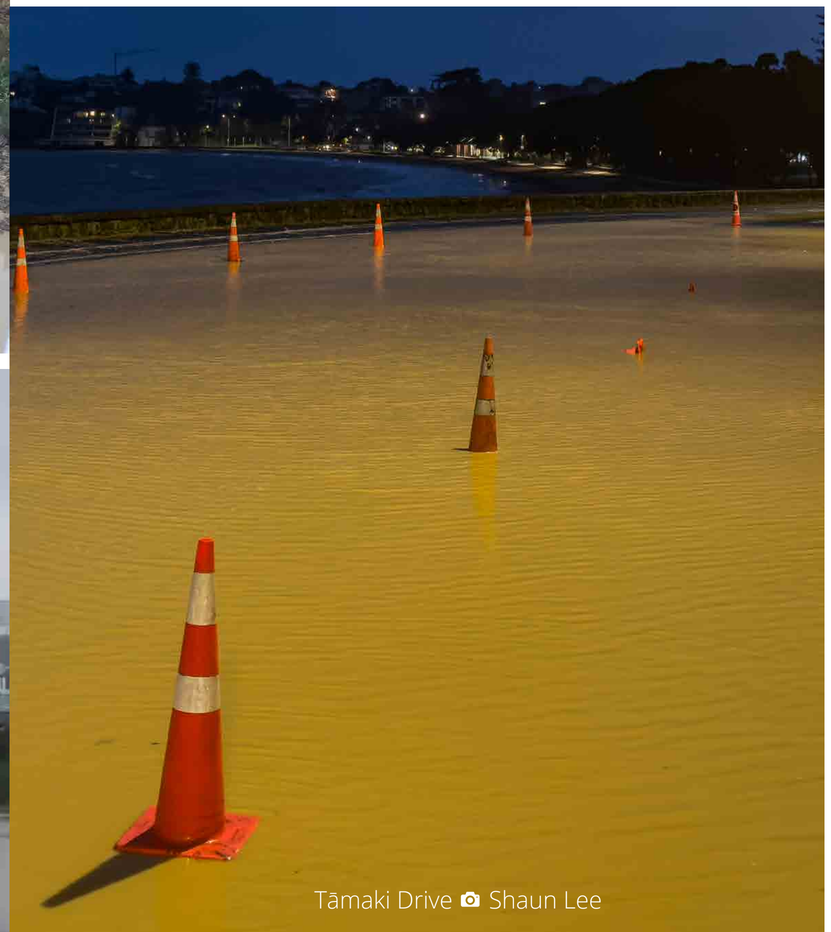

Whitianga Avon Hansford

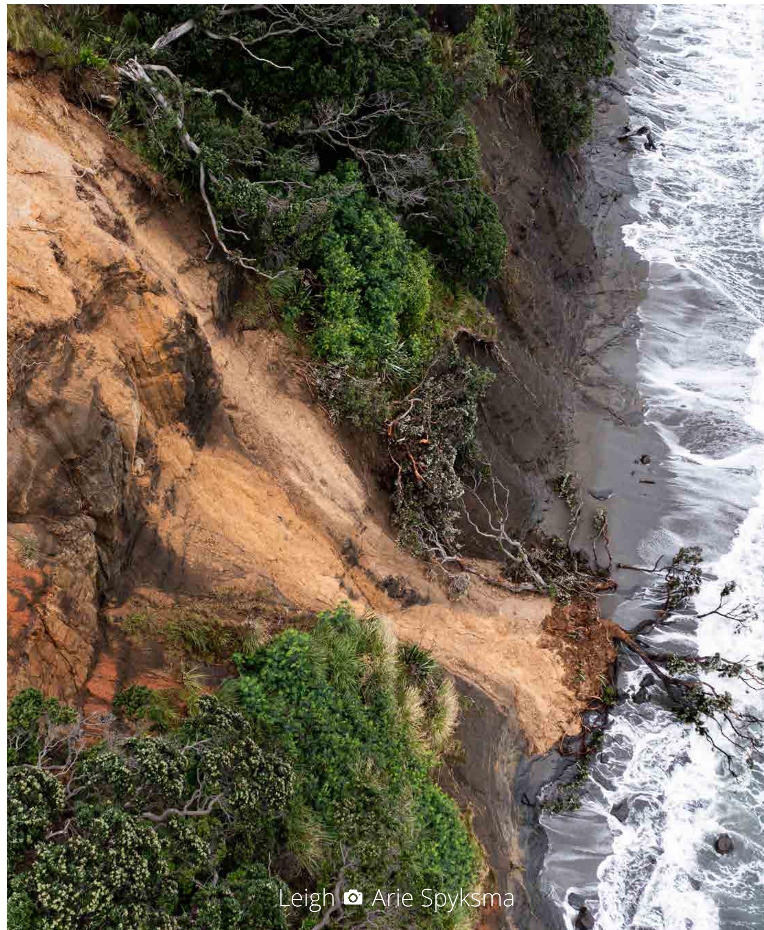

Whitianga Avon Hansford


Wairoa River NZ Flood Pics / Erin


Ōkahu Bay Shaun Lee


Owera John Sefton


Tāmaki Drive Shaun Lee


Leigh Arie Spyksma

TE KANORAU KOIORA
Biodiversity

Kawau tikitiki (Spotted shag) in kūtai (mussel) farm at Waiheke Island © Shaun Lee

In Māori tradition, all elements of the natural world are related through whakapapa, starting with the creation of the world through the union of Ranginui and Papatūānuku and extending to all living things through their descendants. Traditional stories describe the origins and connections between species, as diverse as kauri and tohorā (whales). According to Ngāti Wai kaumātua, Hori Parata, when Tāne (god of the forest) was making kauri he also decided to make a tohorā, which he gave to his brother Tangaroa (god of the sea). After a time, the tohorā returned to see the kauri, asking why don't you come and live with me in the sea. Upon the kauri refusing, the tohorā said that's all right, but take some of my skin. The kauri turned and said, ***"what would I want your skin for?"*** to which the tohorā replied, because ***"one day man is going to cut you down and turn you into a waka"***.[232]

The inter-relatedness between people and the elements of nature underpins a belief that we belong to nature, rather than the other way around. In the Māori world view, we, along with plants, animals, and even inanimate objects all have a mauri (life force), which must be nurtured to maintain its strength. It is within that context we examine biodiversity in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. Note however, that biodiversity is an important component of most indicators in this report. Here we simply put the spotlight on five high-profile biodiversity topics: island biodiversity, Bryde's whales, seabirds, shorebirds, and the threat posed by non-indigenous marine species.

TE KANORAU KOIORA Ā-MOUTERE

Island biodiversity

"About 8:15 the petrel (Cook's) commenced to come in from the sea in their thousands filling the air with their cries of ti-ti-ti, the swish of their wings sounding like the surge of a distant waterfall rising and falling irregularly as the birds drop from a higher altitude to the level of the gorge"

—W. M. Hamilton, describing the nightly arrival of Cook's petrels on Te-Hauturu-o-Toi.[233]

Tītī (Cook's petrel) chick on the Noises

The Islands of Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf provide vital sanctuaries for Aotearoa's plants and animals. In particular, Te-Hauturu-o-Toi and Aotea provide critical habitats and exclusive breeding locations for threatened species such as hihi (stitchbird), tīeke (North Island saddleback), North Island kōkako, takahikare-raro (New Zealand storm petrel), tākoketai (black petrel), wētā punga, niho taniwha (chevron skink) and tuatara.

Most of the Gulf's islands have been highly modified by human activities such as farming and urban development, and the introduction of pests and weeds. Eradication of mammalian pests and restoration of native vegetation on many of the islands have been instrumental to helping threatened species recover. Today, 42 islands in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf are free of wild mammalian pests, totalling around 10,700 ha (***Figure 37*** & ***Figure 38***), and average native forest cover on islands is around 57%. Recent initiatives include eradication programmes underway for the removal of rats and feral cats from Aotea *(see Tū Mai Taonga Case study)*, stoats and rats from Waiheke, and community consultation on the eradication of rats, possums, wallabies and stoats from Kawau Island. Following pest eradication, threatened native species can be moved to these safe havens to help establish new populations in multiple locations, which provide 'insurance' against catastrophic events.

Island restoration has been a massive undertaking by conservation workers and the community, who have worked for countless hours eradicating pests and weeds, and replanting trees. Large revegetation programmes led by iwi, volunteer community groups and the Department of Conservation have occurred, or are in progress, on Tiritiri Matangi, Motuora, Motutapu, Te Motu-a-Ihenga (Motuihe) and Rotoroa, which complement the pest eradications that have occurred on these islands. Significant revegetation has occurred on Motuora and Rotoroa in recent years (***Figure 39***). The groups involved in

Juvenile Tuturuatu (Shore plover) on Motutapu Island Shaun Lee

restoration work sometimes have different objectives and methods, which can cause tension and slow progress. A high level of understanding and communication is often required to successfully work together.[234]

Pest-free islands and their inhabitants are continuously threatened by re-invasions from mammalian pests that stowaway on boats, are deliberately brought onto the islands (including pets), or swim there. Re-invasions by mammalian pests can rapidly undo all this hard work, with a single pregnant female rat and her offspring able to produce up to 300 rats within one year, which can reduce island populations of threatened species such as tūturuatu (shore plover) by up to 80%.[235,236] Biosecurity staff and detection dogs deal with up to a dozen pest incursions in the Marine Park each year, from pests that have been deliberately introduced, accidentally landed with cargo, or have swum over. For example, the Channel Islands in western Coromandel were pest-free for around 10 years but pest management (that was largely being conducted a volunteer basis by one person) ceased and reinvasions have occurred.[dd] Islands are also threatened by diseases, weeds, and non-mammalian pests, such as Argentine ants and plague skinks.

[dd] Pest management on Motutapere was previously funded by DOC, but most of the pest management on the other three privately owned islands was conducted on a volunteer basis by Rob Chappell.

Our most threatened species often require predator-free habitat and help with breeding. Captive breeding and translocation programmes have been established for several endangered species. A few such stories include:

- Mercury Island tusked wētā, which have come back from the brink of probable extinction to 'Nationally increasing' over the last 20 years due to a successful breeding programme and translocation to pest-free islands in the Marine Park.[237]
- Tīeke (saddleback), whose national population has increased from around 500 birds at the beginning of the 20th century to more than 7,000 birds, mainly as a result of translocations to pest-free islands.[237,238]
- North Island brown kiwi, which have improved from 'Nationally Vulnerable' to 'Not Threatened' over the last decade.
- North Island kōkako and pāteke (brown teal), which have improved from 'Nationally Endangered' to 'At Risk: Nationally increasing' over the last 20 years.[239,240]
- Pōpokatea (whitehead), which were almost eliminated from the Marine Park in the late 1800s, with the last remaining population on Te-Hauturu-o-Toi. That population was used to successful translocate birds to other pest-free islands, and in 2021 they were assessed as no longer threatened.[241]

There are many more success stories. Species have been saved from certain extinction, pests have been eliminated, habitats restored, and population resilience built to protect against catastrophic events such as fire, pest reinvasion or disease.

KEY EVENTS

2004: Te-Hauturu-o-Toi (Little Barrier Island) became pest-free.

2007: Motutapere, Motuoruhi, Motukopake and Waimate (Channel Islands) became pest-free.

2009: Rangitoto and Motutapu became pest-free.

2014: Ahuahu (Great Mercury Island) became pest-free.

2016: Argentine ants eradicated from Tiritiri Matangi after a 15-year programme.

2017: Channel Islands lose their pest-free status due to reinvasions.

2018: Introduction of the National Environment Targeted Rates in Auckland provides an addition $35.8 million for island biosecurity over the next 10 years.[242]

A community group, Waikehe Collective, working in conjunction with other relevant organisations, launched Te Korowai o Waiheke, an initiative to make Waiheke predator-free. $10.9 M of funding has been secured to eradicate mustelids and rodents from the island.[243]

Pateke (Brown teal) on Rotoroa Island Shaun Lee

2020–23

2020: Rakitu Island was declared pest-free.

Terrestrial sections of the Auckland Regional Pest Management Plan came into effect, which introduced a range of new programmes focusing protection within the Marine Park, including measures to prevent new pests establishing on Aotea, and multi-species mammal eradications on Waiheke and Kawau.

2021: Marine sections of Auckland Regional Pest Management Plan came into effect, which included the management of 10 marine pests and requires all vessels to have no more than light biofouling.

Ngāti Rehua Ngātiwai ki Aotea Trust launched Tū Mai Taonga, an initiative to make Aotea free of wild cats and rats. Funding of $3 M has been secured to start eradicating wild cats and rodents from the northern part of the island *(see Case Study on Tū Mai Taonga)*.[243]

2022: Auckland Council, Ngati Manuhiri and partners launched a project to eradicate rats, stoats, possums and wallabies from Kawau Island. Significant consultation has been undertaken to inform a feasibility assessment of the proposed eradication. [244]

Monitoring of stoat numbers on Waiheke indicates that low numbers of stoats remain on the island after several years of trapping. Stoat detection dogs, community sightings, and use of alternative lures and traps are being used to track down and catch the remaining stoats.[245]

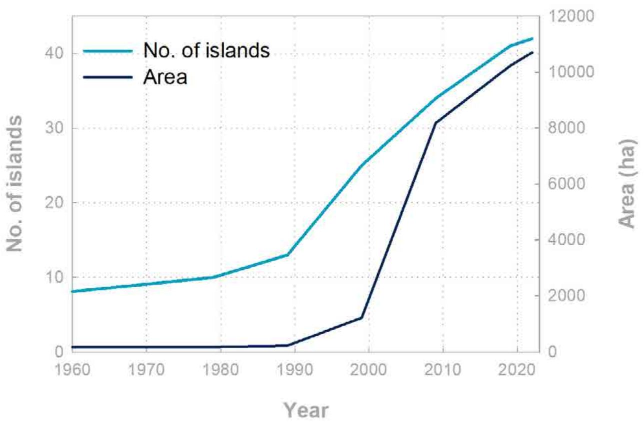


Figure 38: Cumulative number of islands and land area that are free of wild mammalian pests in the Marine Park.

Kawau Island from Tāwharanui Regional Park Shaun Lee

Figure 37: Mammalian pest free islands in the Marine Park.

Rotoroa Island in 1971 (Photo: Whites Aviation Ltd, Alexander Turnbull Library, CC BY 4.0)

Rotoroa Island in 2020. Distorted to match above. (Photo: LINZ, CC BY 4.0).

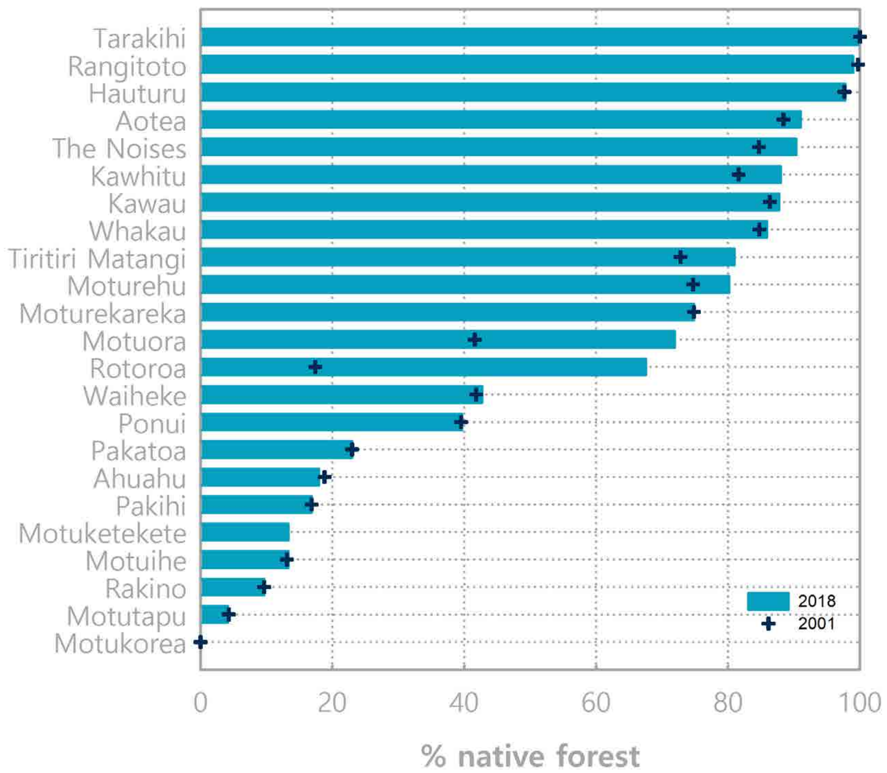
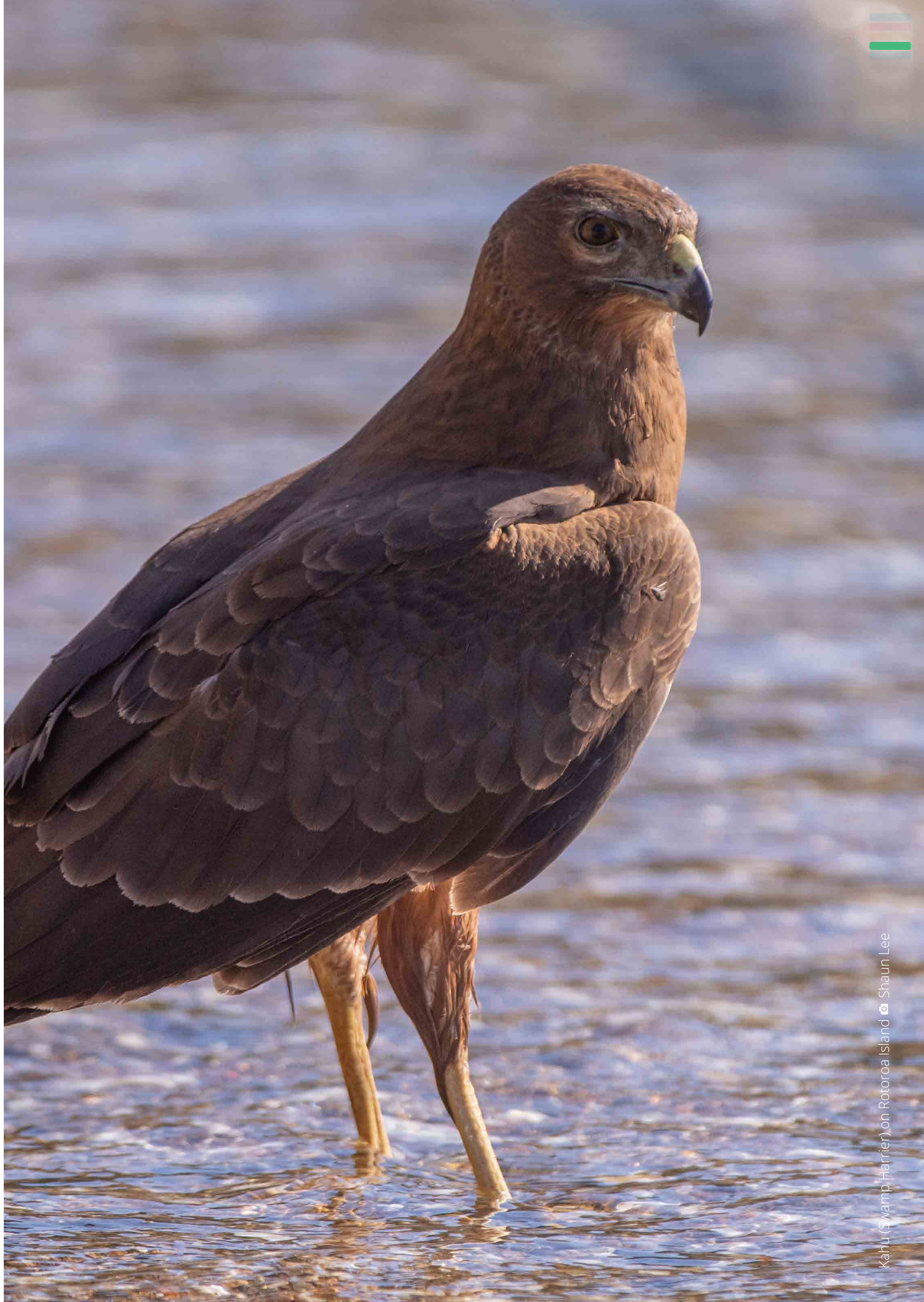


Figure 39: Change in the percentage of island covered by native forests between 2001 and 2018. Data from LCDB 2 and LCDB 5. Motuketekete is missing 2001 data as it was incorrectly classified.



Kahu (Swamp Harrier) on Rotoroa Island © Shaun Lee

HE RANGAHAU WHAKAPŪAHO (Case study)

Aotea Great Barrier Island 📷 Shaun Lee

TŪ MAI TAONGA—HE PŪMAUTANGA NĀ TE MANA WHENUA KIA KONIHI KORE AI TE ANAMATA O AOTEA

Tū Mai Taonga—mana whenua embrace a predator free future for Aotea

Opo and Elaine Ngawaka live among seabirds. Their family are the only residents of Māhuki, one of the Broken Islands south of Port Fitzroy on Aotea (Great Barrier Island), and the largest tākapu (gannet) colony in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. The island is Māori-owned and Opo is chair of a Project Steering Group that oversees the Tū Mai Taonga project, which aims to remove feral cats and rats from Aotea. Opo sees the presence of introduced predators as part of the process of colonisation. *"They are part of the story of loss that Ngāti Rehua Ngātiwai ki Aotea has suffered; of land, language, knowledge, mana and the company of once abundant native wildlife….. There have been many tragedies. This is one of them. We must be involved; it is in our interest."*

In October 2021, a powhiri at Kawa marae marked the start of field work on the Tū Mai Taonga project. A network of feral cat traps and trail cameras is being created over 4,500 ha in the Te Paparahi block in the northernmost part of Aotea, a first step in efforts to unify effort and ambitions for a predator free future around the island.

Annual bird counts show Te Paparahi has one of the lowest densities of birds on Aotea, a fifth of those heard at established sanctuaries like Windy Hill, above Tryphena in the south. There, more than 60,000 rats and nearly 400 feral cats have been removed from 800 ha over 23 years, and birds like kererū, kākā and tūī are increasing. *"Now effort is piecemeal,"* says Opo, *"people are seeing more birds around settled areas because of the efforts of community trapping, but in remote areas the bush is silent."* Te Paparahi is home to remnant populations of seabirds, including tākoketai (black petrel), ōi (grey-faced petrel) and tītī (Cook's petrel), pekapeka (long-tailed bats), and reptiles like the pepeketua (Hochstetter's frog) and niho taniwha (chevron skink). It was the last refuge

Field workers are welcomed onto Kawa marae
📷 Makere Jenner

Te Paparahi
📷 Tim Higham

for kōkako on the island until the last two male birds were relocated to Te-Hauturu-o-Toi in 1994 with mana whenua's blessing and the hope that their offspring could return one day. Tū Mai Taonga was first encouraged by the Aotea Conservation Park Advisory Committee and developed and promoted by the Aotea Great Barrier Environmental Trust with support from island sanctuaries and community groups, gaining funding from Auckland Council and the Jobs for Nature – Mahi mō te Taiao programme, through Predator Free 2050 and the Department of Conservation. When Ngāti Rehua Ngātiwai ki Aotea expressed interest in leading the project, the hapū received strong support from conservation and community groups around the island and set up a Project Steering Committee with representatives of mana whenua and the community responsibilities to oversee it. *"We wished to act as traditional kaitiaki, with the mana that has often been denied us over generations,"* says Opo, *"and to build a strong tikanga-based foundation for the project that would honour Te Tiriti, and be conducive to long-term hapū, community and environmental well-being."* Marilyn Stephens, a mana whenua representative on the Project Steering Committee, has witnessed the loss of taonga species first hand. *"The trees are old, there's no new ones because when the berries fall the rats eat them, and the feral cats eat the birds that distribute them."* *"I went into this sceptical but watching how Tū Mai Taonga has developed I've learned to trust the steering committee members and they've learned to trust Māori. We are holding hands and doing very well together."*

Matthew Ngawaka, another mana whenua representative on the Project Steering Committee, lives on Rangiāhua, also one of the Broken Islands. He says when rats were removed from the island in 2008 two pairs of kākāriki (red crowned parakeets), came back and tarāpunga (red-billed gulls) starting to nest around the southern end of the island. *"But the rats have returned and the kākāriki have moved on. I'd like to see predators off the whole island, not just knocked down. Then native species will flourish." "The project is an opportunity to prove ourselves. I can see a turnaround where the community is leaning toward the hapū. Māori culture is starting to be understood by more people. The project is for everyone, the whole island. I'd like to see the community get right behind it, be helpful, suggest things, push it along with us."*

The Jobs for Nature programme will fund a range of field-based and specialist jobs over the project's first three years, backed by NZQA-linked training and development, providing opportunities for whānau to return to the island and build careers. Tū Mai Taonga's operational plan is informed by a peer reviewed feasibility study that showed the task of ridding the island of feral cats and rodents will be a difficult and skilful, long-term job. It will progress in stages, beginning with the removal of feral cats from Te Paparahi, then using growing knowledge and operational capability to integrate effort around the island, working alongside landowners, agencies and community group effort. For ship rats and kiore, critical research questions have been defined to help understand their unique behaviours in

Tū Mai Taonga Steering Committee, from left: Matthew Ngawaka (mana whenua), Paula Williams (mana whenua), Izzy Fordham (Local Board), Opo Ngawaka (Chair Ngāti Rehua Ngātiwai ki Aotea Trust), Marilyn Stephens (mana whenua), Kate Waterhouse (community rep), Sue Daly (community rep). 📷 Saskia Koerner

the landscapes on Aotea. Smaller offshore islands like Māhuki and Rangiāhua have potential to help the project discover which combinations of tools and approaches are best at completely removing rodents and detecting and responding to reinvasion.

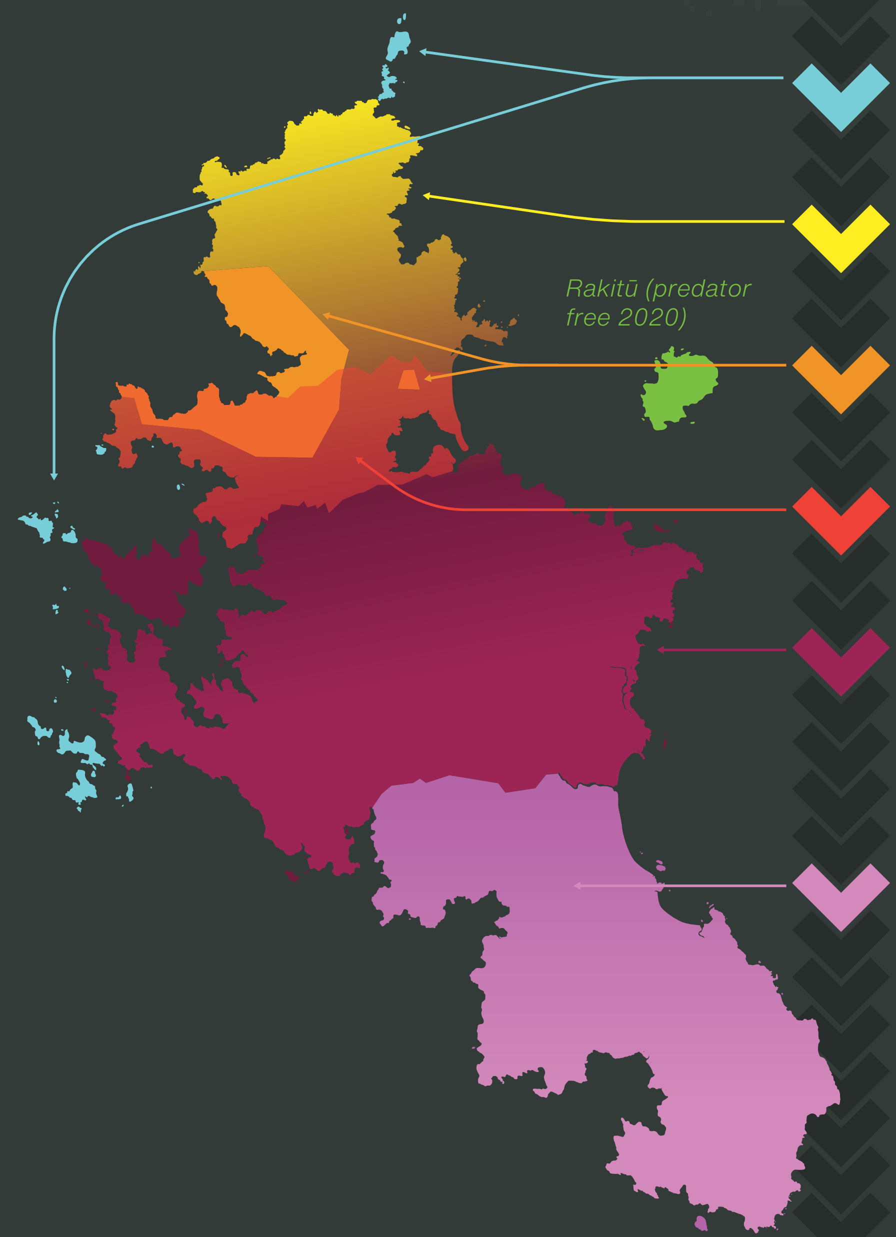
Tū Mai Taonga is linked with other Predator Free 2050 projects which aim to shift from the on-going cost and effort of supressing predators to permanently removing them from large areas. Significant national investment is going into new tools and methods that enable large scale eradication, and potentially promising developments will be considered for operations on Aotea. The project is also connected with other iwi or hapū-led projects and Māori biosecurity networks exploring how mana whenua values and mātauranga can be applied in predator free work.

Tū Mai Taonga Project Lead Makere Jenner at a wananga hosted by Ngati Awa's Korehāhā Whakahau project. 📷 Korehāhā Whakahau

The significance of Aotea as a potential ark for the country's endangered species has long been recognised. Already free of possums, mustelids, Norway rats, deer and goats, the removal of ship rats, kiore and feral cats across 28,500 hectares would be a game changer for conservation in Aotearoa and the network of over 40 other predator free islands in the Marine Park. Kate Waterhouse is a community representative on the Project Steering Committee, chair of the Aotea Great Barrier Environmental Trust, and a champion for many of the community-led conservation projects on the island. *"Islanders have been involved in predator control for more than twenty years, landowner participation is increasing, and surveys have shown strong support for the goal of permanently removing rats and feral cats."* She sees the project as an opportunity for agencies and funders to integrate effort and prove that landscape-scale eradication is possible, with the support of mana whenua and the community. Opo Ngawaka says *"Tū Mai Taonga is not just a project to bring back the birdsong that our tupuna once heard in the ngahere, but a new way of working."*

A pathway to eradication

Objective: To remove feral cats and rodents from Aotea informed by the tikanga of Ngāti Rehua Ngātiwai ki Aotea.



Years 1-3
Offshore northern islands - DISCOVER
(Customary, Crown, private and Māori land)
Rodents - detect, eradicate, defend.

Te Paparahi - PROVE
Rodents – apply learnings and trial tools at scale.
Feral cats – eradicate.
Build workforce capacity.

Māori land blocks - MANAAKI
Apply tikanga across project.

Years 3-5
Okiwi Basin - INTEGRATE
Integrate with landowners and agency expertise and investment.

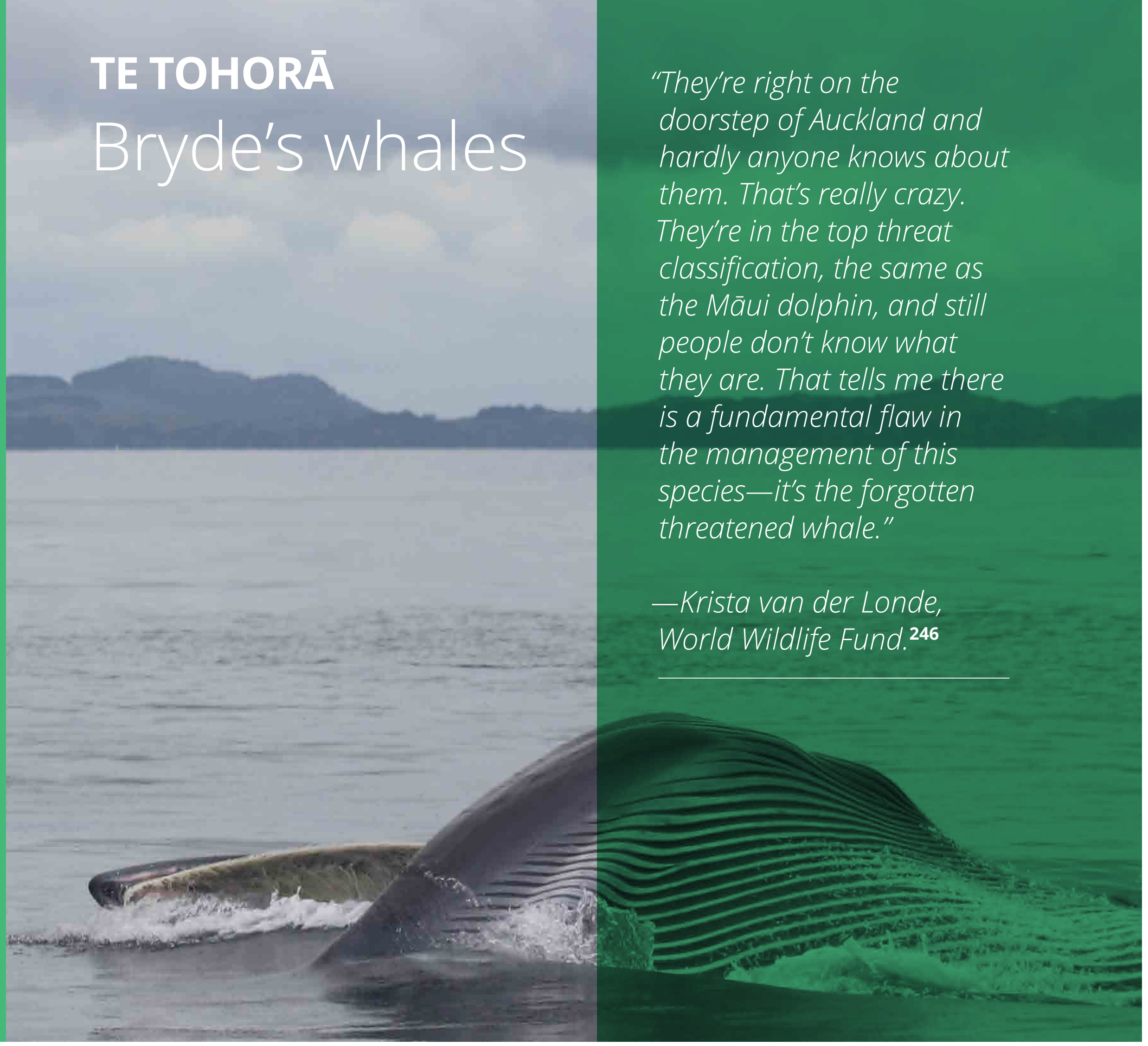
Central - PARTNER
Partner with the conservation community.
Create confidence in methods.

Years 5-10
South - EXTEND
Build informed landowner relationships kanohi ki te kanohi (face to face).
Enable joined-up eradication operations.

Years 10-20
TIAKI
Refine biosecurity to maintain an island ark.

Mokopuna hear the birdsong their tupuna once did and people and wildlife thrive together.

TE TOHORĀ
Bryde's whales



"They're right on the doorstep of Auckland and hardly anyone knows about them. That's really crazy. They're in the top threat classification, the same as the Māui dolphin, and still people don't know what they are. That tells me there is a fundamental flaw in the management of this species—it's the forgotten threatened whale."

—Krista van der Londe, World Wildlife Fund.[246]

Tohorā (Bryde's whale) Jo Logan

Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf is a special place for the Nationally Critical Bryde's whale. It is one of only three places in the world where these whales reside year-round in coastal waters, with around 135 Bryde's whales using the Marine Park.[247] Bryde's whales are most frequently seen in the area between Kawau Island, Waiheke and Aotea (*Figure 40*), where they spend around 90% of their time in surface waters resting and feeding on small schooling fish and zooplankton.[248]

In the past, a key threat to Bryde's whales was ship strike. The Marine Park is one of the busiest waterways in Aotearoa, with the Ports of Auckland handling around 1,000–1,500 ship calls per year. Bryde's whales are particularly vulnerable to being hit by fast-moving ships because they spend most of their time in surface waters. Between 1989 and 2014, 17 whales were likely to have been killed by ship strike, three whales died from entanglement with fishing or aquaculture gear, and 25 whales died from unknown causes.

An average ship strike rate of 2.3 whales per year was unsustainable for the Marine Park's Bryde's whale population given their small population size and low reproductive rate (1 calf every 2–3 years).[249] Concerned scientists, environmental organisations, the shipping industry, government staff and mana whenua started working together in 2011 to try and reduce the ship strike rate. The most feasible solution was to try and get large ships to slow down to 10 knots in the Marine Park. In 2013, a voluntary transit protocol was introduced by the Ports of Auckland and largely adopted in 2014. There has been overwhelming support for this protocol amongst the shipping industry, and the average speed of large vessels has dropped from 13.2 knots to 10 knots.[249] Only one whale has been killed by ship strike since the protocol was introduced (*Figure 41*), showing that the speed reduction has had a major positive impact on local Bryde's whales.

Bryde's whales do not undergo large migrations to the poles to feed on dense prey aggregations, but must obtain all their food

Tohorā (Bryde's whale) Jo Logan

from Aotearoa's coastal waters. They need to eat a lot (600–650 kg per day) to maintain their body size,[250] making them vulnerable to declines in prey availability due to fishing, environmental degradation, or climate change. A decade ago, small fish such as pilchards and saury were the primary food for Bryde's whales, but zooplankton, especially krill, copepods and salps, are becoming an increasingly important part of their diet. The reason for this switch to lower calorific zooplankton is unknown, but it might be an indication of declines in the abundance of small pelagic fish in the Marine Park.[248,251,252] No fisheries stock assessments have been conducted on pilchards, anchovies or saury, and therefore, their trends in abundance are unknown.

Recent research has also found that Bryde's whales from Marine Park consume an estimated 3.4 million microplastics per day, which is mainly consumed through their food. Currently, very little is known about effects on whales from consuming microplastics, but high consumption may have toxic effects or other long-term negative impacts on whales.[253]

KEY EVENTS

2013: Voluntary transit protocol was introduced by the Ports of Auckland.

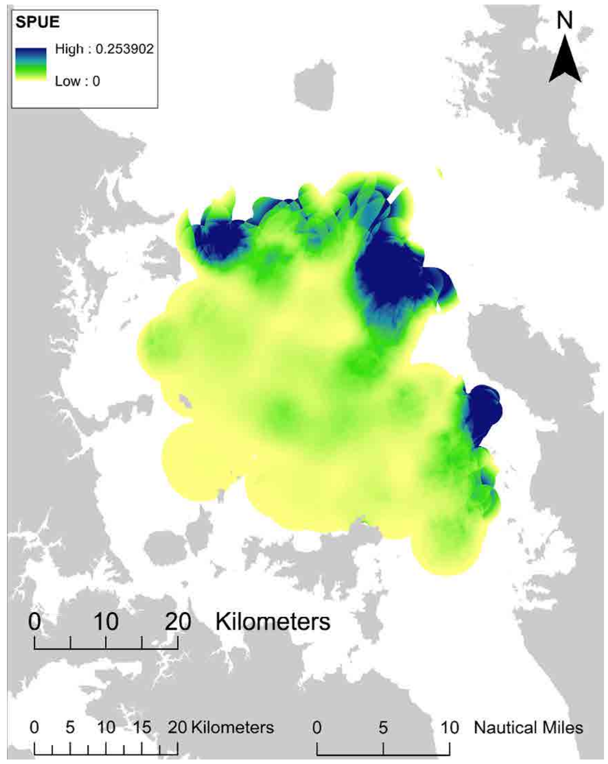


Figure 40: Sightings per unit effort of Bryde's whales in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf between October 2014 and September 2016. Figure reproduced with permission from Ebdon (2017).[254]

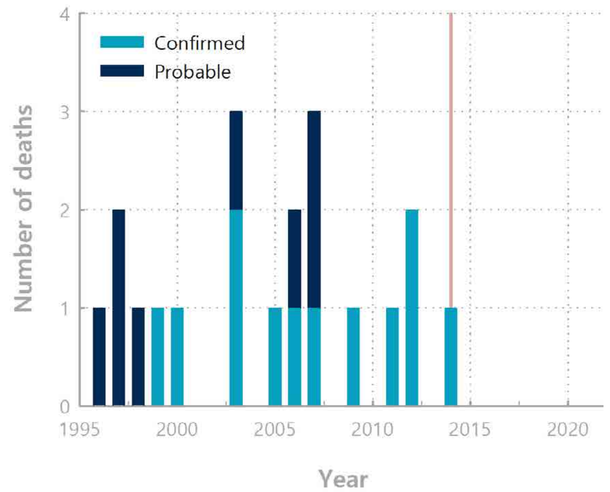


Figure 41: Number of confirmed and probable ship strike deaths of Bryde's whales in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf. The pink line shows when the voluntary transit protocol was adopted (Data from the Department of Conservation).

NGĀ MANU O TE MOANA

Seabirds

Kororā (Little penguin) Te Arai Beach © Shaun Lee

> *"Seabirds get called indicators of the ocean ecosystems a lot, and there's a lot of caveats with what they're actually telling you, but if a lot of them are showing up dead, there's nothing good that's coming of that."*
>
> *—Edin Whitehead, seabird scientist.*[255]

Seabirds are a diverse group of birds that all spend part of their life feeding over open sea. The Marine Park is a globally significant seabird hotspot. Over 70 seabird species (around 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 Aotearoa. Four species (rako (Buller's shearwater), tītī (Pycroft's petrel), tākoketai (black petrel), and takahikare-raro (New Zealand storm petrel)), breed exclusively in the Marine Park. The Marine Park also includes significant populations of other species (tara iti (fairy tern), ōi (grey-faced petrel), tītī (Cook's petrel), pakahā (fluttering shearwater), tākapu (Australasian gannet), and toanui (flesh-footed shearwater)).[256,257]

Seabirds are important ecosystem engineers for islands—their droppings add nutrients to the soil that is mixed by their burrowing activity, which alters the composition and growth of plants, invertebrates and reptiles on the island.[258]

Seabirds are often used as indicators of the health of the marine environment because they are sensitive to changes in prey availability. Seabirds are generally long-lived, slow to mature, and have low fecundity, making them vulnerable to key threats such as fishing, predation, marine pollution, sedimentation, human disturbance, disease, climate change, and loss of prey and habitats *(see infographic)*.[224,259] In particular, seabirds were identified the most sensitive group of animals to climate change impacts.[210]

Aotearoa seabirds have not evolved to deal with mammalian predators, and have very poor breeding success when mammalian predators are present. Pest-free islands have greatly improved the breeding success of seabirds, and populations of several species of petrels and shearwaters on pest-free islands in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf have increased over the last decade.[260-262] However, despite this, the conservation status of the majority of seabirds that breed in the Marine Park has not improved (*Figure 42*).

Other threats to seabirds, both within and beyond the boundaries of the Marine Park out to international waters, are likely to be preventing national population recovery. For example, the mass mortality of thousands of kororā (little blue penguins) in 2018 was thought to be caused by warm and stormy La Niña conditions, which resulted in less prey and more difficult feeding conditions.[82]

Of the seabird species that breed in the Marine Park, 18% were Threatened, 67% were At Risk, and 15% were Not Threatened in 2021.[239] In general, inshore feeders such as shags, penguins and gulls appear to be particularly impacted in recent years with large shifts in the status of some species, while seabirds that feed in offshore waters appear to be improving in the Marine Park.[262] In the 2021 bird conservation status assessment:

The Nationally Critical tara iti (fairy tern) continues to be Aotearoa's most threatened bird with around 40 birds and fewer than a dozen breeding pairs in Aotearoa.[263]

Pārekareka (spotted shags) have worsened from Not Threatened to Nationally Vulnerable. This is the most significant deterioration in status of any Aotearoa bird and is due to the large decline in breeding pairs on Banks Peninsula due to loss of breeding habitat following the 2010 Christchurch earthquake.

Kawaupaka (little shags) have worsened from Not Threatened to At Risk: Relict due to a marked decline in their population around the Rotorua lakes.

Rako (Buller's shearwaters) have worsened from Not Threatened to Nationally Vulnerable due to large declines in the population on the Poor Knights Islands.

Kawau pū (black shags) have worsened from At Risk: Naturally Uncommon to At Risk: Relict.

However, large improvements to the status of two species have occurred:

Toanui (flesh-footed shearwater) improved from Nationally Vulnerable to At Risk: Declining, which is thought to be due to better breeding success on pest-free islands and fewer deaths due to changes in fisheries practices.

Tarāpuka (black-billed gulls) changed from Nationally Critical to At Risk: Declining, but this is thought to be mainly due to better population estimates obtained since 2016.[239]

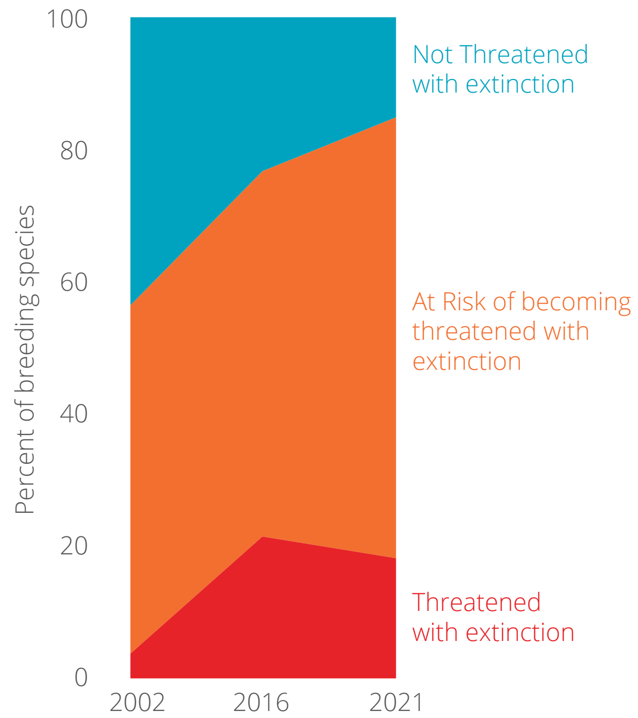


Figure 42: Change in the conservation status of seabirds that breed in the Marine Park.

Seabirds are vulnerable to being accidentally caught by fishing lines, set nets and other fishing methods. Published figures for seabirds caught by commercial fishing in the Marine Park are not available, but in 2019–20, an estimated 366 seabirds were captured in Northland and Hauraki[ee] fisheries, which is about 10% of national estimated seabird captures.[264] Implementation of a variety of mitigation methods have successfully decreased seabird bycatch rates in Northland and Hauraki by over 50% since 2002. These methods include providing training to commercial longline fishers on seabird smart fishing practices and employment of

[ee] Between North Cape and Sugar Loaf Rocks near Cape Coville

seabird liaison officers to assist industry in the development of seabird risk management plans.

Tākoketai and toanui are particularly vulnerable to commercial fishing effects in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf, with around 90 Tākoketai and 144 toanui captured in the bottom longline fishery in Northland and Hauraki in 2019–20.[264] Excellent progress has been made at reducing tākoketai and toanui captures rates, which have decreased by around 60% and 50%, respectively, since 2002 (*Figure 44*). However, current capture rates are still of grave concern for the Nationally Vulnerable tākoketai, which is the seabird most at risk from commercial fishing. The likelihood that the annual potential fatalities from commercial fishing is greater than what the tākoketai population can sustain was estimated to be 70%. All other seabirds had a likelihood of less than 5%.[265]

Significant numbers of seabirds are also caught by recreational fishers, with an estimated 10,568 birds snared in north-eastern Aotearoa (FMA1) in 2017–18. Petrels, shags, gannets and gulls were the most common species fishers reportedly caught, with most (98.4%) birds said to be released alive.[266] Overall, recreational and commercial fishing compound the effects of other threats to seabirds and remain matters of serious concern.

Pāngurunguru (Northern giant petrel) Wednesday Davis

KEY EVENTS

2002: National workshop on reducing seabird mortality held, that lead to the establishment of Southern Seabird Solutions.

2003: Takahikare-raro (NZ storm petrel) found to be living after it was presumed extinct.

2004: First National Seabird Action Plan released by Fisheries NZ.

2006: Mass mortality of kororā in northern Aotearoa was thought to be caused by starvation and rough weather.[7]

2010: Appointment of a seabird liaison officer to work with the northeast Aotearoa longline fishing industry to reduce seabird bycatch.

2014: DOC start a Protected Species Liaison Project for inshore fisheries. A liaison officer helps fishers develop and implement management plans to reduce seabird bycatch.

2014: Establishment of the Black Petrel Working Group that includes members of the fishing industry, environment groups, iwi and government, who pledge to decrease tākoketai bycatch rates in north-eastern Aotearoa.

2018: Changes to mandatory seabird mitigation measures for longlining. These provide for the use of hook shielding devices as a standalone measure, and amend tori line requirements to accommodate smaller vessels.

Mass mortality of kororā in northeast Aotearoa was thought to be caused by starvation due to warm and stormy La Niña conditions.[82]

Auckland Council establishes a regional Seabird and Shorebird Monitoring and Restoration programme that received funding from the Natural Environment Targeted Rates.

2020–23

2022–present: Cameras will be trialled on 300 commercial fishing vessels to monitor the bycatch of seabirds.

Tarāpunga (Red-billed gull) Shaun Lee

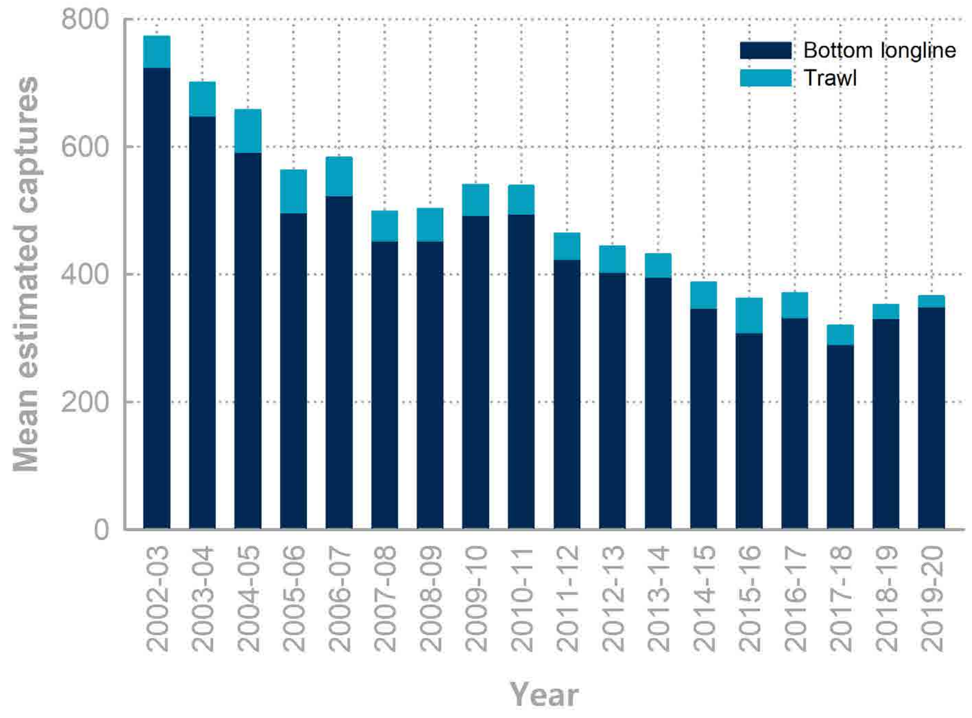


Figure 43: Estimated number of seabirds caught in Northland and Hauraki[ee] by commercial fisheries between the 2002–03 and 2019–20 fishing years. Surface longline data is excluded as it mainly occurs beyond the Marine Park boundaries.[264]

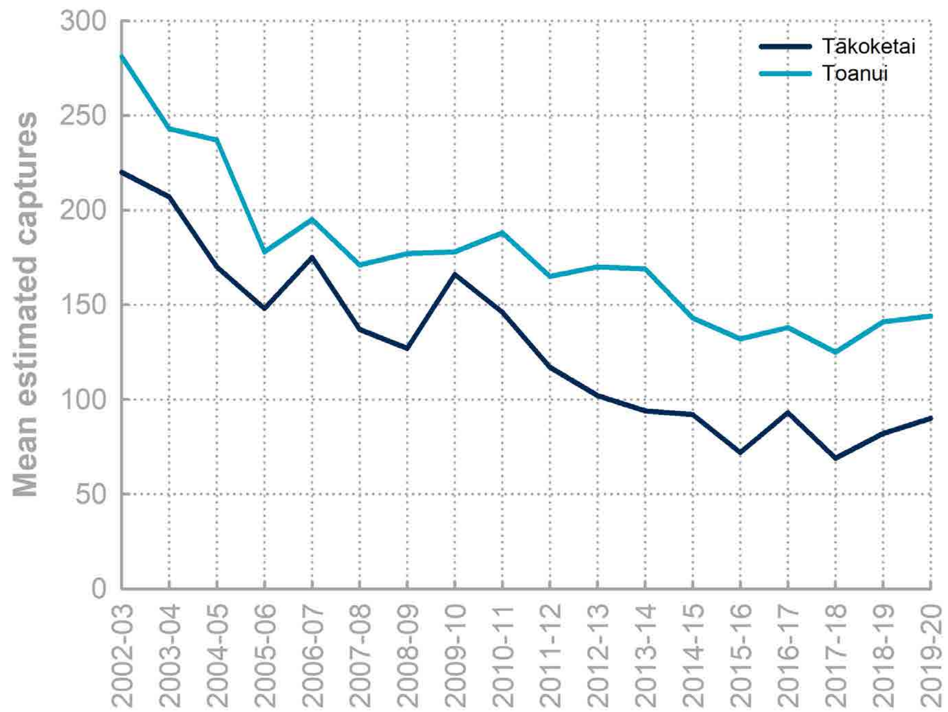


Figure 44: Estimated number of tākoketai and toanui caught in Northland and Hauraki[ee] in the bottom longline fishery between the 2002–03 and 2019–20 fishing years.[264]

[ee] Between North Cape and Sugar Loaf Rocks near Cape Coville

NGĀ MANU O TĀTAHI

Shorebirds

"Most of the world's surface is useless to a shorebird.... so the relatively few places that still suit the birds' needs are important beyond measure"

—Scott Weidensaul[267]

Juvenile tōrea pango (variable oystercatcher) Shaun Lee

TOHU (Indicator)

Shorebirds or waders are birds that feed on our coastal shores. Some species are migratory, flying between the northern and southern hemisphere, while other species are endemic (only found in New Zealand). Many shorebird species are Threatened or At Risk, having suffered large population declines due to predation, loss of breeding habitat, and decreases in food availability due to environmental degradation. Eradication of mammalian pests from islands and mainland sanctuaries such as Tāwharanui, Shakespear Regional Park and Omaha Shorebird Sanctuary have helped provided safe habitats for vulnerable shorebirds.

The Firth of Thames, particularly the Miranda Coast, is an internationally important feeding ground for shorebirds with around 35,000 birds from 43 shorebird species using the area each year. The area is the most important wintering ground for ngutu parore (wrybill), with up to 40% of the population over wintering there before returning to South Island rivers to breed. Tūturiwhatu (northern New Zealand dotterel) and tōrea pango (variable oystercatcher) also breed along the Miranda Coast.[268]

The most common species seen in the Firth of Thames are torea tuawhenua (South Island pied oystercatcher), kuaka (bar-tailed godwit), ngutu parore (wrybill), turuturu pourewa (pied stilt) and huahou (lesser knot). These five species have made up around 95% of the birds counted in the Firth of Thames in the last few years. Encouragingly, counts of pohowera (banded dotterel), tūturiwhatu (northern New Zealand dotterel), and torea pango (variable oystercatchers) have been increasing since the 1990s. On the other hand, counts of huahou (lesser knot) and torea tuawhenua (South Island pied oystercatcher) have been decreasing (*Figure 45*).

Two species of shorebird, tūturiwhatu (northern New Zealand dotterel) and tūturuatu (shore plover), are actively managed in the Marine Park. The management programme for tūturiwhatu started in the 1980s. Predator control, fencing of nest sites, and watching of nests by volunteer 'dotterel minders' and Department of Conservation staff has greatly increased the breeding success of birds. The population of tūturiwhatu has doubled since the programme began to around 2,500 birds, and the conservation status of the subspecies has improved from Nationally Vulnerable to Nationally Increasing.[269] However, the Department of Conservation no longer has an active tūturiwhatu management plan, and management of the population is now largely conducted by volunteers.[270]

As a bonus, tōrea pango (variable oystercatcher), an At Risk species, have benefited from the tūturiwhatu management programme as the two species share the same breeding habitat.

After their extinction on the New Zealand mainland in the 1870s, tūturuatu (shore plover) were confined to the Chatham Islands where a small population of around 120 adult birds persisted on Rangatira Island.[271] A captive breeding programme was started for them in the 1990s and has supplied more than 600 birds to pest-free islands, including around 160 birds for Motutapu Island. However, the population of tūturuatu on Motutapu has struggled to thrive due to a stoat incursion and predation by other birds such as ruru (morepork), kāhu (swamp harrier), and magpie. The total population of shore plover nationwide has increased to around 250, but the species' status is still Nationally Critical.[272-274]

KEY EVENTS

2003: Pūkorokoro Miranda Shorebird Centre starts running annual dotterel management courses.

2004: Predator-proof fence built at Tāwharanui.

2011: Predator-proof fence built at Shakespear Regional Park.

2012: Predator-proof fence built on Omaha's northern spit.

2016: Aotearoa and China signed a Memorandum of Arrangement to protect migratory shorebirds and their habitats in their countries.

2020–23

2021: Four shorebird species that are present in Tīkapa Moana / Te Moananui-ā-Toi / Hauraki Gulf have improved in conservation status in the 2021 assessment[239] and none have decreased in status:

Ngutu parore (wrybill) have improved from Nationally Vulnerable to Nationally Increasing;

Huahou (lesser knot) and pohowera (banded dotterel) have improved from Nationally Vulnerable to At Risk: Declining;

Tōrea pango (variable oystercatcher) have improved from Nationally Increasing to At Risk: Recovering.

Tūturuatu (Shore plover) on Motukorea / Browns Island Shaun Lee

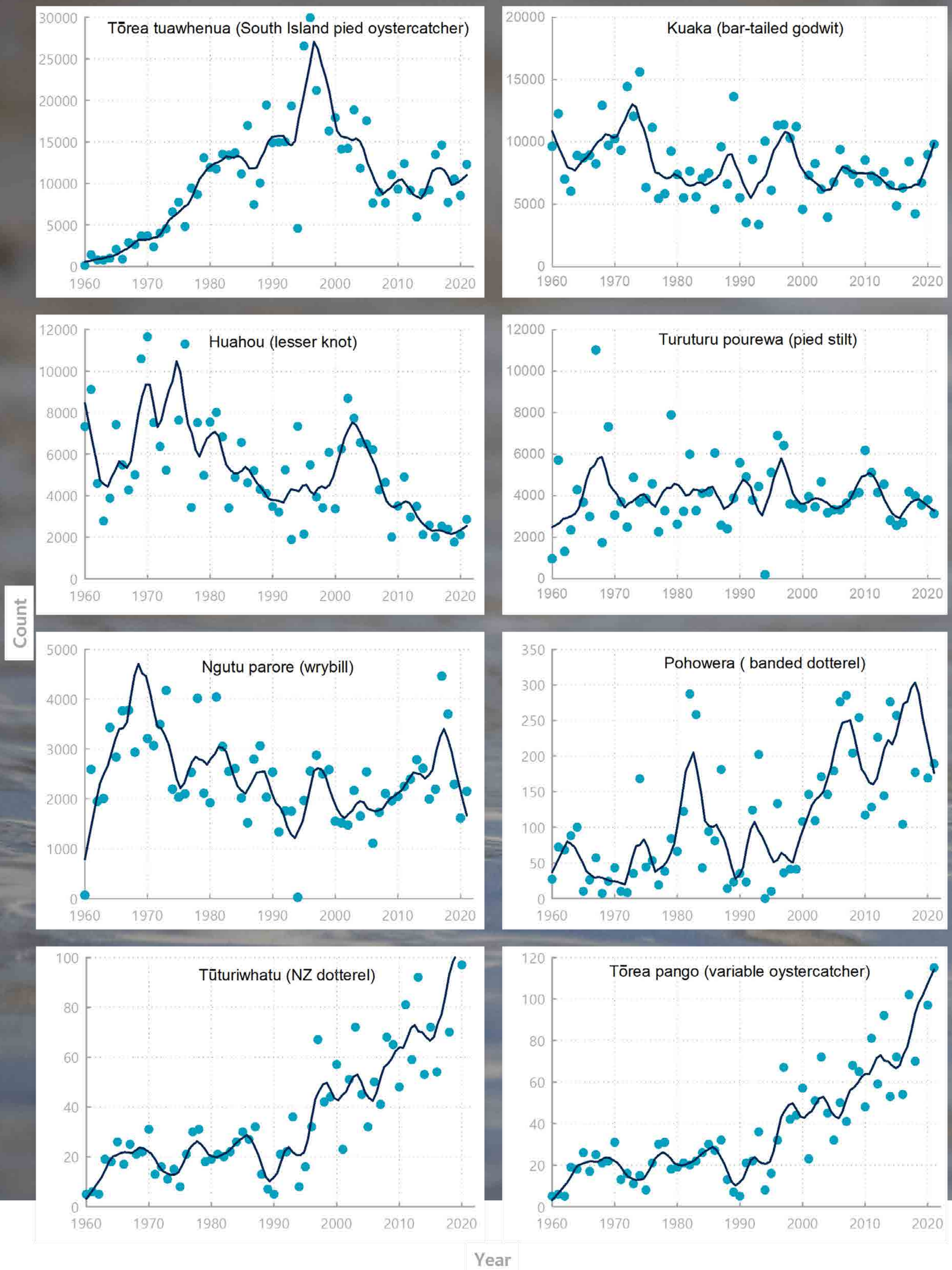


Figure 45: Trends in the number of shorebirds counted during summer and winter surveys conducted by volunteers of Birds New Zealand in the Firth of Thames (data provided by Birds New Zealand).

Ngutu parore (Wrybill) Shaun Lee

TOHU (Indicator)

NGĀ MOMO RĀWAHO O TE MOANA

Marine non-indigenous species

"You can tell they don't whakapapa here, because they're taking control of the environment the live in. They're not family-oriented, they're selfish."

—Hone Martin, Ngātiwai kaumātua talking about invasive Caulerpa.[275]

Caulerpa growing on tipa on Aotea Great Barrier Island © Richie Hughes / NIWA

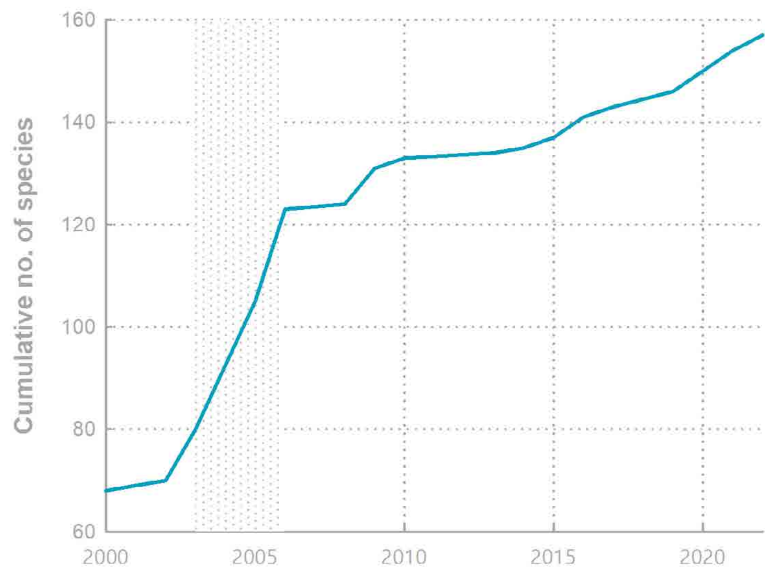


Figure 46: Cumulative number of non-indigenous marine species recorded from the Marine Park between 2000 and 2022. Not all recorded species become established. The shaded area shows when the Auckland ports and harbours baseline surveys were conducted. Data from Marine High Risk Site Surveillance reports, Biosecurity NZ's Surveillance magazine and www.marinepests.nz.

Most marine non-indigenous species hitchhike into Aotearoa on the hulls of ships or floating in ballast water and around 157 non-indigenous species have been recorded from the Marine Park (***Figure 46***). Not all non-indigenous species that arrive here are capable of surviving or pose a threat to our environment. However, some of the non-indigenous species that arrive here flourish in our waters and become pests, including the Asian date mussel, wakame, Mediterranean fan worm, Australian droplet tunicate, clubbed tunicate, Asian paddle crab, carpet sea squirt, mantis shrimp, lightbulb ascidians and exotic *Caulerpa* seaweed.[ff]

Once here, marine non-indigenous species will naturally spread around the region, but the rate of spread is greatly accelerated by boats (particularly those arriving from outside the Marine Park), aquaculture activities, and movement of marine equipment.[276] These pests may compete with our native species for food and space, or consume our native species. They often also cause major fouling problems for boats, marine farms, and other submerged structures, which can result in high cleaning costs and large decreases in aquaculture production rates.[277]

Eradication of non-indigenous marine species is extremely difficult and very expensive. Very few of the marine pests that have established themselves in Aotearoa have been eradicated. Preventing non-indigenous species from entering Aotearoa's waters is the most effective way of protecting the country's marine values. For non-indigenous species that are established in Aotearoa, limiting their spread is the key to their management.

Over the past two decades the government has implemented several measures to try and reduce the number of marine non-indigenous species arriving and becoming established in Aotearoa. Overseas vessels are now required to exchange or treat all their ballast water and have a clean hull before arriving in our waters.[278,279] A six-monthly surveillance programme of high-risk ports and harbours has been running since 2002 to provide an early warning system for the arrival of new species, and to record the spread of marine non-indigenous species around the country,[280] and a pest and disease reporting hotline is available for the public.

Once a marine pest is established in a region, regional councils are also responsible for pest management. Auckland Council added 10 marine pests to its Regional Pest Management Plan 2020–30, has prohibited the movement of those marine pests within the Auckland Region, and requires all vessels to be regularly cleaned so that they have no more than light biofouling on their hulls.[281] No marine pests are specified in Waikato Regional Council's Regional Pest Management Plan 2022–32. Both Auckland Council and Waikato Regional Council conduct annual dive surveys at approximately 40 high-risk sites around the Marine Park, in total, to check for the presence of marine pests on boat hulls, moorings and the surrounding seabed. If pests or high levels of biofouling are found on boats, the owners are required to clean their hulls. Regional councils around the Top of the North Island (Northland, Auckland, Waikato and Bay of Plenty) are currently working towards a shared Clean Hull Plan, which would provide a consistent set of rules relating to hull fouling on vessels and help manage the spread of marine pests around northern Aotearoa.[282]

In 2019, Aquaculture New Zealand, an aquaculture industry body, joined the Government Industry Agreement for biosecurity readiness and response (GIA). Under this GIA, industry and government share the decision-making and responsibilities, of preparing for, and responding to, biosecurity incursions. Aquaculture New Zealand has also developed industry-led biosecurity standards for mussel, oyster and salmon farms that sign up to the programme.[283]

Although marine pests such as the clubbed tunicate, wakame, and Mediterranean fan worm are now commonly found in parts of the Marine Park, for many species, there is little information about how they affect our native species. Most marine pests flourish on artificial surfaces or in disturbed communities, where they can dominate the community reaching very high densities. However, densities on natural substrates are typically much lower, and studies to date have found that impacts are varied and depend on the environmental conditions and the size of the marine pest population.[284,285] One of the most well-studied marine pests in New Zealand, the Mediterranean fan worm, has been shown to cause changes in the abundance of macroinvertebrates at densities of 10–50 worms/m^2, but not at lower densities of up to 2 worms/m^2; increase the biodiversity of epibiota (surface-dwelling species); and reduce the denitrification rate of the sediment. The ecological significance of these impacts is currently unknown.[286-290] Further research is underway on the impacts of marine pests in Aotearoa, and the development of novel tools to limit their spread.[284,285,291]

KEY EVENTS

1998: A ballast water import health standard was implemented for international ships arriving in Aotearoa.

2001–2007: Biosecurity NZ conducted baseline surveys in 27 ports, marinas and high value locations for marine non-indigenous species.

2002: Marine High-Risk Surveillance programme started in high-risk ports.

2005: Marine Invasives Taxonomic Service started to provide marine pest identifications.

2013: Waikato Regional Council Marine Biosecurity Programme established.

2014: A Biofouling Import Health Standard was implemented for ships arriving in Aotearoa. Initially voluntary, the standard become mandatory in 2018.

2016: Auckland Council Marine Biosecurity Programme established.

2016: Top of the North Marine Biosecurity Partnership formed (Northland down to Hawkes Bay).

2018: Auckland Council introduces a Natural Environment Targeted Rate, which provides an additional $2.1 million over the next 10 years for marine biosecurity.[242]

2019: Aquaculture NZ joins the GIA, which is a partnership between government and industry for improving New Zealand's biosecurity.

Forest and Bird appeal Auckland's Council's Regional Pest Management Plan 2020–30 in Environment Court due to the lack of inclusion of marine pests.

2020–23

2020–present: Eleven new non-indigenous species have arrived in the Marine Park, of which, *Caulerpa brachypus* and *Caulerpa parvifolia* (exotic *Caulerpa*), were designated as unwanted organisms due to its potential threat *(see Case Study on exotic Caulerpa)*.

2020: Auckland Council creates a Controlled Area for the area of the Marine Park that lies within the Auckland Region. It is prohibited to move specified pests (including 10 marine pests) within the Controlled Area.[281]

2021: Auckland Council's Regional Pest Management Plan 2020–30 is amended to include 10 marine pests following an Environment Court appeal.

2022: Waikato Regional Pest Management Plan 2022–32 excludes marine pests.

Kūtai (Mussel) farm laden with Mediterranean fanworm. © Shaun Lee

TE URUTOMO NOHOPUKU A TE RIMURIMU *CAULERPA*

The silent invasion of *Caulerpa*

Caulerpa on Aotea Great Barrier Island 📷 Glenn Edney

Lying beneath the clear waters of Blind Bay, Aotea is a lush, dense carpet of green seaweed that stretches in all directions as far as the eye can see. Small pākirikiri (spotties) and triplefins dart amidst the short green fronds. To the casual snorkeller this may appear to be an idyllic underwater paradise, but rather, it is a worrisome example of an ecosystem that is out-of-balance.

The carpet of green seaweed is a mixture of two very similar looking invasive species, *Caulerpa brachypus* and *C. parvifolia*. These exotic *Caulerpa* were first discovered by a botanist, Jack Warden, who grew up on Aotea. During a visit back to the island in June 2021, Jack noticed a seaweed growing near the water's edge that he didn't recognise. A photo posted on iNaturalist, a community-driven species identification webpage, led to marine scientists collecting some samples and confirming that the seaweeds are not native to Aotearoa.

Overseas, species of *Caulerpa* have a bad rap. The related *Caulerpa taxifolia*, dubbed the 'killer alga' can grow up to 1 cm per day, is highly toxic, and smothers native rimurimu (seaweeds), karepō (seagrasses), sessile invertebrates such as sponges and ascidians. Native species diversity and fish habitat are vastly reduced within *C. taxifolia* meadows. Native fish that are able to eat this killer alga accumulate toxins making them unsafe for human consumption.[292,293] Similarly, other species of *Caulerpa (C. prolifera* and *C. racemosa*) have been found to outcompete karepō meadows and pūngorungoru (sponges).[294-296]

Initial dive surveys carried out by marine scientists from NIWA in mid-2021 found that exotic *Caulerpa* already covered an extensive area in Blind Bay—around 44 rugby fields. Based on the size of this area it is likely that the weed arrived at Aotea at least two years earlier and silently spread throughout the bay unnoticed. The warning cry had come too late and eradication in Blind Bay was deemed unfeasible by Biosecurity NZ. Latter surveys of high-risk areas around the Gulf in March 2022 found smaller patches of exotic *Caulerpa* in Tryphena Harbour, Whangaparapara Harbour and on the west coast of Ahuahu (Great Mercury Island). While the coverage of exotic *Caulerpa* in Ahuahu was patchy, it still covered an area of more than 32 ha, which was assessed by Biosecurity NZ as too large to eradicate.

Caulerpa on Aotea Great Barrier Island 📷 Irene Middleton / NIWA

The arrival of these tauiwi kino (bad foreigners) is extremely concerning for mana whenua (Ngāti Rehua Ngātiwai ki Aotea, Ngāti Hei and Ngātiwai), local residents, Councils, DOC, and Biosecurity NZ, who are working together in response to this invasion. Collectively these parties have formed two governance groups (one for Aotea and one for Ahuahu), which lead the biosecurity response.

The natural rate of spread for exotic *Caulerpa* is thought to be restricted to the local area. However, the seaweed is easily broken into fragments, which can be transported by boats and marine equipment to distant locations, where they rapidly grow into new plants. To limit the spread of the weed, mana whenua laid down a rāhui simultaneously with Biosecurity NZ issuing a controlled-area notice (CAN) for Blind Bay, Tryphena Harbour, and later Whangaparapara Harbour and the western site of Ahuahu, where the weed has been found. The CAN: 1) prohibits boats from anchoring without a permit, and prohibits all types of fishing, except shore-based fishing, in the Aotea controlled areas; 2) prohibits all types of fishing, but permits anchoring in Ahuahu, provided that gear is checked and cleaned before leaving.[297]

Biosecurity NZ also designated exotic *Caulerpa* as unwanted organisms, meaning that it is prohibited to move the weed around the country. Over the last two summers, mana whenua, Biosecurity NZ staff and locals spread the word about exotic *Caulerpa* in Aotea and enforced the anchoring ban in the three bays. Despite the limitations that the CAN has on people's ability to provide kaimoana for their families, the local community have ***"been awesome about the whole thing and really embraced and obeyed the CAN"*** (I. Fordham, Aotea Local Board, pers. comm.). As Jeff Cleave from Ngāti Rehua Ngātiwai ki Aotea eloquently stated *"The pain that we feel on Aotea is the pain we don't want the rest of Aotearoa to have."*[275]

Small-scale research trials were conducted to try and eliminate exotic *Caulerpa* from areas where the population was still small. Surprisingly, the most promising technique was treatment with coarse salt, though, given that salt rapidly dissolves in seawater, a lot of salt was needed (50 kg of salt per square metre). Divers blanketed the weed with salt and then covered it with hessian mats. The salt was found to be effective at killing exotic *Caulerpa*—and everything else that was present. As John Walsh, MPI's Director of Readiness and Response Services described ***"It's pretty scorched-earth."***[275] Three months later the biodiversity on the seabed had started to recover, but unfortunately, exotic *Caulerpa* recovered faster—rapidly growing over treated areas that had no native plants and animals left to compete for the space.[298]

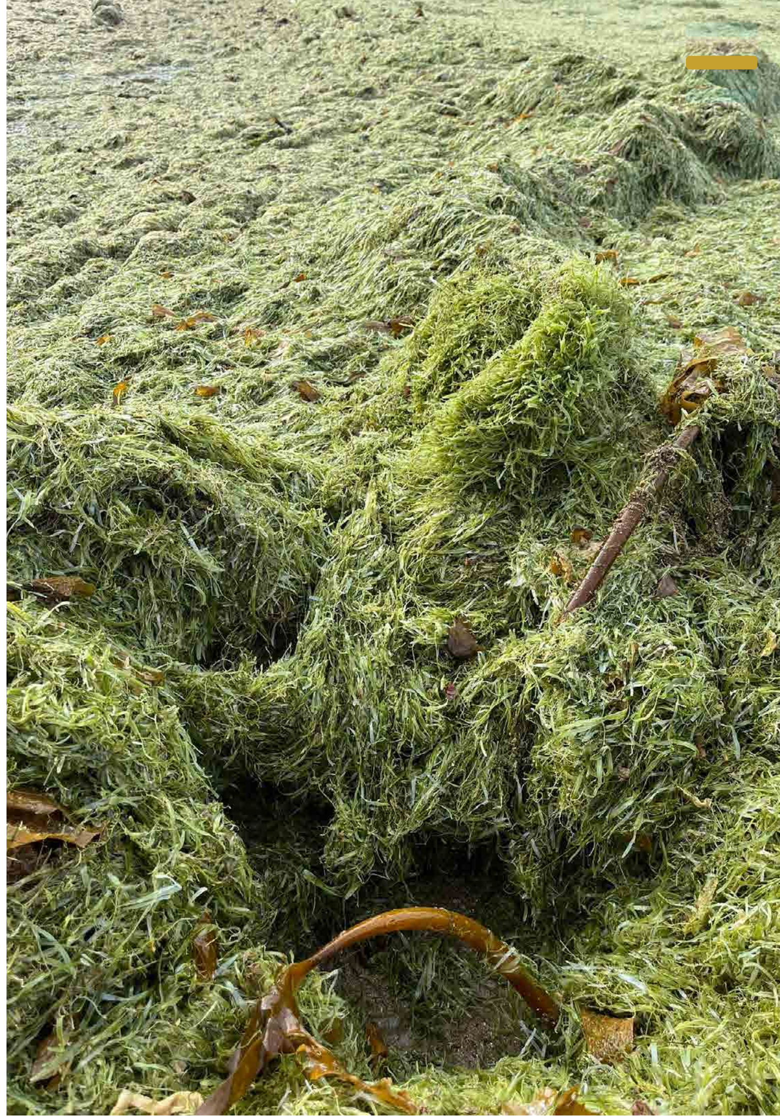
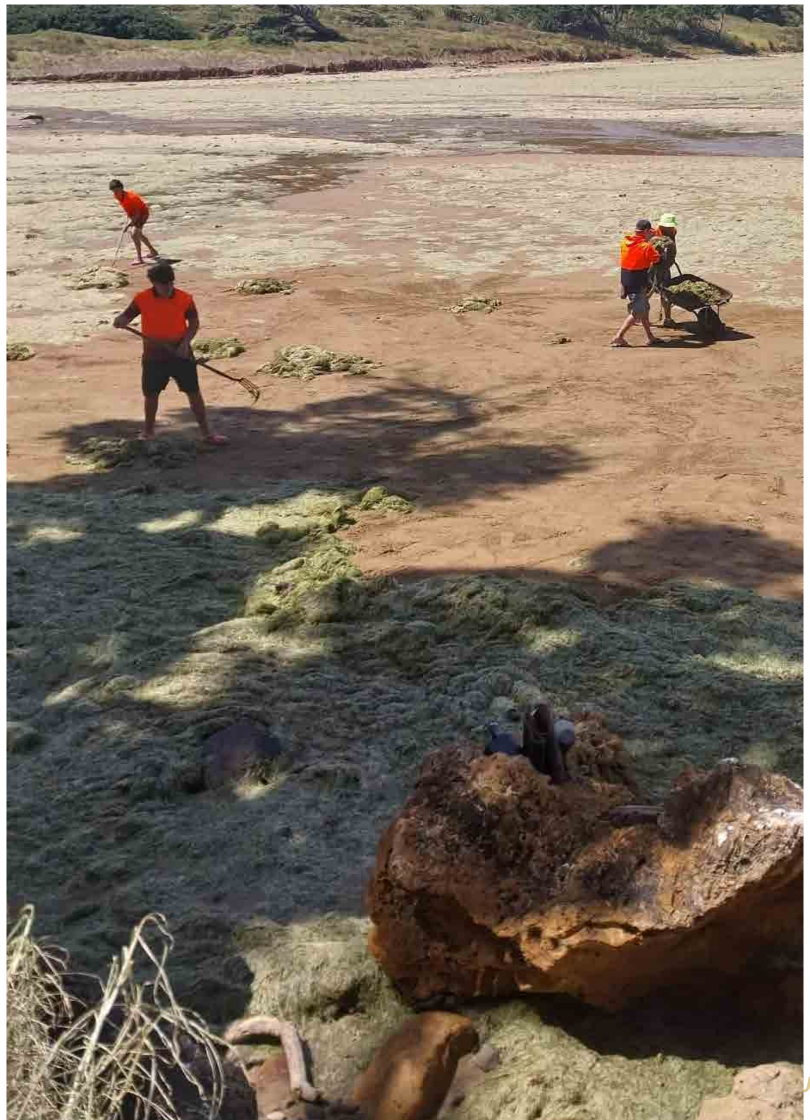
Given the results of the salt trial and the size of the exotic *Caulerpa* population, elimination was deemed unfeasible, and Biosecurity NZ are now moving to a longer-term management programme that will focus on preventing further spread by raising public awareness and encouraging the community to report any sightings of exotic *Caulerpa*.

The growth rate of the seaweed within established locations is alarmingly quick. By March 2023, NIWA divers estimated that exotic *Caulerpa* covered over 90% of the seabed in Blind Bay at depths of 10 m or less. The marine pest was also found to grow on wharf piles, mooring lines and rocky reefs. In the aftermath of Cyclone Gabrielle, piles of exotic *Caulerpa*, up to 1 m high, covered the shoreline of Blind Bay and quickly turned into a rotting mess.

Many of local community members are left despondent about the lack of options for the eradication of exotic *Caulerpa* from Aotea and Ahuahu, and the potential impacts that the marine pest may have on the marine environment. Kate Waterhouse, Chair of the Aotea Great Barrier Environment Trust, believes that the response to exotic *Caulerpa* was a failure, and that Auckland Council and Biosecurity NZ should be conducting regularly marine pest surveillance on Aotea, as it appears to be a high-risk site for marine non-indigenous species.

Early detection, a rapid response, and sufficient resources are key requirements for the successful eradication of an invasive species.[299] Unfortunately for Aotearoa, detection of exotic *Caulerpa* was too late to allow for the possibility of complete eradication[299] and the pest has now spread to other locations. In May 2023 a large area of exotic *Caulerpa* was found in the Bay of Islands, and in July 2023 small patches of exotic *Caulerpa* were found around Kawau Island. We need to encourage more proactive reporting of unusual species from our community members who swim, dive, work and play in our waters to get a better chance of eliminating the next marine pest that arrives on our shores.

Currently, the effects of exotic *Caulerpa* on our marine ecological communities are unknown though several research trials are underway: NIWA are studying the impacts of exotic *Caulerpa* on our native communities; Auckland University of Technology are investigating the of using kina as a possible biocontrol; and Ngāti Hei and Cawthron Institute are investigating the possibility of using eDNA as a surveillance method. Hopefully the results of these studies will provide us with a better understanding for its future management.


Opposite: Motairehe Limited clean up beach cast *Caulerpa* in Okupe on Aotea Great Barrier Island Wiremu Cleave

NGĀ WHAKAOTINGA
Conclusions

South Island takahē on Tiritiri Matangi Island 📷 Shaun Lee

HE WHIRIWHIRI I TE WHENU: KO TE ANGANGA WHAKAMUATANGA O TE WHAKAURUURU ME NGĀ URUPARE KI NGĀ TAKE RAUTAKI

Weaving the strands: progress towards integration and responses to strategic issues

Ngāti Manuhiri kūtai restoration © Shaun Lee

"The Hauraki Gulf / Tīkapa Moana / Te Moananui-ā-Toi is currently in a degraded state. It is suffering from impacts off the land and at sea. The Hauraki Gulf Marine Park Act is a key component of the legislative framework advancing integrated management of the Gulf, but after 22 years it is now timely and necessary to consider how best the Act can be updated and strengthened. This moment was foreseen when the Act was passed back in 2000."—Opening statement of the Hauraki Gulf Forum's 2022 Advocacy Position

The requirement for State of the Gulf reports is established in law. Part 2 of the Hauraki Gulf Marine Park Act 2000 created the Hauraki Gulf Forum and required it to produce a report on the state of the environment of the Hauraki Gulf Marine Park every three years.

This 2023 State of the Gulf report is the seventh edition: and with it the story of the overall state of the Gulf has now been comprehensively told. While there are always changes in every three-year reporting period, the core objective of that part of the legislation—to understand the state of the Gulf—has now been well and truly met.

The debate is no longer about the damage we have collectively caused, and the continued impacts on the Gulf from our activities on the land and at sea. Instead, discussion is now rightly focused on how we can restore and protect it, and the urgency and effectiveness of proposed or potential changes.

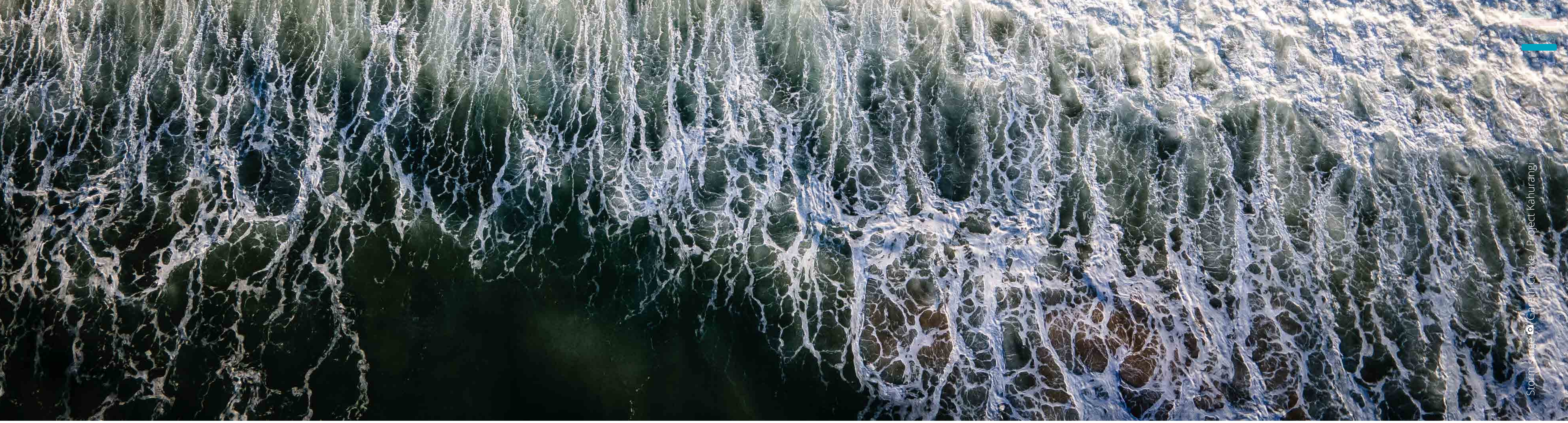
The past three-year period has been very significant for the development of new proposals from central government. The proposals seek to change how fishing is managed in the Gulf,[3] and to bring in new Marine Protected Areas.[300] The implementation of these initiatives is respectively being led by Fisheries New Zealand and the Department of Conservation, as part of the government's Revitalising the Gulf package in response to the Sea Change Tai Timu Tai Pari Marine Spatial Plan. The next 12 to 18 months will determine whether these once-in-a-generation proposals will swim or sink.

While they may not be perfect solutions, the proposals will significantly advance the health of the Marine Park and are critical to the attainment of two of the Forum's big goals: 30% marine protection by 2030, and the restoration of lost kai moana beds. They are also central to the Forum's strategic issue related to restoring marine ecosystems. The Forum has made it clear that it wants the proposals implemented, even though they fall short of an ideal solution.

While government agencies have been busy designing proposals for change, mana whenua and communities have been enacting real change. Well over half of the entire Marine Park has been placed under rāhui for various species since the last State of the Gulf report. And most, but not all, of those rāhui have been formally approved with temporary fisheries closures. This use of tikanga has been, and will likely continue to be, nimbler, more responsive, and more dynamic than the complex legislative framework surrounding the Marine Park.

However, it has not been easy. A decision to leave open Aotearoa's last functional scallop beds, in the face of a near complete collapse of scallop populations, resulted in a very risky situation that was hard to comprehend given the upsides (extraction of a few tonnes) versus the downsides (the possible loss of those scallop populations). This situation highlighted the challenge of local management and local community expectations versus the current large-scale Quota Management Area system. Ultimately though, the Minister for Oceans and Fisheries decided to close the remaining beds at the end of 2022, using the seldom-called-upon 'Emergency Measures' under the Fisheries Act as more data revealed a significant decline in the health of those beds. In March 2023, the Coromandel fishery was closed indefinitely. The Gulf is now, for the first time in generations, a scallop dredge-free zone. The Forum supports making that permanent.

Significant developments have also continued in the courts. In recent years, the Courts have found that Regional Councils can manage the indirect effects of fishing, provided they are not doing so for Fisheries Act purposes. That



Storm surge Gareth Cooke / Project Kahurangi

'game-changing' decision directly led to areas being identified in Northland and Bay of Plenty Regional Plans where fishing is now prohibited or restricted, for the protection of indigenous biodiversity. Similar actions are yet to be taken in the Gulf, though Waikato Regional Council and Auckland Council know they will need to tackle this in the years ahead—unless the new resource management legislation changes this.

The High Court also ordered a review of kōura (crayfish) catch limits in the Northland (CRA1) fishery because the Minister was not provided with adequate information on incidental effects of fishing, such as those on kina and kelp forests, when the 2022–23 limits were set.[50] Similar considerations also apply to Tīkapa Moana – Te Moananui-ā-Toi – Hauraki Gulf, and are expected to be reflected in future decisions on the CRA2 kōura stock that covers the Gulf.

The High Court has also provided direction on the weight to be given to the Harvest Strategy Standard (HSS) when considering decisions on rebuilding fish stocks. The HSS is considered best-practice in New Zealand fisheries management. The Court found it to be a ***"mandatory relevant consideration"***.[27] In contrast, the court held that a tarakihi stock rebuilding plan prepared by the fishing industry had no relevance in relation to determining how long the rebuild should take. In future decisions, greater weight is expected to be given to technical advice and the application of science-based standards, rather than appeals by industry.

Hearings on major resource consents have also had consequential outcomes. Commissioners declined two of three Pakiri sand extraction consent applications, and gave the other limited approval, with cultural factors given significant weight. These decisions have since been appealed. An application from a Waharoa dairy factory to discharge to water was also declined by a Waikato Regional Council hearing panel, largely because of nutrient effects on the Firth of Thames. That discharge was subsequently approved on appeal, subject to a revised proposal that included irrigation to land over summer and discharges to water largely limited to winter/spring when effects on the Firth of Thames are expected to be minor.

Mediation over dredging of the Rangitoto Channel has also resulted in a long-term commitment by Ports of Auckland to improve harbour health, in addition to a $100,000 per year contribution to marine restoration for the next 15 years. This resulted from a challenge brought by Protect Aotea.

Overshadowing all of this is the increasing impact of climate change. Record after record is being broken.[301] Since 2020, we have experienced extreme dry, extreme heat, and extreme wet.[301] 2021 was the warmest year on record in Aotearoa. 2022 was warmer. The country's four warmest years on record have occurred in the past six years.

The decade began with a severe meteorological drought that covered Northland, Auckland, much of Waikato, western Bay of Plenty, East Cape, and southern Marlborough—breaking records in Auckland.[302] This was followed by a 37-day period between December 2021 and January 2022, where Auckland City experienced its second longest dry spell since records began in 1943.[301,303,304]

Leigh recorded its highest annual average temperature in 2021, and again in 2022. Sponges 'melted' during a significant marine heat wave that began in November 2021 and lasted 205 days over which average and maximum sea surface temperatures increased by 2 °C and 3.8 °C, respectively.[84]

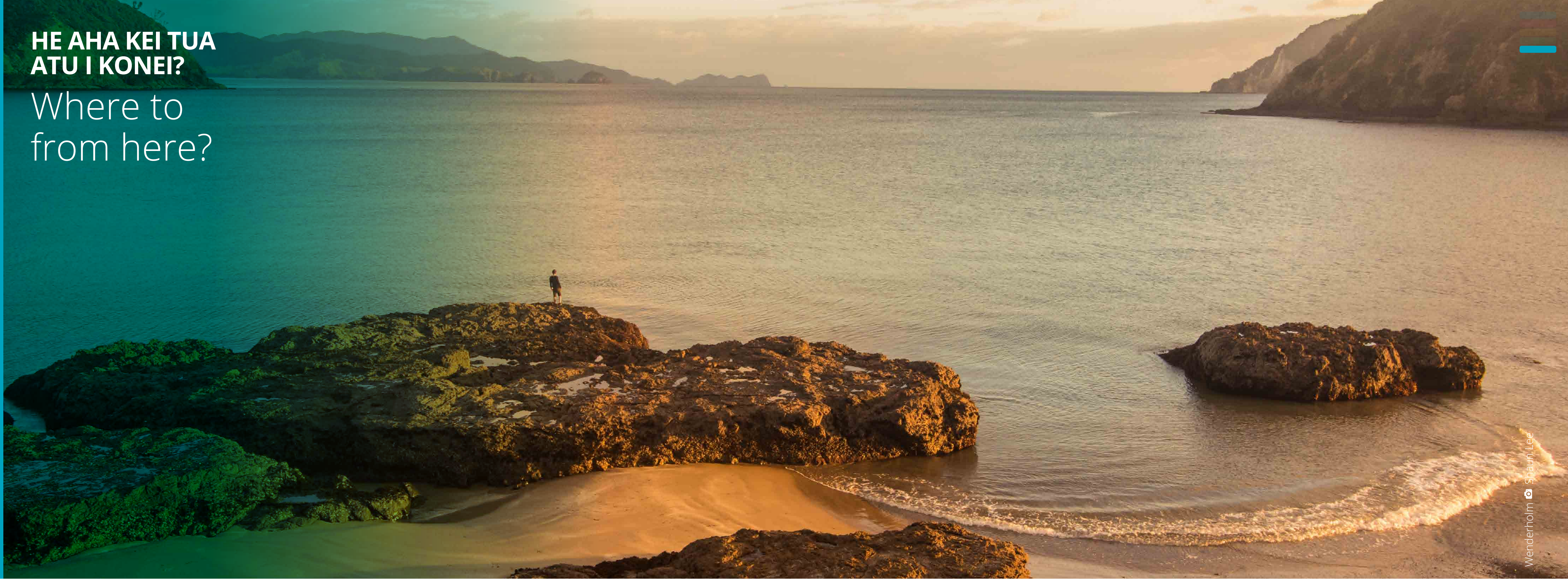
To top things off, in early 2023 two historically significant weather events occurred in quick succession. The first: a raging atmospheric river that poured out of the tropics and plunged down onto Tāmaki Makaurau, the Coromandel Peninsula and Hauraki Plains. A tempest of cyclonic wind and rain followed a week or two later. Cyclone Gabrielle emerged out of the tropics and edged down the east coast of Te Ika-a-Māui. Unprecedented flooding accompanied the deluges brought by these systems. Masses of water swelled beyond the confines of streams and rivers, and poured through cherished homes and businesses. Critical infrastructure was tested and found wanting. Pipe capacity was quickly exceeded and wastewater pumps drowned, adding sewage to the surrounding turmoil. Power and communication infrastructure was quickly overwhelmed, and failed.

The strength of the whenua was no match for the forces unleashed. Steep ground, weakened and saturated by water collapsed carrying a river of mud, vegetation, and other debris—devouring homes, ripping roads apart and spilling into the sea. Roads became impassable, communities cut off. In the aftermath, flooded homes were made unliveable, lives and livelihoods lost.

Sadly, the impacts of these events on many people are likely to be long-lasting. Their effects on the Gulf are yet to be determined, but they too, are also likely to be significant and long-lasting. It remains to be seen if this is the new normal, but the signals are pointing in that direction.

HE AHA KEI TUA ATU I KONEI?

Where to from here?


Wenderholm © Shaun Lee

Taking all of the above into consideration, the situation in 2023 feels like a crossroads. The rules are changing.

The expectations and actions of mana whenua and communities have become more prominent. Rāhui, the restoration of mussel beds, an application for the Hākaimangō-Matiatia (Northwest Waiheke) Marine Reserve, and a long list of achievements on the islands of the Gulf are great examples of direct actions.

When the Marine Park was created, management authorities assumed that fisheries impacts could not be addressed through the provisions of the Resource Management Act, even though little regard was being had to the broader ecological effects of fishing activities. Since then, mana whenua and community organisations have successfully challenged that, and other assumptions and practices through the Courts, leading to fundamental changes in the application of fisheries and resource management regulation.

There are additional moves afoot to develop a bespoke management plan for the Gulf's fisheries, and significantly increase the extent of its Marine Protected Areas. The big question is whether politics will get in the way of realising the outcomes being sought. This moment has been a decade in the making. If we fail to take it, and do not meaningfully advance marine protection and reduce the adverse effects of fishing, we stare down the barrel of another decade without substantive progress.

However, recent events have underscored the precarious nature of our actions, and their potential to tip environmental states. Recent examples include the decline of tipa (scallop) beds in the Gulf culminating in a complete closure of the fishery, growing evidence about reduced food availability for top predators, the arrival of *Caulerpa,* another serious marine pest, and adverse effects of nitrogen on the Firth of Thames. These negative developments clearly illustrate that change cannot come soon enough.

And then there is climate change. A global issue with catastrophic, local consequences. We have so far failed to reverse course on greenhouse gas emissions, so actions are urgently needed to adapt to the inevitable consequences. Events since the beginning of 2023 demonstrate that resilient solutions are going to require a huge investment in cash, resources, labour, and political leadership. In terms of the natural environment, Aotearoa New Zealand's first national adaptation plan[305] notes that, ***"Reducing human pressures and planning for ecosystem corridors are the best ways to enable coastal ecosystems to respond to climate change"***. Central Government proposals for changing how fishing is managed in the Gulf, and to create new Marine Protected Areas can do just that, and at comparatively little cost. Dealing with land-based contaminants is arguably harder, particularly for the sediment generated during extreme weather events. However, the risks of inaction are now too great. We must act quickly, and at scale, to reduce the harm we are causing from our activities on land and at sea, and to provide the resilience needed to weather coming storms.

One thing is clear, the Hauraki Gulf Marine Park Act 2000 is no longer fit for purpose. The Forum is therefore seeking changes that include updating the composition of the Forum, strengthening its advocacy role, and increasing the legal status of the Gulf.[306] The Forum reached this position at the end of a two-year period of reflection and change, beginning in 2020 with the adoption of a new Governance Statement[307], the appointment of Co-Chairs, and agreement around four big goals for the Gulf. Further deliberation over a two-year period culminated in a set of recommendations to Ministers.[308] Decisions on any update to the Act are now in the hands of Ministers. There may not be agreement across Parliament on all aspects of the update required, but there is agreement on one thing: the Gulf deserves better.

Acknowledgements

We would like to thank the people and organisations that contributed to this report. The report was prepared on behalf of the Hauraki Gulf Forum by Shane Kelly, Carina Sim-Smith, Shaun Lee, and Peter van Kampen, with contributions from Rauru Kirikiri, Tim Higham and Martin Cryer. Information, review and feedback was provided by Alex Rogers, and the staff and members of the iwi and organisations the Forum members represent.

Special thanks also goes to Merryn Jones. Sidney Wales and Marine Pomarède (MPI), Janine Kamke, Hamish Allen, Tarn Drylie, Tom Stepheson, Holly Foreman, Alan Moore, Wendy Zapart, Andrew Price, Dimitri Colella and Megan Carbines (Auckland Council), Nathan Singleton, Bill Vant, Joao Paulo, Danielle Kruger, and Upashana Pillay (Waikato Regional Council), Nathaniel Wilson and Brent Evans (Watercare Services), Craig Radford, Rochelle Constantine and Karen Tricklebank (University of Auckland), Dorothy-Jean McCoubrey (Dorothy-Jean & Associates), Tom Hollings (Coromandel Marine Farmers Association), Martin Neale (Puhoi Stour), John Zeldis (NIWA) Tim Haggitt (eCoast), Mike McMurtry (Maritime NZ), Ingrid Hutzler and Adrian Riegen (Birds New Zealand) and Jim Cooke for the provision of information. Thanks also goes to Ara Auaha for the design of the section icons and Nīkau Beazley and Kounga Ltd for te reo translations.

Technical review and feedback on relevant sections was provided by: Sidney Wales, Marine Pomarede, John Taunton-Clarke, Marc Griffiths, Marty Bowers, Tanayaz Patil, Olivia Hamilton, Bruce Hartill, Ian Tuck, Clifford Baird, Finn Sumner, Campbell Murray, Michael Nielsen, Hsiao-Heng Pan, Abraham Growcott, and Anjali Pande from the Ministry for Primary Industries (Fisheries New Zealand and Biosecurity New Zealand); Dave Houston, Clinton Duffy and Laura Boren from the Department of Conservation; Dave Allen, Liz Brooks, Tarn Drylie, Megan Carbines, Janine Kamke, and Hamish Allen from Auckland Council; Katie McLaren from Hauraki District Council; Michael Townsend, Judy van Rossem, Emily O'Donnell, Tutahanga Douglas and Yanbin Deng from Waikato Regional Council; Leslie Vyfhuis and Mitchell King of Thames-Coromandel District Council.

Tamure (Snapper) in the Whanganui A Hei / Cathedral Cove Marine Reserve © Shaun Lee

NGĀ TOHU
REFERENCES

1. **Mead HM.** Ngā pēpeha a ngā tīpuna. Victoria University Press; 2003.
2. **Ministry of Business Innovation and Employment.** 2022 Endeavour Round Successful Projects. Accessed 4 April, 2023. https://www.mbie.govt.nz/dmsdocument/24045-list-of-endeavour-round-2022-successful-projects
3. **Fisheries NZ.** Hauraki Gulf Fisheries Plan. Draft. Fisheries New Zealand; 2023.
4. **Fisheries NZ.** Fisheries assessment plenary, May 2022: Stock assessments and stock status. Compiled by the Fisheries Science Team, Fisheries New Zealand; 2022:1886.
5. **Hartill B, Rush N, Armiger H, Bian R.** Aerial-access recreational harvest estimates for snapper, kahawai, red gurnard, tarakihi and trevally in FMA 1 in 2017–18. New Zealand Fisheries Assessment Report 2019/23. New Zealand Fisheries; 2019.
6. **Hauraki Gulf Forum.** State of our Gulf 2020. Hauraki Gulf / Tīkapa Moana / Te Moananui-ā-Toi State of the Environment Report 2020. Hauraki Gulf Forum; 2020.
7. **Pinkerton MH, Moore BR, O'Driscoll RL.** Role of low- and mid-trophic level fish in the Hauraki Gulf ecosystem. New Zealand Aquatic Environment and Biodiversity Report no 301. Fisheries NZ; 2023.
8. **Ministry for Primary Industries.** Aquatic environment and biodiversity annual review 2017. Compiled by the Fisheries Science Team, Ministry for Primary Industries; 2017.
9. **Morrison M, Tuck ID, Taylor RB, Miller A.** An assessment of the Hauraki Gulf Cable Protection Area, relative to the adjacent seafloor. Auckland Council Technical Report 2016/004. Auckland Council; 2016.
10. **Department of Conservation, Ministry for Primary Industries, Fisheries New Zealand.** Revitalising the Hauraki Gulf: Government action on the Sea Change Plan. 2021.
11. **Court of Appeal.** Attorney-General v The Trustees of the Motiti Rohe Moana Trust & Others. Courts of New Zealand; 2019.
12. **Northland Regional Council.** Environment Court establishes new no-take fishing areas in Northland. Accessed 14 Feb 2023, https://www.nrc.govt.nz/news/2022/december/environment-court-establishes-new-no-take-fishing-areas-in-northland/
13. **MacDiarmid A, McKenzie A, Sturman J, Beaumont J, Mikaloff-Fletcher S, Dunne J.** Assessment of anthropogenic threats to New Zealand marine habitats. New Zealand Aquatic Environment and Biodiversity Report no 93. Ministry of Agriculture and Forestry; 2012.
14. **Parker D.** New rules to include all finfish in combined daily bag limit for recreational fishers. New Zealand Government. Accessed 29 May 2023, https://www.beehive.govt.nz/release/new-rules-include-all-finfish-combined-daily-bag-limit-recreational-fishers
15. **O'Conner M.** Iwi to place rāhui on Hauraki Gulf to help scallop beds recover. Accessed 2 Feb 2023, 2023. https://www.rnz.co.nz/news/national/460908/iwi-to-place-rahui-on-hauraki-gulf-to-help-scallop-beds-recover
16. **Maxwell KH, Penetito W.** How the use of rāhui for protecting taonga has evolved over time. MAI Review. 2007;2:15.
17. **Best E.** Notes on the custom of rāhui. Its application and manipulation, as also its supposed powers, its rites, invocations and superstitions. Journal of the Polynesian Society. 1904;13(2):83–88.
18. **Ngāti Manuhiri Settlement Trust.** Hauturu-ō-Toi and Aotea scallop beds at risk. Accessed 31 Jan 2023, 2023. https://www.ngatimanuhiri.iwi.nz/post/hauturu-%C5%8D-toi-and-aotea-scallop-beds-at-risk
19. **Parker D.** Serious scallop decline prompts emergency closure of Coromandel fishery. Accessed 31 Jan 2023, 2023. https://www.beehive.govt.nz/release/serious-scallop-decline-prompts-emergency-closure-coromandel-fishery
20. **Nash S.** Fisheries (SCA CS closure) notice 2023 (MPI 1603). Accessed 22 Mar 2023, https://gazette.govt.nz/notice/id/2023-sl920
21. **Berkenbusch K, Hill-Moana T, Neubauer P.** Intertidal shellfish monitoring in the northern North Island region, 2021–22. New Zealand Fisheries Assessment Report 2022/57. Fisheries New Zealand; 2022.
22. **Royal A.** Request for extension of temporary closure for Te Māta and Waipatukahu mahinga mātaitai. Ngāti Tamaterā Treaty Settlement Trust. Accessed 7 Feb 2023, https://www.mpi.govt.nz/dmsdocument/51340-The-closure-request-for-extension-letter
23. **Fisheries NZ.** Review of sustainability measures for scallop (SCA CS) for 2023/24. Fisheries NZ Discussion Paper no 2022/21. Fisheries New Zealand; 2022.
24. **Hauraki Gulf Forum.** Waiheke rāhui. Accessed 3 Feb 2023, https://gulfjournal.org.nz/2021/05/waiheke-rahui/
25. **Evans K.** Where are all the spotted shags? New Zealand Geographic. 2019;May–June:68–87.
26. **Langley AD.** A stock assessment of eastern tarakihi for 2021. New Zealand Fisheries Assessment Report 2022/07. Fisheries New Zealand; 2022.
27. **High Court of New Zealand.** Royal Forest and Bird Protection Society of New Zealand Incorporated vs Minister Of Fisheries, Fisheries Inshore New Zealand Limited, and Te Ohu Kai Moana Trustee Limited. 2021.
28. **Nash S.** Changes to sustainability measures and other management controls for 1 Ocotober 2018, and closure of the Kaipara Harbour to the taking of scallops. Minister of Fisheries. https://www.mpi.govt.nz/dmsdocument/30846/direct
29. **Parker D.** Changes to fisheries sustainability measures for the 2022 October round. Ministers decision letter. Minister for Oceans and Fisheries. Accessed 3 Feb 2023, https://www.mpi.govt.nz/dmsdocument/53391-The-ministers-decision-letter-changes-to-fisheries-sustainability-measures-for-the-2022-October-round
30. **Anon.** Snapper in Hauraki Gulf found with milky white flesh syndrome, scientists investigating. Radio NZ. Accessed 4 Apr 2023, https://www.rnz.co.nz/news/national/486867/snapper-in-hauraki-gulf-found-with-milky-white-flesh-syndrome-scientists-investigating
31. **Biosecurity NZ.** Investigation: snapper milky-white flesh syndrome. Accessed 4 Apr 2023, https://www.scribd.com/document/633965233/OIA-Milky-Fish-Appendix-1#
32. **Walsh C, Parsons D, Bian R, et al.** Age composition of commercial snapper landings in SNA 1, 2017–18. New Zealand Fisheries Assessment Report 2019/45. Fisheries New Zealand; 2019.
33. **Parsons DM, Bian R.** Trawl surveys of the Hauraki Gulf and Bay of Plenty in 2020 and 2021 to estimate the abundance of juvenile snapper. New Zealand Fisheries Assessment Report 2022/10. Fisheries New Zealand; 2022.
34. **Kelly S, MacDiarmid AB, Babcock RC.** Characteristics of spiny lobster, Jasus edwardsii, aggregations in exposed reef and sandy areas. Marine & Freshwater Research. 1999;50:409–416. doi:10.1071/MF98126

35. **Kelly S.** Temporal variation in the movement of the spiny lobster Jasus edwardsii. Marine & Freshwater Research. 2001;52:323–331. doi:10.1071/MF00028

36. **Webber DN, Starr PJ, Haist V, Rudd MB, Edwards CTT.** The 2017 stock assessment and management procedure evaluation for rock lobsters (Jasus edwardsii) in CRA 2. New Zealand Fisheries Assessment Report 2018/17. Ministry for Primary Industries; 2018.

37. **Hanns BJ, Haggitt T, Shears T.** Marine protected areas provide unfished reference areas to empirically assess fishery status. Biological Conservation. 2022;276:109775. doi:10.1016/j.biocon.2022.109775

38. **Fisheries NZ.** Changes to rock lobster recreational fishing rules. Accessed 7 Feb 2023, https://www.mpi.govt.nz/dmsdocument/40625/direct

39. **Fisheries NZ.** Fisheries Assessment Plenary, November 2022: stock assessments and stock status. Compiled by the Fisheries Science Team Fisheries New Zealand; 2022.

40. **Anon.** Kōura~crayfish survey 2022. Waiheke Marine Project. Accessed 14 Feb 2023, https://www.waihekemarineproject.org/koura-survey-pipi

41. **Haggitt T.** Subtidal ecological survey Noises Islands. Prepared for the Noises Marine Protection and Restoration Project Team. 2021.

42. **Haggitt TR, Shears N.** Summary Cape Rodney to Okakari Point Marine Reserve and Tawharanui Marine Reserve lobster (Jasus edwardsii) monitoring programme. eCoast and University of Auckland; 2021.

43. **MacDiarmid AB, Freeman D, Kelly S.** Rock lobster biology and ecology: contributions to understanding through the Leigh Marine Laboratory 1962–2012. New Zealand Journal of Marine and Freshwater Research. 2013;47(3):313–333. doi:10.1080/00288330.2013.810651

44. **Shears NT, Babcock RC.** Marine reserves demonstrate top-down control of community structure on temperate reefs. Oecologia. 2002;132(1):131–142. doi:10.1007/s00442-002-0920-x

45. **Dartnall L.** The extent of kina barrens over time at Hauturu-o-Toi and the Noises Islands. MSc. University of Auckland; 2022.

46. **LaScala-Gruenewald D, Grace RV, Haggitt TR, et al.** Small marine reserves do not provide a safeguard against overfishing. Conservation Science and Practice. 2021;3:e362. doi:10.1111/csp2.362

47. **Kelly S, MacDiarmid AB.** Movement patterns of mature spiny lobsters, Jasus edwardsii, from a marine reserve. New Zealand Journal of Marine and Freshwater Research. 2003;37(1):149–158. doi:10.1080/00288330.2003.9517153

48. **Kelly S, Scott D, MacDiarmid AB.** The value of a spillover fishery for spiny lobsters around a marine reserve in northern New Zealand. Coastal Management. 2002;30:153–166. doi:10.1080/089207502753504689

49. **Department of Conservation, Fisheries NZ.** Sea Change – Tai Timu Tai Pari Plan marine protected area (MPA) proposals: agency analysis and advice on selection of MPAs towards development of the Hauraki Gulf Marine Park MPA network. Department of Conservation and Fisheries NZ; 2021.

50. **High Court of New Zealand.** The Environment Law Initiative and Te Uri o Hikihiki Hapū vs Minister for Oceans and Fisheries, New Zealand and Rock Lobster Industry Council. 2022.

51. **Nash S.** Changes to sustainability measures for the Northland spiny rock lobster fishery (CRA 1). Accessed 3 Apr 2023, https://mpi.govt.nz/dmsdocument/56209/direct

52. **Anon.** Rock lobster levels in Cape Rodney-Okakari Point (Goat Island) Marine Reserve. Department of Conservation. Accessed 13 Feb 2023, https://www.doc.govt.nz/nature/habitats/marine/type-1-marine-protected-areas-marine-reserves/marine-reserve-report-cards/cape-rodney-okakari-point-goat-island-marine-reserve/rock-lobster/

53. **Anon.** Rock lobster levels in Tāwharanui marine reserve. Department of Conservation. Accessed 13 Feb 2023, https://www.doc.govt.nz/nature/habitats/marine/type-1-marine-protected-areas-marine-reserves/marine-reserve-report-cards/tawharanui-marine-reserve/rock-lobster/

54. **Fisheries NZ.** Review of sustainability measures for New Zealand scallops (SCA1 & SCA CS) for 2022/23. Fisheries Discussion Paper no 2021/30. Fisheries New Zealand; 2021.

55. **Parker D.** Fisheries (SCA CS closure) notice 2022 (MPI 1456). New Zealand Government. Accessed 3 Feb 2023, https://gazette.govt.nz/notice/id/2022-go1123

56. **Fisheries NZ.** Fisheries Assessment Plenary November 2021: stock assessments and stock status. Compiled by the Fisheries Science and Information Group. Fisheries New Zealand; 2021.

57. **Fisheries NZ.** Scallop Coromandel scallop fishery (SCACS). Fisheries New Zealand. 21 December 2022. https://fs.fish.govt.nz/Page.aspx?pk=8&tk=41&ey=2023

58. **Tuck I, Parkinson D, Dey K, Oldman J, Wadhwa S.** Information on benthic impacts in support of the Coromandel Scallop Fishery Plan. Final Research Report ZBD2005-15. Ministry of Fisheries; 2006.

59. **5Williams JR.** Abundance of scallops (Pecten novaezelandiae) in Coromandel recreational fishing areas, 2009 and 2010. New Zealand Fisheries Assessment Report 2012/24. Ministry for Primary Industries; 2012.

60. **Anon.** Undersized pāua and illegally gathered cockles seized. Radio New Zealand. Accessed 15 Feb 2023, https://www.rnz.co.nz/news/national/434233/undersized-paua-and-illegally-gathered-cockles-seized

61. **Wells SR, Wing LC, Smith AM, Smith IWG.** Historical changes in bivalve growth rates indicate ecological consequences of human occupation in estuaries. Aquatic Conservation: Marine and Freshwater Ecosystems. 2019;29:1452–1465. doi:10.1002/aqc.3039

62. **Salmond NH.** The response of estuarine bivalve Austrovenus stutchburyi to hypoxic multiple-stressor environments. MSc. University of Otago; 2020.

63. **Booth JD.** Reviewing the far-reaching ecological impacts of human-induced terrigenous sedimentation on shallow marine ecosystems in a northern New Zealand embayment. New Zealand Journal of Marine and Freshwater Research. 2020;54(4):593–613. doi:10.1080/00288330.2020.1738505

64. **Norkko J, Hewitt JE, Thrush SF.** Effects of increased sedimentation on the physiology of two estuarine soft-sediment bivalves, Austrovenus stutchburyi and Paphies australis. Journal of Experimental Marine Biology and Ecology. 2006;333:12–26. doi:10.1016/j.jembe.2005.11.015

65. **Anderson MJ, Ford RB, Feary DA, Honeywill C.** Quantitative measurements of sedimentation in an estuarine system and its relationship with intertidal soft-sediment infauna. Marine Ecology Progress Series. 2004;272:33–48. doi:10.3354/meps272033

66. **Taylor M.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases. Surveillance. 2018;45(4):18–19.

67. **Bingham P.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases. Surveillance. 2014;41(4):23–24.

68. **Tricklebank KA, Grace RV, Pilditch C.** Decadal population dynamics of an intertidal bivalve (Austrovenus stutchburyi) bed: pre- and post- a mass mortality event. New Zealand Journal of Marine and Freshwater Research. 2021;55(2):352–374. doi:10.1080/00288330.2020.1772323

69. **Ross L, Williams J.** Hauraki Gulf Forum community monitoring programme annual report 2012–2013. Hauraki Gulf Forum; 2013.

70. **Meadows H, Ford R.** Hauraki Gulf Forum community monitoring programme annual report 2014–15. Auckland Council and Waikato Regional Council; 2015.

71. **Parker D.** Fisheries (Cockle Bay shellfish closure) notice 2021 (notice no. MPI 1304). New Zealand Government. Accessed 21 Nov 2022, https://gazette.govt.nz/notice/id/2021-go1122

72. **Harrowell C.** Ban placed on shellfish gathering. Accessed 21 Nov 2022, https://www.times.co.nz/news/ban-placed-on-shellfish-gathering/

73. **Chen H.** New Zealand sea sponge populations ‘dying by the millions’ due to climate change. Accessed 15 Feb 2023, https://www.ctvnews.ca/climate-and-environment/new-zealand-sea-sponge-populations-dying-by-the-millions-due-to-climate-change-1.5961257

74. **Cole R, Babcock RG.** Mass mortality of a dominant kelp (Laminariales) at Goat Island, north-eastern New Zealand. Marine and Freshwater Research. 1996;47:907–911. doi:10.1071/MF9960907

75. **Easton LM, Lewis GD, Pearson MN.** Virus-like particles associated with dieback symptoms in the brown alga Ecklonia radiata. Diseases of Aquatic Organisms. 1997;30(3):217–222. doi:10.3354/dao030217

76. **Chang H, Richardson K, Uddstrom M, Pinkerton M.** Eye in the sky: tracking harmful algal blooms with satellite remote sensing. Water and Atmosphere. 2005;13(2):14–15.

77. **Bingham P.** Quarterly report of investigations of suspected exotic diseases. Surveillance. 2009;36(4):21–27.

78. **Barratt-Boyes M.** Pacific oysters will become a pricey delicacy. New Zealand Aquaculture. 2012;45(January/February 2012):11.

79. **Bingham P.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases. Surveillance. 2011;38(3):63–65.

80. **Bingham P.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases. Surveillance. 2016;43(1):25–27.

81. **Bingham P.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases. Surveillance. 2017;44(1):25.

82. **Robson S.** Hundreds of blue penguins die off, starved by La Niña. Radio New Zealand. 11 April. Accessed Dec 2019. https://www.rnz.co.nz/news/national/354729/hundreds-of-blue-penguins-die-off-starved-by-la-nina

83. **Taylor M.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases. Surveillance. 2018;45(3):61–62.

84. **Bell JJ, Smith RO, Micaroni V, et al.** Marine heat waves drive bleaching and necrosis of temperate sponges. Current Biology. 2023;33:158–163. doi:10.1016/j.cub.2022.11.013

85. **Williams R.** Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases: July to September 2022. Surveillance. 2022;49(4):37–39.

86. **Sparks Z.** Paralytic shellfish poisoning: Woman shares story as warning to others. Accessed 23 Feb 2023, https://www.nzherald.co.nz/bay-of-plenty-times/news/paralytic-shellfish-poisoning-woman-shares-story-as-warning-to-others/TKDFNVV7Y3T5WH7JYYZNTJ3FPY/

87. **Wear RG, Gardner JPA.** Biological effects of the toxic algal bloom of February and March 1998 on the benthos of Wellington Harbour, New Zealand. Marine Ecology Progress Series. 2001;218:63–76. doi:10.3354/meps218063

88. **MacKenzie L.** Toxic and noxious phytoplankton in Big Glory Bay, Stewart Island. Journal of Applied Phycology. 1991;3:19–34. doi:10.1007/BF00003916

89. **Rolton A, Rhodes L, Hutson KS, et al.** Effects of harmful algal blooms in fish and shellfish species: a case study of New Zealand in a changing environment. Toxins. 2022;14:341. doi:10.3390/toxins14050341

90. **NZFS.** Toxic algal blooms. New Zealand Food Safety. Accessed October 2019, https://www.mpi.govt.nz/travel-and-recreation/fishing/shellfish-biotoxin-alerts/toxic-algal-blooms/

91. **Hallegraeff G, Schweibold L, Jaffrezic E, et al.** Overview of Australian and New Zealand harmful algal species occurrences and their societal impacts in the period 1985 to 2018, including a compilation of historic records. Harmful Algae. 2021;102:101848. doi:10.1016/j.hal.2020.101848

92. **McCoubrey D-J.** PSP can paralyse shellfish consumers and the industry. Aquaculture Magazine. 2018;July–August:16.

93. **Nelson WA, Neill KF, D'Archino R.** When seaweeds go bad: an overview of outbreaks of nuisance quantities of marine macroalgae in New Zealand. New Zealand Journal of Marine and Freshwater Research. 2015;49(4):472–491.

94. **Rhodes L, Smith KF.** Review of the potential effects of climate change on marine harmful algal blooms (HABs): implication for public health Aotearoa New Zealand. Cawthron report no 3758 prepared for the New Zealand Ministry of Health. 2022.

95. **Rhodes LL, Smith KF, Muarry S, Nishimura T, Finch SC.** Ciguatera fish poisoning: the risk from an Aotearoa/New Zealand perspective. Toxins. 2020;12(1):50. doi:10.3390/toxins12010050

96. **Williams C.** Algae blood red by day, electric blue by night on Auckland's Hibiscus Coast. Stuff. Accessed 3 Apr 2023, https://www.stuff.co.nz/environment/300201411/algae-blood-red-by-day-electric-blue-by-night-on-aucklands-hibiscus-coast

97. **McCoubrey D-J.** Information on biotoxin activity within the Hauraki Gulf Marine Park. Memorandum produced for Coast and Catchment Ltd. 2022.

98. **Ministry for Primary Industries.** Public health warning: shellfish biotoxin alert–Firth of Thames. Accessed 23 Feb 2023, https://www.mpi.govt.nz/news/media-releases/public-health-warning-shellfish-biotoxin-alert-firth-of-thames/

99. **Ministry for Primary Industries.** Shellfish biotoxin alerts. 2023.

100. **Anon.** Waijeke residents advised to avoid black algae. Auckland Council. Accessed 3 Apr 2023, https://ourauckland.aucklandcouncil.govt.nz/news/2023/03/waiheke-residents-advised-to-avoid-black-algae/

101. **Chang H.** Seeing red. New Zealand Geographic. 2003;61(Jan–Feb)

102. **AQNZ.** NZ-farmed shellfish match tofu's low carbon footprint. Aquaculture New Zealand. Accessed 8 Dec 22, https://drive.google.com/file/d/1p1sR6w3C7rai5wl5fRPOBk3tG77ZeMLn/view

103. **McConnell H.** Assessment of ecological effects on marine mammals from proposed aquaculture development: Coromandel Marine Farming Zone. SLR report prepared for Pare Hauraki Kaimoana. 2020.

104. **The New Zealand Government.** Aquaculture strategy. 2019:19.

105. **AQNZ.** Aquaculture for New Zealand: a sector overview with key facts and statistics for 2022. Aquaculture New Zealand. Accessed 8 Dec 2022, https://drive.google.com/file/d/1-Emyq4ulIt1qYcpyw10ZGu2a-xeFdJGr/view

106. **Dawber C.** Lines in the water: a history of mussel farming in New Zealand. Picton; 2004.

107. **Crimp D.** Aquaculture. New Zealand Geographic. 2007;84(Mar–Apr)

108. **Orsman B.** Ports of Auckland: no more harbour reclamations. Accessed 1 Mar 2023, https://www.nzherald.co.nz/nz/ports-of-auckland-no-more-harbour-reclamations/YF5O7FOOYPV4ONDBUIC63BW35I/?c_id=1&objectid=11914802

109. **Pollard N.** Hearing report Te Whau pathway Auckland Council Community Facilities. Auckland Council; 2020.

110. **Independent Hearing Panel for Auckland Council.** Decision following the hearing of an application for resource consent under the Resource Management Act, for a shared (pedestrian and cycle) path linking the Waitematā and Manukau Harbours to be known as the *"Te Whau Pathway"* (Application BUN60337530 (CST60337531 & DIS60337533). Auckland Council; 2020.

111. **Independent Hearing Panel for Auckland Council.** Decision following the hearing of an application for resource consent under the Resource Management Act, for capital and maintenance dredging works within the Waitemata Navigation Channe (Application BUN60348750 (CST60348302 & CST60348751)). Auckland Council; 2020.

112. **Independent Hearing Panel for Auckland Council.** Decision following the hearing of an application for resource consent under the Resource Management Act, to extract sand from the seabed within a 'In-shore' area within the Pākiri embayment (Application BUN60352951). Auckland Council; 2022.

113. **Independent Hearing Panel for Auckland Council.** Decision following the hearing of an application for resource consent under the Resource Management Act, to extract sand from the seabed within a 'Mid-shore' area within the Pākiri embayment (Application 1991BUN60369079). Auckland Council; 2022.

114. **Independent Hearing Panel for Auckland Council.** Decision following the hearing of an application for resource consent under the Resource Management Act, to extract sand from the seabed within a 'Offshore-shore' area within the Pākiri embayment (Application CST60343373 and DIS60371583). Auckland Council; 2022.

115. **Expert Panel of the Environmental Protection Authority.** Record of decision of the Expert Consenting Panel under Clause 37 Schedule 6 of the FTA: Application for resource consents by Ariki Tahi Sugarloaf Wharf Limited for the upgrade of the Ariki Tahi (Sugar Loaf) Wharf, Waipapa Bay, Coromandel Harbour. Environmental Protection Authority; 2022.

116. **Expert Panel of the Environmental Protection Authority.** Record of decision of the Expert Consenting Panel under Clause 37 Schedule 6 of the FTA to consider applications for resource consents by the Thames-Coromandel District Council for activities associated with the Kōpū Marine Service Area at Quay Street and King Street Paper Road, Kōpū (Kōpū Marine Precinct). Environmental Protection Authority; 2022.

117. **Putland RL, Constantine R, Radford CA.** Exploring spatial and temporal trends in the soundscape of an ecologically significant embayment. Scientific Reports. 2017;7(1):5713. doi:10.1038/s41598-017-06347-0

118. **Solé M, Lenoir M, Fontuño JM, Durfort M, van der Schaar M, André M.** Evidence of cnidarians sensitivity to sound after exposure to low frequency noise underwater sources. Scientific Reports. 2016;6(1):37979. doi:10.1038/srep37979

119. **Duarte CM, Chapuis L, Collin SP, et al.** The soundscape of the Anthropocene ocean. Science. 2021;371(6529):eaba4658. doi:10.1126/science.aba4658

120. **Wilson L, Pine MK, Radford CA.** Small recreational boats: a ubiquitous source of sound pollution in shallow coastal habitats. Marine Pollution Bulletin. 2022;174:113295. doi:10.1016/j.marpolbul.2021.113295

121. **van Oosterom L, Montgomery JC, Jeffs AG, Radford CA.** Evidence for contact calls in fish: conspecific vocalisations and ambient soundscape influence group cohesion in a nocturnal species. Scientific Reports. 2016;6(1):19098. doi:10.1038/srep19098

122. **Putland RL, Merchant ND, Farcas A, Radford CA.** Vessel noise cuts down communication space for vocalizing fish and marine mammals. Global Change Biology. 2018;24(4):1708–1721. doi:10.1111/gcb.13996

123. **Radford CA, Ghazali S, Jeffs AG, Montgomery JC.** Vocalisations of the bigeye Pempheris adspersa: characteristics, source level and active space. Journal of Experimental Biology. 2015;218(6):940–948. doi:10.1242/jeb.115295

124. **Ports of Auckland.** Annual review 2015. Ports of Auckland; 2016. http://www.poal.co.nz/media-publications/resultsandreviews/Annual%20Review%202015.pdf

125. **Erbe C, Marley SA, Schoeman RP, Smioth JN, Trigg LE, Embling CB.** The effects of ship noise on marine mammals—a review. Frontiers in Marine Science. 2019;6:606. doi:10.3389/fmars.2019.00606

126. **Bjòrnò L, Bjòrnò I.** Underwater acoustics and its applications. A historical review. presented at: Proceedings of the 2nd EAA International Symposium on Hydroacoustics; 1999; Gdańsk-Jurata, Poland.

127. **Pine MK, Wilson L, Jeffs AG, et al.** A Gulf in lockdown: How an enforced ban on recreational vessels increased dolphin and fish communication ranges. Global Change Biology. 2021;27(19):4839–4848. doi:10.1111/gcb.15798

128. **Ministry for the Environment.** A guide for the management of closing and closed landfills in New Zealand. Ministry for the Environment; 2001.

129. **MacDonald DD, Carr RS, Calder FD, Long ER, Ingersoll CG.** Development and evaluation of sediment quality guidelines for Florida coastal waters. Ecotoxicology. 1996;5:253–278. doi:10.1007/BF00118995

130. **Kenworthy A.** Together we can clean up the Gulf. Sustainable Business Network. Accessed 13 Feb 2023, https://sustainable.org.nz/learn/news-insights/together-we-can-clean-up-the-gulf/

131. **Anon.** Cleaning up zinc run-off from roofs. New Zealand Herald. Accessed 13 Feb 2023, https://www.nzherald.co.nz/the-vision-is-clear/news/cleaning-up-zinc-run-off-from-roofs/QGJHQJFTRJJ4J6CH3SW5WVUHUI/

132. **Anon.** New invention could help clean up waterways. Christchurch City Council. Accessed 13 Feb 2023, https://newsline.ccc.govt.nz/news/story/new-invention-could-help-clean-up-waterways

133. **ANZECC.** Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No 4. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand; 2000.

134. **ARC.** Stormwater treatment devices design guideline manual. Auckland Regional Council Technical Publication TP10. Auckland Regional Council; 2003.

135. **Anon.** RMS Niagara Wikipedia. Accessed 13 Feb 2023, https://en.wikipedia.org/wiki/RMS_Niagara

136. **Simpson A.** RMS Niagara wreck dive. Accessed 13 Feb 2023, https://www.youtube.com/watch?v=Q9y2Gu-WZe0

137. **Anon.** 'Environmental time-bomb' still ticking. Gulf News. 2023;2 Feb

138. **Livestock Improvement Corporation, DairyNZ.** Dairy statistics. LIC. Accessed 26 Jan 2023, 2023. https://www.lic.co.nz/about/research-publications/dairy-statistics/

139. **Vant B.** Sources of nitrogen and phosphorus in two major catchments in the Waikato Region, 2011–20. Waikato Regional Council Technical Report 2022/05. Waikato Regional Council; 2022.

140. **Vant B.** Sources of nitrogen and phosphorus in two major catchments in the Waikato Region, 2011–20. Waikato Regional Council Technical Report 2022/05. Waikato Regional Council; 2022.

141. **Hauraki Gulf Forum.** State of our Gulf 2014: Hauraki Gulf Tikapa Moana/Te Moananui a Toi state of the environment report 2014. Prepared by Kelly, S, Sim-Smith, C, Faire, S, Pierre, J, Hikuroa, D. Hauraki Gulf Forum; 2014.

142. **Zeldis JR, Swaney DP.** Balance of catchment and offshore nutrient loading and biogeochemical response in four New Zealand coastal systems: implications for resource management. Estuaries and Coasts. 2018;41:2240–2259. doi:10.1007/s12237-018-0432-5

143. **Zeldis JR, Currie KI, Graham SL, Gall MP.** Attributing controlling factors of acidification and hypoxia in a deep, nutrient-enriched estuarine embayment. Frontiers in Marine Science. 2022;8:803439. doi:10.3389/fmars.2021.803439

144. **Vant B.** Water quality of the Hauraki Rivers and Southern Firth of Thames, 2000–09. Waikato Regional Council Technical Report 2011/06. Waikato Regional Council; 2011.

145. **Fraser I, Wilcken J, Buley K.** Rotoroa Wildlife Management and Translocation Plan 2013–2018. 2013. http://www.aucklandzoo.co.nz/media/1002159/auckland-zoo-rotoroa-management-plan.pdf

146. **Judd W.** Natural values. New Zealand Geographic. 2015;(133)

147. **Hunt J.** Wetlands of New Zealand. A bitter-sweet story. Random House New Zealand; 2007.

148. **Newnham RM, de Lange PJ, Lowe DJ.** Holocene vegetation, climate and history of a raised bog complex, northern New Zealand based on palynology, plant macrofossils and tephrochronology. The Holocene. 1995;5(3):267–282. doi:10.1177/095968369500500302

149. **Orwin J.** Kauri: witness to a nation's history. New Holland Publishers; 2004.

150. **Waitangi Tribunal.** The Hauraki Report. Vol. 3. 2006.

151. **Hatvany M.** Environmental failure, success and sustainable development: The Hauraki Plains wetlands through four generations of New Zealanders. Environment and History. 2008;14:469–495. doi:10.3197/096734008X368402

152. **Swales A, Bell RG, Ovenden R, Hart C, Horrocks M, Hermanspahn N.** Mangrove-habitat expansion in the southern Firth of Thames: sedimentation processes and coastal-hazards mitigation. Environment Waikato Technical Report 2008/13. Environment Waikato; 2008.

153. **Battley PF, Brownell B.** Population biology and foraging ecology of waders in the Firth of Thames: update 2007. ARC Technical Publication no TP347. Auckland Regional Council; 2007.

154. **Paul LJ.** A history of the Firth of Thames dredge fishery for mussels: use and abuse of a coastal resource. New Zealand Aquatic Environment and Biodiversity Report no 94. Ministry of Agriculture and Forestry; 2012.

155. **Ministry of Fisheries.** Aquaculture legislative reforms 2011. Ministry of Fisheries, Aquaculture Unit; 2011.

156. **Rawling C.** Nearly every beach in Auckland unsafe to swim at after another deluge. Accessed 1 Mar 2023, https://www.newshub.co.nz/home/new-zealand/2023/02/nearly-every-beach-in-auckland-unsafe-to-swim-at-after-another-deluge.html

157. **Auckland Council.** Get your septic system checked - compliance is coming in June 2022. Accessed 1 Mar 2023, https://ourauckland.aucklandcouncil.govt.nz/news/2022/05/get-your-septic-system-checked-compliance-is-coming-in-june-2022/

158. **World Health Organization.** Guidelines on recreational water quality: Volume 1 coastal and fresh waters World Health Organization; 2021.

159. **PMCSA.** Challenges for the marine environment. Office of the Prime Minister's Chief Science Advisor. Accessed 2 Nov 2022, https://www.pmcsa.ac.nz/topics/fish/challenges-for-the-marine-environment/

160. **Hunt S.** Summary of historic estuarine sedimentation measurements in the Waikato region and formulation of a historic baseline. Waikato Regional Council Technical Report 2019/08. Waikato Regional Council; 2019.

161. **Cummings VJ, Hailes SF, Edhouse S, Halliday J.** Mahurangi Estuary ecological monitoring programme: report on data collected from July 1994 to January 2015. Auckland Council Technical Report no TR2016/028. Auckland Council; 2016.

162. **Anon.** New Cawthron Endeavour Fund projects will tackle aquatic diseases and transform coastal environmental monitoring. Cawthron Institute. Accessed 1 May 2023, https://www.cawthron.org.nz/our-news/endeavour-fund-projects-2022/

163. **Swales A, Gibbs M, Olsen G, Ovenden R, Costley K, Stephens T.** Sources of eroded soils and their contribution to long-term sedimentation in the Firth of Thames. Waikato Regional Council Technical Report 2016/32. Waikato Regional Council and Dairy NZ; 2016.

164. **Senior A, Oldman J, Green MO, et al.** Risks to estuarine biota under proposed development in the Whitford catchment. Auckland Regional Council Technical Publication no 205. Auckland Regional Council; 2003.

165. **Swales A, Gibbs M, Ovenden R, Budd RG, Hermanspahn N.** Sedimentation in the Okura-Weiti-Karepiro system. Auckland Regional Council Technical Report 2008/026. Auckland Regional Council; 2008.

166. **Gibbs M.** Sediment source mapping in Mahurangi Harbour. Auckland Regional Council Technical Publication no 321. Auckland Regional Council; 2006.

167. **WRC.** Your catchment Coromandel zone. Waikato Regional Council. Accessed 20 December 2022, https://www.waikatoregion.govt.nz/services/regional-services/river-and-catchment-management/catchment-management-zone-map/your-catchment-coromandel-zone/

168. **Cole C.** Phase 3 of action plan to connect the dots. Accessed October 2019, http://www.mahurangi.org.nz/2018/11/24/phase-3-to-connect-the-dots/

169. **Wright M, Gepp S, Hall D.** A review of the Resource Management (National Environmental Standards for Plantation Forestry) Regulations 2017. Environmental Defence Society Inc.; 2019.

170. **Leersnyder H, Bunting K, Parsonson M, Stewart C.** Erosion and sediment control guide for land disturbing activities in the Auckland region. Auckland Council Guideline Document GD2016/005. Auckland Council; 2018.

171. **WRC.** Sediment sampling and depositon. Accessed December 2019, https://www.waikatoregion.govt.nz/environment/natural-resources/coast/coastal-monitoring/regional-estuary-monitoring-programme/methods/sediment/

172. **Hewitt J, McCartain LD.** Auckland east coast estuarine monitoring programme: report on data collected up until October 2015. Auckland Council Technical Report no TR2017/003. Auckland Council; 2017.

173. **Neilson M.** To mangrove or not to mangrove? Forest & Bird 'shocked' over Auckland Council support for Waiuku project. New Zealand Herald. 17 April 2019. Accessed 7 Feb 2023. https://www.nzherald.co.nz/nz/to-mangrove-or-not-to-mangrove-forest-bird-shocked-over-auckland-council-support-for-waiuku-project/LH5HCNPQZXF76BFLTDPYJDJ42Y/

174. **Morrison MA, Jones EG, Consalvey M, Berkenbusch K.** Linking marine fisheries species to biogenic habitats in New Zealand: a review and synthesis of knowledge. New Zealand Aquatic Environment and Biodiversity Report no 130. Ministry for Primary Industries; 2014.

175. **Morrisey D, Beard C, Morrison M, Craggs R, Lowe M.** The New Zealand mangrove: review of the current state of knowledge. Auckland Regional Council Technical Publication TP325. 2007.

176. **Bulmer RH, Schwendenmann L, Lundquist CJ.** Carbon and nitrogen stocks and below-ground allometry in temperate mangroves. Original Research. Frontiers in Marine Science. 2016;3:150. doi:10.3389/fmars.2016.00150

177. **Montgomery J, Bryan K, Horstman E, Mullarney J.** Attenuation of tides and surges by mangroves: contrasting case studies from New Zealand. Water. 2018;10(9):1119. doi:10.3390/w10091119

178. **Jones HFE, Hunt S, Kamke J, Townsend M.** Historical data provides context for recent monitoring and demonstrates 100 years of declining estuarine health. New Zealand Journal of Marine and Freshwater Research. 2022;56(3):371–388. doi:10.1080/00288330.2022.2086588

179. **Halliday J, Thrush SF, Hewitt J.** Ecological monitoring for potential effects of forestry activity on the intertidal habitats of Whangapoua Harbour: long-term review 1993–2006. NIWA client report HAM2006-113 for Ernslaw One Ltd. 2006.

180. **Jones H.** Coastal sedimentation: what we know and the information gaps. Environment Waikato Technical Report 2008/12. Environment Waikato; 2008.

181. **Swales A, Bentley SJ, Lovelock CE.** Mangrove-forest evolution in sediment-rich estuarine system: opportunists or agents of geomorphic change? Earth Surface Processes and Landforms. 2015;40(12):1672–1687. doi:DOI 10.1002/esp.3759

182. **Glover HE, Stokes DJ, Ogston AS, Bryan KR, Pilditch CA.** Decadal-scale impacts of changing mangrove extent on hydrodynamics and sediment transport in a quiescent, mesotidal estuary. Earth Surface Processes and Landforms. 2022;47:1287–1303. doi:10.1002/esp.5317

183. **Le Heron R, Lundquist CJ, Logie J, et al.** A socio-ecological appraisal of perceived risks associated with mangrove (Mānawa) management in Aotearoa New Zealand. New Zealand Journal of Marine and Freshwater Research. 2022;56(3):447–465. doi:10.1080/00288330.2022.2097270

184. **de Satgé J.** Mangrove mangement in Aotearoa New Zealand: a bird's eye review. Massey University; 2021.

185. **Horstman EM, Lundquist CJ, Bryan KR, Bulmer RH, Mullarney JC, Stokes DJ.** The dynamics of expanding mangroves in New Zealand. In: Makowski C, Finkl C, eds. Threats to mangrove forests. Springer; 2018.

186. **Bulmer RH, Lewis M, O'Donnell E, Lundquist CJ.** Assessing mangrove clearance methods to minimise adverse impacts and maximise the potential to achieve restoration objectives. New Zealand Journal of Marine and Freshwater Research. 2017;51(1):110–126. doi:10.1080/00288330.2016.1260605

187. **Parker D.** Freshwater regulations updated. Accessed 23 Mar 2023, https://www.beehive.govt.nz/release/freshwater-regulations-updated

188. **NIWA.** Annual Climate Summary 2022. National Institute of Water and Atmospheric Research. Accessed 1 March 2023, https://niwa.co.nz/climate/summaries/annual-climate-summary-2022#:~:text=2022%20was%20Aotearoa%20New%20Zealand's%20warmest%20year%20on%20record%2C%20surpassing,2021%20by%20%2B0.20%CB%9AC.

189. **Ministry for the Environment, Statistics New Zealand.** Our marine environment 2019. New Zealand's Environmental Reporting Series. Ministry for the Environment; 2019.

190. **Blunden J, Boyer T, (Eds).** State of the climate in 2021. Bulletin of the American Meteorological Society. 2022;103(8):Si–S465. doi:10.1175/2022BAMSStateoftheClimate.1

191. **World Meteorological Organization.** State of the global climate 2021. WMO-no 1290. 2022.

192. **Ministry for the Environment, Statistics NZ.** New Zealand's environment reporting series: our atmosphere and climate 2020. Ministry for the Environment and Statistics New Zealand; 2020.

193. **Ministry for the Environment.** About the Paris Agreement. Ministry for the Environment. Accessed 2 Sep 2022, https://www.mfe.govt.nz/climate-change/why-climate-change-matters/global-response/paris-agreement

194. **United Nations Environment Programme.** Emissions gap report 2021: the heat is on – a world of climate promises not yet delivered. United Nations Environment Programme; 2021.

195. **Middleton I.** Range shifts and the population dynamics of tropical, subtropical, and rare fishes in New Zealand. PhD. Massey University; 2022.

196. **Pecorino D, Barker MF, Dworjanyn SA, Bryne M, Lamare MD.** Impacts of near future sea surface pH and temperature conditions on fertilisation and embryonic development in Centrostephanus rodgersii from northern New Zealand and northern New South Wales, Australia. Marine Biology. 2014;161(1):101–110. doi:10.1007/s00227-013-2318-1

197. **Kulins S.** A pointed predicament: the long-spined sea urchin. Hauraki Gulf Forum. Accessed 19 Sep 2022, https://gulfjournal.org.nz/2022/07/a-pointed-predicament-the-long-spined-sea-urchin/

198. **Wilton H.** Widespread sponge bleaching found in Fiordland: an update from Professor James Bell (VUW). Accessed 5 Sep 2022, https://www.fmg.org.nz/news/widespread-sponge-bleaching-found-fiordland-update-professor-james-bell-vuw

199. **Thomsen MS, Mondardini L, Alestra T, et al.** Local extinction of bull kelp (Durvillaea spp.) due to a marine heatwave. Frontiers in Marine Science. 2019;6:84. doi:10.3389/fmars.2019.00084

200. **McClure T.** Major New Zealand salmon producer shuts farms as warming waters cause mass die-offs. The Guardian. 26 May 2022. Accessed 7 Sep 2022. https://www.theguardian.com/world/2022/may/26/major-new-zealand-salmon-producer-shuts-farms-as-warming-waters-cause-mass-die-offs

201. **Neuheimer A, Thresher R, Lyle J, Semmens JM.** Tolerance limit for fish growth exceeded by warming waters. Nature Climate Change. 2011;1(2):110–113. doi:10.1038/nclimate1084

202. **Chiswell S, Grant B.** New Zealand coastal sea surface temperature. NIWA client report 2018295WN prepared for the Ministry for the Environment. National Institute of Water and Atmospheric Research; 2018.

203. **Parsons DM, Sim-Smith CJ, Cryer M, et al.** Snapper (Chrysophrys auratus): a review of life history and key vulnerabilities in New Zealand. New Zealand Journal of Marine and Freshwater Research. 2014;48(2):256–283. doi:10.1080/00288330.2014.892013

204. **McMahon SJ, Parsons DM, Donelson JM, Pether SMJ, Munday PL.** Elevated temperature and CO_2 have positive effects on the growth and survival of larval Australasian snapper. Marine Environmental Research. 2020;161:105054. doi:10.1016/j.marenvres.2020.105054

205. **Cummings VJ, Lundquist CJ, Dunn MR, et al.** Assessment of potential effects of climate-related changes in coastal and offshore waters on New Zealand's seafood sector. New Zealand Aquatic Environment and Biodiversity Report no 261. Fisheries New Zealand; 2021.

206. **McMahon SJ, Parsons DM, Donelson JM, Pether SMJ, Munday PL.** Elevated CO_2 and heatwave conditions affect the aerobic and swimming performance of juvenile Australasian snapper. Marine Biology. 2020;167:6. doi:10.1007/s00227-019-3614-1

207. **Parsons D, Bian R, McKenzie JR, McMahon SJ, Pether S, Munday PL.** An uncertain future: effects of ocean acidification and elevated temperature on a New Zealand snapper (Chrysophrys auratus) population. Marine Environmental Research. 2020;161:105089. doi:10.1016/j.marenvres.2020.105089

208. **Lane H, Brosnahan CL, Poulin R.** Aquatic disease in New Zealand: synthesis and future directions. New Zealand Journal of Marine and Freshwater Research. 2022;56(1):1–42. doi:10.1080/00288330.2020.1848887

209. **Poulin R, Mouritsen K.** Climate change, parasitism and the structure of intertidal communities. Journal of Helminthology. 2006;80(2):183–191. doi:10.1079/JOH2006341

210. **Keegan LT, White RSA, Mcinnis-Ng C.** Current knowledge and potential impacts of climate change on New Zealand's biological heritage. New Zealand Journal of Ecology. 2022;46(1):1–24. doi:10.20417/nzjecol.46.10

211. **Kibria G, Nugegoda D, Rose G, Haroon AKY.** Climate change impacts on pollutants mobilization and interactive effects of climate change and pollutants on toxicity and bioaccumulation of pollutants in estuarine and marine biota and linkage to seafood security. Marine Pollution Bulletin. 2021;167:112364. doi:10.1016/j.marpolbul.2021.112364

212. **Petersen W, Willer E, Willamowski C.** Remobilization of trace elements from polluted anoxic sediments after resuspension in oxic water. Water, Air & Soil Pollution. 1997;99(1–4):515–522. doi:10.1007/BF02406891

213. **Kowalczyk ND, Reina RD, Preston TJ, Chiaradia A.** Selective foraging within estuarine plume fronts by an inshore resident seabird. Frontiers in Marine Science. 2015;2:42. doi:10.3389/fmars.2015.00042

214. **Bencheikh Z, Refes W, Brito PM, et al.** Chemical pollution impairs the health of fish species and fishery activities along the Algeria coastline, Mediterranean Sea. Environmental Monitoring and Assessment. 2022;194(7):497. doi:10.1007/s10661-022-10059-y

215. **Chang S, Zdanowicz VS, Murchelano RA.** Associations between liver lesions in winter flounder (Pleuronectes americanus) and sediment chemical contaminants from northeast United States estuaries. ICES Council Meeting Papers. International Council for the Exploration of the Sea; 1996.

216. **Eisler R.** Zinc hazards to fish, wildlife, and invertebrates: a synoptic review. Biological Report no 10 Contaminant Hazard Reviews 26. US Department of the Interior Fish and Wildlife Service; 1993.

217. **Law C, Bell J, HC B, et al.** Ocean acidification in New Zealand waters: trends and impacts. New Zealand Journal of Marine and Freshwater Research. 2018;52(2):155–195. doi:10.1080/00288330.2017.1374983

218. **Search for clues and bodies of hundreds of little blue penguins wash ashore in New Zealand.** Accessed 5 Sep 2022, https://www.theguardian.com/world/2022/jun/14/search-for-clues-as-bodies-of-hundreds-of-little-blue-penguins-wash-ashore-in-new-zealand

219. **Department of Conservation.** Little penguin/kororā deaths over summer factsheet. Department of Conservation. Accessed 6 Sep 2022, https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/penguins/little-penguin-korora/little-penguin-korora-deaths-factsheet/

220. **Breitburg D, Levin LA, Oschiles A, et al.** Declining oxygen in the global ocean and coastal waters. Science. 2018;359(6371):eaam7240. doi:10.1126/science.aam7240

221. **Law C, Zeldis JR, Bostock H, et al.** A synthesis of New Zealand ocean acidification research, with relevance to the Hauraki Gulf. Waikato Regional Council Technical Report 2020/16. Waikato Regional Council; 2020.

222. **Pinkerton MH.** Impacts of climate change on New Zealand fisheries and aquaculture. In: Phillips BF, Pérez-Ramírez M, eds. Climate Change Impacts on Fisheries and Aquaculture: A Global Analysis. John Wiley & Sons Ltd; 2018.

223. **Zabarte-Maeztu I, Matheson FE, Manley-Harris M, Davies-Colley R, Oliver M, Hawes I.** Effects of fine sediment on seagrass meadows: A case study of Zostera muelleri in Pāuatahanui Inlet, New Zealand. Journal of Marine Science and Engineering. 2020;8(9):645. doi:10.3390/jmse8090645

224. **Whitehead E, Adams N, Baird KA, et al.** Threats to seabirds of northern Aotearoa New Zealand. Northern New Zealand Seabird Charitable Trust; 2019.

225. **Dowding JE.** Sites of importance to shorebirds and seabirds in the Waikato Region. Waikato Regional Council Technical Report 2019/20. 2019.

226. **National Institute of Water and Atmospheric Research.** The National Climate Database. National Institute of Water and Atmospheric Research. Accessed 2 Sep 2022, https://cliflo.niwa.co.nz/

227. **Intergovernmental Panel on Climate Change.** IPCC WGI Interactive Atlas. Accessed 2 Sep 2022, https://interactive-atlas.ipcc.ch/

228. **Ministry for the Environment.** Coastal sea-level rise 1901–2018. Ministry for the Environment. Accessed November 2019, https://data.mfe.govt.nz/table/104055-coastal-sea-level-rise-1901-2018/metadata/

229. **Statistics NZ.** Coastal sea-level rise. Accessed 1 Mar 2022, https://www.stats.govt.nz/indicators/coastal-sea-level-rise/

230. **Anon.** NZ SeaRise. Accessed 2 Sep 2022, https://www.searise.nz/

231. **Cimate Action Tracker.** Accessed 2 Sep 2022, https://climateactiontracker.org/countries/new-zealand/

232. **Parata H.** The story of the whale and the kauri. Accessed 23 Mar 2023, https://vimeo.com/90155187

233. **Marsh S.** Hauturu – resting place of the wind. New Zealand Geographic. 2002;Jan–Feb

234. **Wall T, Jacobs M.** How iwi, DOC and a community trust buried the hatchet for the sake of Motutapu. Stuff. Accessed 1 Feb 2023. https://www.stuff.co.nz/pou-tiaki/300760682/how-iwi-doc-and-a-community-trust-buried-the-hatchet-for-the-sake-of-motutapu

235. **Russell JC, Towns DR, Clout MN.** Review of rat invasion biology: implications for island biosecurity. Department of Conservation; 2008.

236. **Department of Conservation.** Tūturuatu/Tchūriwat'/Shore plover. Department of Conservation. Accessed 1 Nov 2022, https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/shore-plover/

237. **Nelson NJ, Briskie JV, Constantine R, et al.** The winners: species that have benefited from 30 years of conservation action. Journal of the Royal Society of New Zealand. 2019;49(3):281–300. doi:10.1080/03036758.2018.1518249

238. **Parker KA.** North Island saddleback. Accessed 24 Feb 2023, https://www.nzbirdsonline.org.nz/species/north-island-saddleback

239. **Robertson HA, Baird KA, Elliott GP, et al.** Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation; 2021.

240. **Hitchmough R.** New Zealand threat classification systems lists—2002. Threatened Species Occasional Publication 23. Department of Conservation; 2002.

241. **Leuschner N.** Whitehead | Pōpokitea. Accessed 24 Feb 2023, https://nzbirdsonline.org.nz/species/whitehead

242. **Petherick M.** Komiti Taiao a-Hapori Hoki/Environment and Community Committee. Accessed December 2019, https://infocouncil.aucklandcouncil.govt.nz/Open/2019/02/ENV_20190212_AGN_6847_AT.PDF#page=37

243. **Predator Free 2050.** Tū Mai Taonga. Accessed 10 January 2023, https://pf2050.co.nz/project/tu-mai-taonga/

244. **Predator Free 2050.** Kawau Island. Accessed 10 January 2023, https://pf2050.co.nz/project/kawau-island/

245. **Anon.** The celebration towards predator-free Waiheke — 4 year anniversary. Accessed 1 May 2023, https://tekorowaiowaiheke.org/latest-news/the-celebration-towards-predator-free-waiheke-4-year-anniversary

246. **Wane J.** Dire straits: warmings from the *"canary of the sea"* on an ecosystem on the verge of collapse. New Zealand Herald. 2 Apr 2022. Accessed 7 Feb 2023. https://www.nzherald.co.nz/lifestyle/whale-tales-the-hauraki-gulf-is-in-crisis-and-brydes-whales-hold-the-key/UVFNMSBZM43TVGM4H6RG7C33OM/

247. **Tezanos-Pinto G, Hupman K, Wiseman N, et al.** Local abundance, apparent survival and site fidelity of Bryde's whales in the Hauraki Gulf (New Zealand) inferred from long-term photo-identification. Endangered Species Research. 2017;34:61–73. doi:10.3354/esr00839

248. **Izadi S, Aguilar de Soto N, Constantine R, Johnson M.** Feeding tactics of resident Bryde's whales in New Zealand. Marine Mammal Science. 2021;38:1104–1117. doi:10.1111/mms.12918

249. **Ebdon P, Riekkola L, Constantine R.** Testing the efficacy of ship strike mitigation for whales in the Hauraki Gulf, New Zealand. Ocean & Coastal Management. 2020;184:105034. doi:10.1016/j.ocecoaman.2019.105034

250. **Anon.** Bryde's whales. NOAA Fisheries. Accessed October 2019, https://www.fisheries.noaa.gov/species/brydes-whale

251. **Carroll EL, Gallego R, Sewell MA, et al.** Multi-locus DNA metabarcoding of zooplankton communities and scat reveal trophic interactions of a generalist predator. Scientific Reports. 2019;9(1):281. doi:10.1038/s41598-018-36478-x

252. **Gostischa J, Massolo A, Constantine R.** Multi-species feeding association dynamics driven by a large generalist predator. Frontiers in Marine Science. 2021;8:739894. doi:10.3389/fmars.2021.739894

253. **Zantis LJ, Bosker T, Lawler F, et al.** Assessing microplastic exposure of large marine filter-feeders. Science of the Total Environment. 2022;818:151815. doi:10.1016/j.scitotenv.2021.151815

254. **Ebdon P.** Testing the efficacy of ship strike mitigation for whales in the Hauraki Gulf, New Zealand. MSc. University of Auckland; 2017.

255. **Whitehead E.** For the love of seabirds. Radio New Zealand. Accessed 15 Feb 2023, https://www.rnz.co.nz/national/programmes/ourchangingworld/audio/2018852117/for-the-love-of-seabirds

256. **Gaskin CP, Rayner MJ.** Seabirds of the Hauraki Gulf: natural history, research and conservation. Hauraki Gulf Forum; 2013.

257. **Gaskin C.** Description of seabird life and use of the area associated with the Coromandel Marine Farming Zone. Client report prepared for Pare Hauraki by Northern New Zealand Seabird Trust. 2019.

258. **Orwin KH, Wardle DA, Towns DR, et al.** Burrowing seabird effects on invertebrate communities in soil and litter are dominated by ecosystem engineering rather than nutrient addition. Oecologia. 2016;180(1):217–230. doi:10.1007/s00442-015-3437-9

259. **Lukies KA, Gaskin CP, Whitehead EA.** Effects of sediment on birds foraging in intertidal and nearshore habitats in Aotearoa New Zealand: A literature review and recommendations for future work. Northern New Zealand Seabird Trust; 2021.

260. **Rayner MJ, Hauber ME, Imber MJ, Stamp RK, Clout MN.** Spatial heterogeneity of mesopredator release within an oceanic island system. Proceedings of the National Academy of Sciences. 2008;104(52):20862–80865. doi:10.1073/pnas.0707414105

261. **Bellingham PJ, Towns DR, Cameron EK, et al.** New Zealand island restoration: seabirds, predators, and the importance of history. New Zealand Journal of Ecology. 2010;34(1):115–136.

262. **Gaskin CE.** State of our Seabirds 2021. Northern New Zealand Seabirds Charitable Trust; 2021.

263. **Pullman G, Wilson D.** Fairy tern | tara iti. https://nzbirdsonline.org.nz/species/fairy-tern

264. **Fisheries NZ.** Protected species bycatch in New Zealand fisheries. Accessed 15 Feb 2023, https://protectedspeciescaptures.nz/PSCv6/

265. **Richard Y, Abraham ER, Berkenbusch K.** Assessment of the risk to commercial fisheries to New Zealand seabirds, 2006-07 to 2016-17. New Zealand Aquatic Environment and Biodiversity Report 237. Fisheries New Zealand; 2020.

266. **Abraham E.** Capture of protected species in New Zealand recreational marine fisheries. Dragonfly Data Science report prepared for the Department of Conservation. 2021.

267. **Weidensaul S.** Living on the Wind: Across the Hemisphere with Migratory Birds. North Point Press; 1999.

268. **Anon.** Shorebirds at Miranda. Accessed September 2019, http://www.miranda-shorebird.org.nz/shorebirds-at-miranda

269. **Anon.** Northern dotterel back form brink after protection programme. Radio New Zealand. Accessed September 2019, https://www.rnz.co.nz/news/national/387513/northern-dotterel-back-from-brink-after-protection-programme

270. **Eagles J.** The saving of the NZ dotterel. Pūkorokoro Miranda News. 2021;122:11–13.

271. **Department of Conservation.** Tūturuatu Telegraph: Turning the tide for a unique shore bird. Department of Conservation. Accessed 5 May 2023, https://blog.doc.govt.nz/2021/12/15/tuturuatu-telegraph-turning-the-tide-for-a-unique-shore-bird/

272. **Anon.** Rare shore plover chicks hatch on Motutapu Island. Department of Conservation. Accessed September 2019, https://www.doc.govt.nz/news/media-releases/2018/rare-shore-plover-chicks-hatch-on-motutapu-island/

273. **Anon.** Rare shore plover/tūturuatau release on Motutapu. Department of Conservation. Accessed September 2019, https://www.doc.govt.nz/news/media-releases/2019/rare-shore-plovertuturuatu-released-on-motutapu/

274. **Clent D.** Rare birds to be sent back to Auckland's Motutapu Island despite stoat threat. Accessed 18 Nov 2022, https://www.stuff.co.nz/environment/124424177/rare-birds-to-be-sent-back-to-aucklands-motutapu-island-despite-stoat-threat

275. **Evans K.** Killer algae. New Zealand Geographic. 2022;Sep–Oct

276. **Fletcher L, Johnston O.** Marine biosecurity risks arising from activities/stressors within the Waikato coastal marine area. Waikato Regional Council Technical Report 2020/09. Waikato Regional Council; 2020.

277. **Soliman T, Inglis G.** Forecasting the economic impacts of two biofouling invaders on aquaculture production of green-lipped mussels Perna canaliculus in New Zealand. Aquaculture Environment Interactions. 2018;10:1–12. doi:10.3354/aei00249

278. **Ministry for Primary Industries.** Import health standard: ballast water from all countries. Ministry for Primary Industries; 2016.

279. **Ministry for Primary Industries.** Craft risk management standard: biofouling on vessels arriving to New Zealand. Ministry for Primary Industries; 2014.

280. **Biosecurity NZ, NIWA.** National Marine High Risk Site Surveillance. Accessed 9 Sep 2022, https://www.marinebiosecurity.org.nz/surveillance/

281. **Auckland Council.** Hauraki Gulf Controlled Area notice. Accessed 9 Sep 2022, https://www.aucklandcouncil.govt.nz/environment/what-you-can-do-for-environment/Documents/hauraki-gulf-can-2020.pdf

282. **Anon.** The proposed Clean Hull Plan. Accessed 5 May 2023, https://www.marinepests.nz/clean-hull-plan?gclid=CjwKCAjwo7iiBhAEEiwAsIxQEas05MFbXU_b1KH_fv14d_1VVB5REcUNt5YKG_J_7ACwk-TLlgICmBoC0KEQAvD_BwE

283. **AQNZ.** Biosecurity Standards releases. Aquaculture New Zealand. Accessed 9 Sep 2021, http://www.aplusaquaculture.nz/media

284. **South P, Floerl O, Forrest BM, Thomsen MS.** A review of three decades of research on the invasive kelp Undaria pinnatifida in Australasia: an assessment of its success, impacts and status as one of the world's worst invaders. Marine Environmental Research. 2017;131:243–257. doi:10.1016/j.marenvres.2017.09.015

285. **Fletcher LM.** Background information on the Mediterranean fanworm Sabella spallanzanii to support regional response decisions. Cawthron Report no. 2479A prepared for Marlborough District Council; 2014.

286. **O'Brien AL, Ross DJ, Keough MJ.** Effects of Sabella spallanzanii physical structure on soft sediment macrofaunal assemblages. Marine and Freshwater Research. 2006;57:363–371.

287. **Atalah J, Floerl O, Pochon X, Townsend M, Tait L, Lohrer AM.** The introduced fanworm, Sabella spallanzanii, alters soft sediment macrofauna and bacterial communities. Frontiers in Ecology and Evolution. 2019;7:481.

288. **Ross DJ, Keough MJ, Longmore A, Knott N.** Impacts of two introduced suspension feeders in Port Phillip Bay, Australia. Marine Ecology Progress Series. 2007;340:41–53.

289. **Douglas EJ, Townsend M, Tait L, Greenfield L, Inglis G, Lohrer.** A. Sabella spallanzanii and seafloor biodiversity enhancement in a marine soft-sediment system. Diversity. 2020;12:228.

290. **Tait LW, Lohrer A, Townsend M, Atalah J, Floerl O, Inglis G.** Invasive ecosystem engineers threaten benthic nitrogen cycling by altering native infaunal and biofouling communities. Scientific Reports. 2020;10:1581.

291. **Marine Biosecurity Toolbox.** Accessed 9 Sep 2022, https://www.biosecurity-toolbox.org.nz/

292. **Hoddle M.** Caulerpa taxifolia or killer alga. Center of Invasive Species Research, University of California, Riverside. Accessed 10 Feb 2023, https://cisr.ucr.edu/invasive-species/caulerpa-taxifolia-or-killer-alga

293. **Global Invasive Species Database.** Caulerpa taxifolia Accessed 10 Feb 2023, http://www.iucngisd.org/gisd/species.php?sc=115

294. **NOAA Fisheries.** Caulerpa species on the west coast. National Oceanic and Atmospheric Administration, Fisheries. Accessed 10 Feb 2023, https://www.fisheries.noaa.gov/west-coast/habitat-conservation/caulerpa-species-west-coast

295. **Klein J, Verlaque M.** The Caulerpa racemosa invasion: a critical review. Marine Pollution Bulletin. 2008;56(2):205–225. doi:10.1016/j.marpolbul.2007.09.043

296. **Zuljevic A, Thibaut T, Despalatovic M, et al.** Invasive alga Caulerpa racemosa var. cylindracea makes a strong impact on the Mediterranean sponge Sarcotragus spinosulus Biological Invasions. 2011;13(10):2303–2308. doi:10.1007/s10530-011-0043-6

297. **Biosecurity New Zealand.** Exotic Caulerpa Controlled Area Notice 2023. Accessed 2 May 2023, https://www.mpi.govt.nz/dmsdocument/47557-Exotic-Caulerpa-Controlled-Area-Notice-2022

298. **Biosecurity NZ.** Exotic Caulerpa seaweed at Aotea Great Barrier Island and Ahuahu Great Mercury Island. Accessed 9 Feb 2023, https://www.mpi.govt.nz/dmsdocument/51430-Public-presentation-on-the-biosecurity-response-to-exotic-Caulerpa.

299. **Simberloff D.** We can eliminate invasions or live with them. Successful management projects. Biological Invasions. 2009;11:149–157. doi:10.1007/s10530-008-9317-z

300. **Department of Conservation.** Revitalising the Gulf: Marine protection proposals. 2022.

301. **NIWA.** Aotearoa New Zealand Climate Summary: 2022. NIWA National Climate Centre; 2023.

302. **Johnson K.** Hydrologic effects of the 2020 drought on Auckland regional waterbodies. Discussion Paper DP2021-2, Auckland Council. 2021.

303. **NIWA.** Aotearoa New Zealand Climate Summary: 2020. NIWA National Climate Centre; 2021.

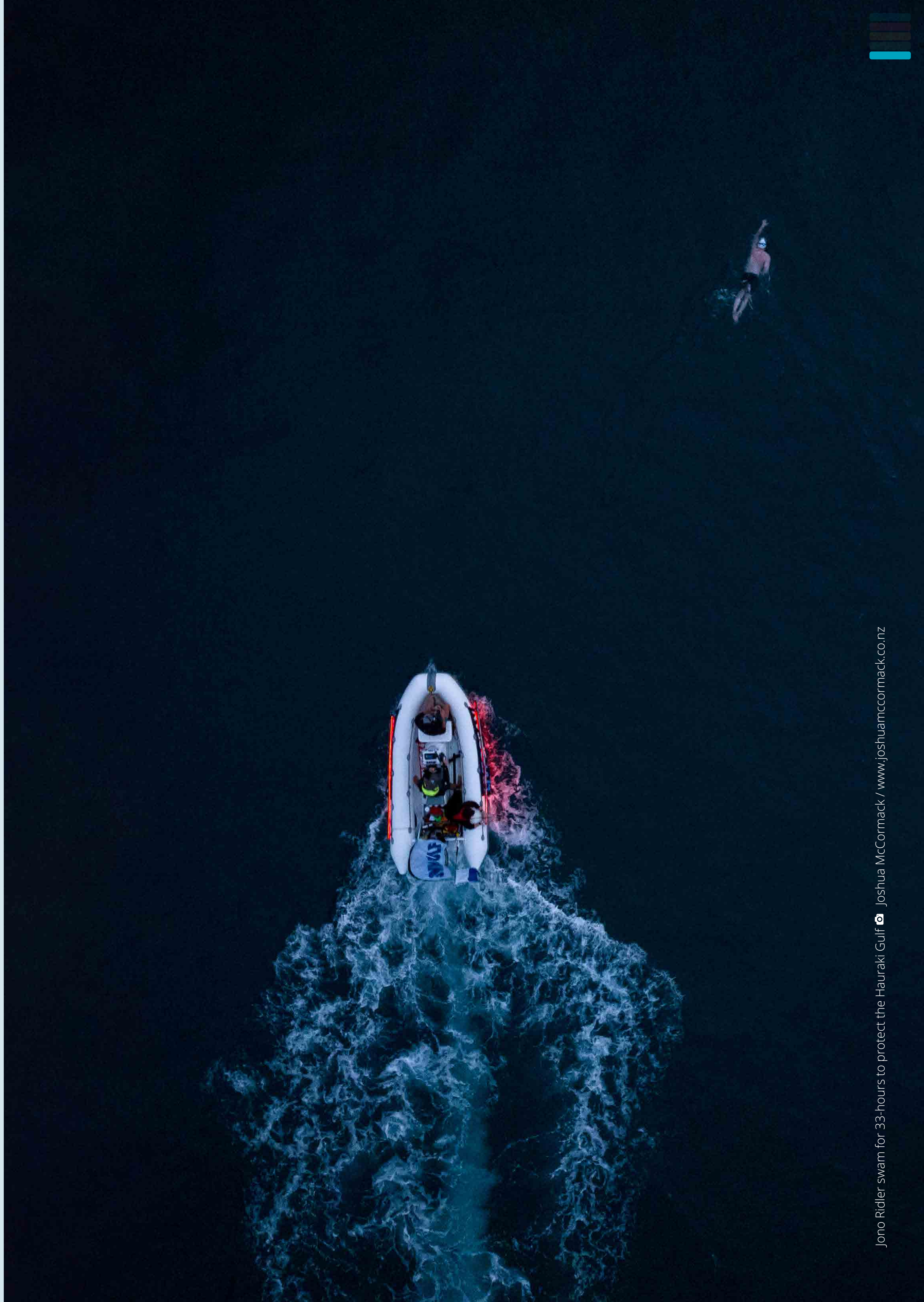
304. **NIWA.** Aotearoa New Zealand Climate Summary: 2021. NIWA National Climate Centre; 2022.

305. **Ministry for the Environment.** Aotearoa New Zealand's first national adaptation plan. Ministry for the Environment; 2022.

306. **Hauraki Gulf Forum.** Hauraki Gulf Forum's Advocacy Position (Adopted 28 February 2022). Hauraki Gulf Forum; 2022.

307. **Hauraki Gulf Forum.** Tauākī kāwanatanga: Governance statement. Accessed 6 April, 2023. https://gulfjournal.org.nz/wp-content/uploads/2020/09/governance-statement.pdf

308. **Hauraki Gulf Forum.** Hauraki Gulf Forum's Advocacy Position – Adopted 28 February 2022. Hauraki Gulf Forum; 2022.



Jono Ridler swam for 33-hours to protect the Hauraki Gulf 📷 Joshua McCormack / www.joshuamccormack.co.nz

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 / Tīkapa Moana. The Forum has representation on behalf of the Ministers of Conservation, Oceans & Fisheries and Māori Development, elected representatives from Auckland Council (including the Aotea 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.

www.haurakigulfforum.org.nz

Hauraki Gulf Forum
Tīkapa Moana
Te Moananui-ā-Toi