Ngā taonga koiora o tō tātou rohe

Our Biological Heritage

2022

Te ora o te taiao State of the Environment *Te Taitokerau*

Northland Regional Council

Te Kaunihera ā rohe o Te Taitokerau

RECOMMENDED CITATION:
Northland Regional Council (2022). Ngā taonga koiora o tō tātou rohe, Our Biological Heritage 2022. Te ora o te taiao, State of the Environment Te Taitokerau, Whangārei, New Zealand: Northland Regional Council.

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Executive summary

Our mission to create a healthy environment, strong economy and resilient communities underpins everything we do at Northland Regional Council.

Our natural environment not only provides us all with a place to live, it also helps generate income for the region and is a place for our community to relax in and explore. The people who whakapapa to Te Taitokerau also have a strong spiritual and cultural connection with the land. Without a healthy environment, the quality of all life in Northland suffers.

In this report you will find the latest information and data about our biological heritage, and analysis of current pressures which threaten it.

Te Taitokerau is a unique and special place. We are a long and narrow region at the top of the North Island, with a land area of 1.25 million hectares and a population of around 180,000. Our sub-tropical climate makes us the warmest region in the country.

There are three distinct sections within this report — terrestrial, freshwater (lakes and wetlands), and marine — which provide a window into the current state of biodiversity and biosecurity values. This is scientific knowledge and data collated and collected by Council teams over many years and is the best knowledge we have at the time of writing.

Through the data we can form conclusions about the state of each part of our environment and identify the unique features that make up many of our ecosystems. What follows is a snapshot of the current state of Northland's natural environment.

Each of the three sections also look at the differing pressures and impacts that affect them. For example, in the terrestrial section we evaluate the impact of invasive plant pests such as wilding pines, as well as the impact of Kauri dieback disease — an issue of major concern, considering Te Taitokerau's significant kauri forest area. We also look closely at what Council is doing in response to various threats – both to ecosystems on land, in our freshwater systems, and in the coastal and marine environment. Emerging issues like climate change, and the implications and opportunities this poses for biosecurity and biodiversity, are also discussed.

Northland Regional Council places great emphasis and value on the partnerships we form with community groups who, like us, seek to preserve, protect, and grow the biodiversity we currently have.

The story told within this report speaks of both good and bad outcomes for the state of Northland's natural environment. For example, pest control successes over many years have seen strong recovery in the region's brown kiwi population. However, we know the state of many of our freshwater ecosystems is not good and that sediment through erosion, as well as high levels of Escherichia coli (*E. coli*) as an indicator microbial contamination, are present in many rivers and streams, threatening the health of not just native plant and animal species, but also humans.

We hope you find this report informative and that it prompts continued interest in working collaboratively to help preserve Northland's unique natural environment. Through continued partnerships and a greater understanding and use of mātauranga Māori, we will ensure Te Taitokerau remains a region of unique beauty and ecological diversity for future generations.

Reporting on the state of our environment

The Resource Management Act 1991 (RMA) requires us to monitor and report on the state of the environment every three years across five different areas:

- Biodiversity and biosecurity (covered in this report)
- Land
- Marine (water quality and the receiving environment)
- Freshwater
- Air quality and climate.

Our last full State of the Environment report was in 2015. Instead of reporting on all five areas at the same time, our aim is to spread things out more and report on one or two areas each year.

Ngā tirohanga ao Māori

Te Ao Māori perspectives

The Māori world view (Te Ao Māori) sees people as an integral part of Te Taiao (the environment) and dependent on its resources for sustenance. Tāngata whenua are connected to te Taiao through whakapapa. Māori will thus often speak about their maunga (mountain) and awa (river) before introducing themselves. This way of thinking is illustrated by the following whakataukī (saying):

Ko au te awa, ko te awa ko au — I am the river, and the river is me

In te ao Māori, the physical aspects of te Taiao are not separate from the metaphysical. Many Māori trace their ancestry from atua in their whakapapa, and atua are regarded as ancestors with influence over particular domains of te Taio. This connection to place and to te Taiao in a spiritual way is also felt as a tuakana-teina (familial) relationship that entails a duty of care. Te Taiao is a taonga tuku iho (a treasure passing down to each generation) to care for, maintain, and improve for future generations. Kaitiakitanga (exercising a custodial or guardian role) stems from this deep-rooted sense of connection.

Māori traditionally take a holistic perspective with regard to te Taiao, rather than separating it into components such as air, land, or water. This reflects the sense of all things being interconnected.

Mātauranga Māori

Mātauranga Māori can be described as an expanding knowledge continuum containing both old and new Māori knowledge, building on a foundation of traditional wisdom and practices. It is often held by those who have occupied a place or area for many generations, and it provides a foundation of knowledge that includes important principles and values for kaitiakitanga of te Taiao.

Mātauranga Māori is regularly updated. It is often developed through research driven by Māori philosophy and executed using Māori research methodologies (Kaupapa Māori). New Mātauranga Māori can also emerge from research that is not purely Kaupapa Māori. It can be discovered through applying traditional knowledge in innovative ways, or from a Māori world view used in a new setting.

Māori ways of knowing and monitoring the environment

Māori often take a qualitative approach using human senses to observe, measure and/or monitor the environment. For example, this approach might include consideration of:

- The presence, abundance, and distribution of taonga species, or their absence (e.g. tūangi, pipi, titiko, flounder etc)
- Presence, abundance and distribution of pest plant and animal species (e.g., possums, rabbits, gorse)
- Colour and clarity of water in a stream, river, estuary, or harbour
- Presence (or absence) of birdsong
- Odour, taste, or texture of harvested kai
- Physical. The feel of water including its temperature. How a river or harbour bed feels to your feet (e.g., slimy)
- Metaphysical. The wairua of a place – how the place makes you feel.

Cultural monitoring frameworks

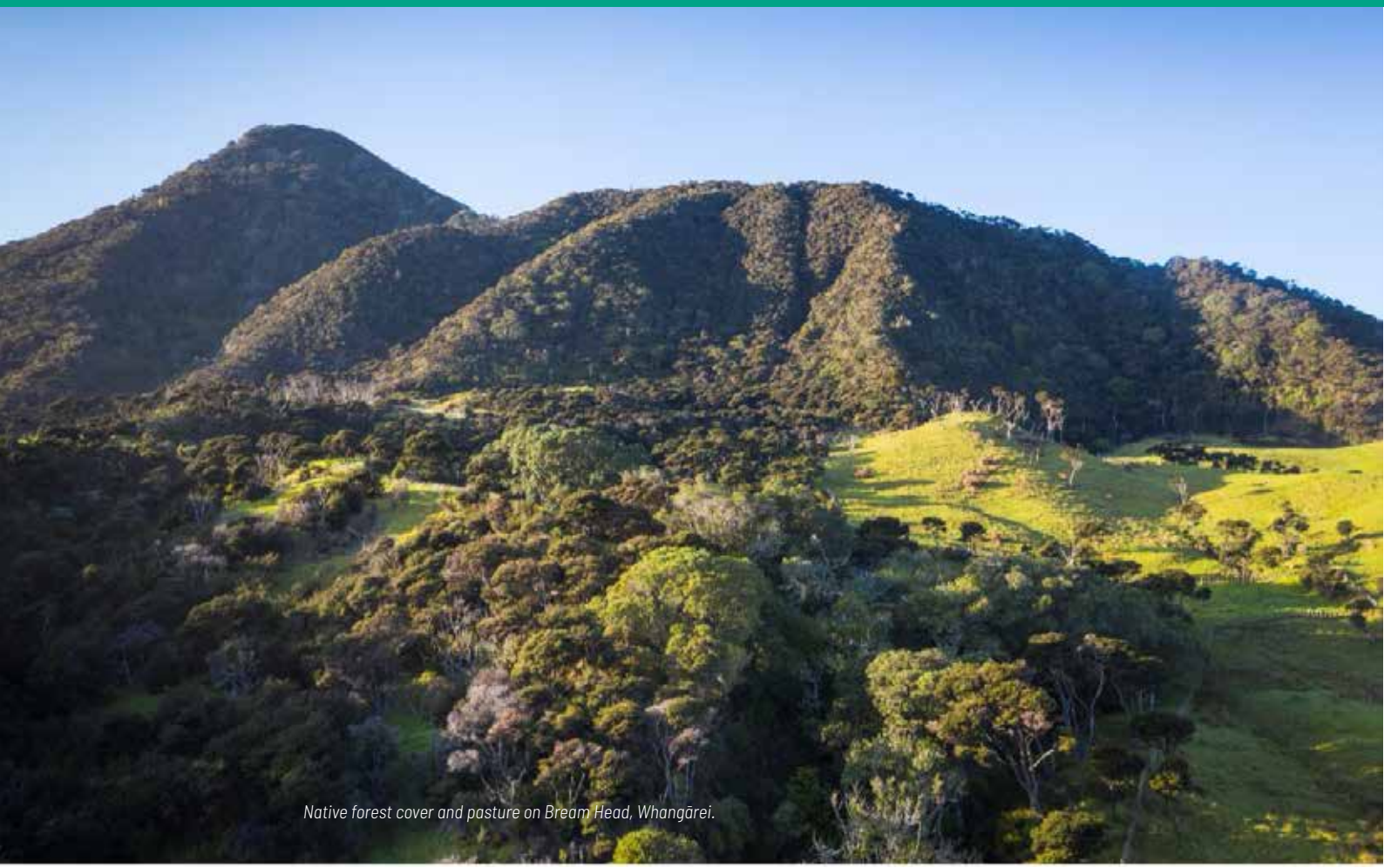
Tāngata whenua groups in Te Taitokerau Northland have been developing and refining cultural monitoring frameworks for measuring their health and wellbeing. These are based on understandings such as those expressed by Patuharakeke in their 2014 environmental management plan below:

- Traditional, economic and subsistence foods and practices, and traditional cultural activities are interrelated, as well as mutually supportive and interdependent.
- Overall health and cultural wellbeing are directly related to the ability to manage, harvest, prepare and eat traditional foods and continue traditional practices.
- Traditional knowledge and practices will, with proper technical support and resourcing, help to meet tāngata whenua economic and environmental needs and ensure wellbeing.
- Ways to measure the current state of the environment, changes and rates of change need further development and refinement. These may involve Mātauranga Māori methods as well as international science-based methods.

Partnership

Northland Regional Council partners with iwi and hapū on a range of environmental activities in the region, including wilding conifer control, community pest and predator control programmes, dune lake restoration and protection, environmental education programmes, and marine pest monitoring. This involves consultation, joint planning, technical support and information sharing, funding for development and update of iwi/hapū environmental management plans, and a new initiative to provide funding and technical support for tāngata whenua environmental monitoring.

1 Ā-whenua
Terrestrial biodiversity and biosecurity



Native forest cover and pasture on Bream Head, Whangārei.

Te tirohanga whānui
Overview

Northland's subtropical climate, strong coastal influence, diverse soils and landforms, and long geological periods of isolation from the rest of New Zealand has given rise to an array of unique and distinctive ecosystems and biodiversity.

Ongoing active management in Northland is helping to reduce the impact of introduced pests and diseases and has improved the threat classification status of some species.

E pēhea ana te ora ināianei?

What is the current state?

Our region

Northland holds a notably high proportion of the country's uncommon biodiversity and contains the fourth largest number of threatened or uncommon plant species by region (de Lange, Norton, Courtney, & Heenan, 2009).

Northland is recognised as "one of the three biological treasure chests in NZ" (Department of Conservation, 2014), as it is home to a high number of Threatened and At-Risk species compared to the rest of the country.

Northland's terrestrial land area occupies around 1.25 million hectares, with approximately 36% of this being forest and 12% being scrub/shrubland (LAWA, 2021).

Around half of Northland's important terrestrial habitat area is on public conservation land, but equally, many significant natural areas are found on private or Māori land.

Northland's unique ecosystems

In Northland, there are 31 types of New Zealand's 72 recognised unique and rare ecosystems, of which 61% are endangered or critically endangered and a further 16% are vulnerable (Table 1; Holdaway, Wiser, & Williams, 2012).

The Kai Iwi and Poutō lake systems are of significance nationally and globally with their extensive and ecologically productive ecosystems (Forester, 2020). Otou/North Cape Scientific Reserve's unique geology is home to various flora and fauna and is a focus area for scientific research.

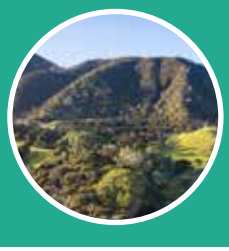
Ngāwhā Geothermal Field is now highly modified but still considered unique. The water chemistry has high boron, ammonia, bicarbonate, and mercury mineralisation which differentiates it from other geothermal fields New Zealand (Northland Regional Council, 2002).

Low fertility gumland heathlands, which once covered over 100,000 ha in Northland and formed where generations of kauri (*Agathis australis*) grew, are now listed as Critically Endangered (Holdaway, Wiser, & Williams, 2012).

Table 1: The status of naturally uncommon ecosystems in Northland (Holdaway et al., 2012).

Ecosystem category	Ecosystem	Threat status	Comments
Coastal	Active sand dunes	Endangered	Widespread, associated with dune systems
Coastal	Dune deflation hollows	Endangered	Widespread, associated with dune systems
Coastal	Stable sand dunes	Endangered	Widespread, fixed back dunes
Coastal	Coastal turfs	Critically Endangered	Uncommon in Northland
Coastal	Marine mammal influenced sites	Critically Endangered	Fur seal haul outs, uncommon
Coastal	Seabird burrowed soil	Critically Endangered	Previously common, now mostly offshore islands
Coastal	Seabird guano deposits	Critically Endangered	Small and localised
Coastal	Ultramafic sea cliffs	Endangered	Surville Cliffs, North Cape - serpentine
Coastal	Coastal cliffs on mafic rocks	Vulnerable	Mostly east coast of Northland
Coastal	Shingle beaches	Endangered	Mostly east coast of Northland
Coastal	Coastal cliffs on acidic rocks	Not threatened	Mostly east coast - rhyolites, sandstone, and mudstone
Coastal	Rock stacks	Not threatened	Widespread
Geothermal	Geothermal heated ground (dry)	Critically Endangered	Ngāwhā
Geothermal	Geothermal stream sides	Critically Endangered	Ngāwhā
Inland and Alpine	Basic cliffs, scarps and tors	Vulnerable	Especially common in Northland and Coromandel
Inland and Alpine	Calcareous cliffs, scarps and tors	Vulnerable	Occasional
Inland and Alpine	Acidic cliffs, scarps and tors	Not threatened	Occasional, hill country. Acidic rocks, relatively infertile - rhyolite, sandstones, mudstones
Inland and Alpine	Cloud forest	Not threatened	Possibly upland high points e.g., Waimā Ranges
Inland and Alpine	Ultramafic cliffs, scarps and tors	Not threatened	Includes parts of Surville Cliffs - serpentine
Subterranean	Sinkholes	Endangered	Uncommon in Northland
Subterranean	Cave entrances	Critically Endangered	Uncommon in Northland
Subterranean	Caves	Not yet assessed	Uncommon in Northland
Wetlands	Damp sand plains	Critically Endangered	Associated with active dune systems
Wetlands	Dune slacks	Endangered	Widespread and associated with active dune systems
Wetlands	Gumlands	Critically Endangered	Northland has most of the viable remaining gumlands. Often mosaics with bogs and dry heathlands
Wetlands	Ephemeral wetlands	Critically Endangered	Localised and uncommon in Northland
Wetlands	Lake margins	Vulnerable	Mostly dune lakes in Northland. Widespread but mostly west coast
Wetlands	Lagoons	Endangered	Waitahora Lagoon, Te Paki
Wetlands	Estuaries	Vulnerable	Widespread in Northland
Wetlands	Seepages and flushes	Endangered	Uncommon in Northland
Wetlands	Cold water springs and soda springs	Not yet assessed	Uncommon nationally and in Northland

1.25
million hectares of land in Northland



48%
grassland or herbaceous vegetation

38%
indigenous and exotic forest

12%
Scrub/shrubland

93
pest plant species

98,000
wilding pines controlled in 2020/21 year

33
CoastCare dune restoration sites

81,183
native plants planted at CoastCare sites

13
dune sites monitored using vegetation transects

Native vegetation landcover

Northland land cover is dominated by grassland or other herbaceous vegetation (48%), indigenous and exotic forest (36%), while scrub/shrubland occupies 12% of the region (LAWA, 2021).

The various types of indigenous landcover include broadleaf hardwoods, fern and flax lands, indigenous forest, herbaceous freshwater and saline vegetation, mangrove, and mānuka and kānuka.

Between 1996 and 2018, the area of exotic grassland decreased by 13,900 ha (or 2%), indigenous forest by 900 ha (or 1%), and indigenous scrub/shrubland by 318 ha (or 4%) (LAWA, 2021). The area of exotic forest increased by about 13,500 ha (or 8%) and urban area increased by about 1,500 ha (or 19%).

The decrease in the areas of indigenous forest and indigenous scrub/shrubland could have implications for the conservation of indigenous biodiversity.

Mairehau (Leionema nudum) an endemic shrub recorded in Tāika Forest.

Native species

Northland holds a notably high proportion of the country's uncommon species and is recognised as a biological treasure chest. The abundance of ecologically significant offshore islands and large harbours and estuaries contributes to our ecosystem. These connected ecosystems support an abundance of species including several threatened migratory seabirds and waders, such as bar-tailed godwits (Limosa lapponica baueri) and lesser knots (Calidris canutus rogersi).

The previous Northland State of the Environment (SOE) Report (2015) stated "Northland habitats supported many threatened species, including 16 birds, three freshwater fish, two bats, and one lizard (Northland Regional Council, 2015). This included two bird species in Northland which held the highest threat ranking of Nationally Critical: the grey duck (Anas superciliosa) and New Zealand fairy tern (Sternula nereis davisae).

Measurement of the health of New Zealand's indigenous plants and fauna are commonly presented by data held in the New Zealand Threat Status Classification (NZTCS) system which is updated every five years by the Department of Conservation (DOC; Department of Conservation, 2021).

The 2021 NZTCS data reveals there have been changes in the status of some of Northland's Threatened and At Risk indigenous vertebrate species since 2015 (Table 2a).

Table 2a: Classification of Northland's 'Threatened' or 'At Risk' Fauna.

Note: Data for 2017 – 2021 is based on the latest threat classification reports (see sources below 1-5) and the list in Appendix 6 of the 2014 Conservation Management Strategy.

	Birds[1]	Lizards[2]	Bats[3]	Frogs[4]	Fish[5]
Threat Status Classification 2015[6]					
Threatened (2015)	16	1	2		3
At Risk (2015)	22	10		1	10
Total (2015)	**38**	**11**	**2**	**1**	**13**
Threat Status Classification 2017 – 2021					
Threatened - Nationally Critical	3		1		
Threatened - Nationally Endangered	1				
Threatened - Nationally Vulnerable	4		1		3
Threatened - Nationally Increasing	6				
At Risk - Declining	13	7		1	7
At Risk - Recovering	5	3			
At Risk - Relict	11	5			1
At Risk - Naturally Uncommon	5	4			1
Extinct					
Total (2017 – 2021)	**48**	**19**	**2**	**1**	**12**

Source: [1] Robertson et al 2021; [2] Hitchmough et al., 2021; [3] O'Donnell et al., 2018; [4] Burns et al 2018; [5] Dunn et al., 2018; [6] Department of Conservation, 2014.

Two birds that occur in Northland, North Island brown kiwi (*Apteryx mantelli)* and pied stilt (*Himantopus himantopus*), classified previously as Threatened, were reclassified as Not Threatened. One bat and one fish species are now classed as Taxonomically Indistinct.

All 19 determinate and 6 indeterminate plant taxa in the Myrtaceae (myrtle family) in Northland, including pōhutukawa (*Metrosideros excelsa*) are listed as Threatened in de Lange et al. (2018), due to the impact of the serious fungal disease myrtle rust (*Austropuccinia psidii*). Of these myrtle species, eight are ranked Nationally Critical, including two taxonomically indeterminate mānuka (*Leptospermum aff. scoparium*), Three Kings kānuka (*Kunzea triregensis*), ramarama (*Lophomyrtus bullata*), rōhutu (*Lophomyrtus obcordata*), rātā moehau (*M. bartlettii*), a second species of rōhutu (*Neomyrtus peduncutata*) and swamp maire (maire tawake; *Syzygium maire*).

Improvement in score:

- Vertebrates: 10 birds, one fish.

Deterioration in score:

- Vertebrates: 10 birds, one fish, one bat
- Vascular plants[1] : 15[2]

Extinction:

- Vascular plant: One (Adams mistletoe (*Trilepidea adamsii*))

[1]*Vascular plants include ferns, conifers, flowering plants, and clubmosses.*
[2]*Based on the analysis of Table 3 in de Lange et al. (2018). Table 3 lists the taxa that have moved to a worse category because of the actual decline since assessment of the de Lange et al. (2013).*

Table 2b: Conservation Status of Northland's vascular plants from the (de Lange et al., 2018) list of the conservation status of all known NZ indigenous plants.

Conservation Status of Vascular Plants – 2017	NZ (National)	Northland (Region)
Extinct(EX)	7	1
Data Deficient (DD)	107	14
Threatened - Nationally Critical (NC)	213	51
Threatened - Nationally Endangered (NE)	77	14
Threatened - Nationally Vulnerable (NV)	113	42
At Risk - Declining (Dec)	158	42
At Risk - Recovering (Rec)	8	1
At Risk - Relict (Rel)	23	14
At Risk - Naturally Uncommon (NU)	662	127
Non-resident Native - Vagrant (VAG)	14	6
Non-resident Native - Coloniser (COL)	20	9
Total	**1402**	**321**

Table 2b contains the numbers of threatened plants for Northland in the different categories as of 2017 assessed for Northland using herbarium collections, species lists and the knowledge of local botanists, to ascertain whether they have been recorded in the wild. For NZ, de Lange et al. (2018) assessed 2799 vascular plant taxa considered to be indigenous of which 1402 or around half were assessed as Extinct, Data Deficient, Threatened, At Risk or Non-resident Native. For this report these 1402 species were assessed for Northland. Based on analysis of herbarium records these include 19 plants which have not been recorded in Northland the last 30 or more years. It also includes one extinct plant (*Trilepidea adamsii* or Adams mistletoe) and 14 plants suspected to be threatened for which there is insufficient current information to make an assessment (Data Deficient status). Non-resident Native status (15 plants in Northland) denotes plants which have a discontinuous, sporadic, or temporary presence in NZ or have succeeded in establishing a resident breeding population since 1950. In total for Northland 321 vascular plants were assessed as Nationally Extinct, Data Deficient (likely threatened), Threatened, At Risk or Non-resident Native (Table 2b).

North Island brown kiwi – a flagship species

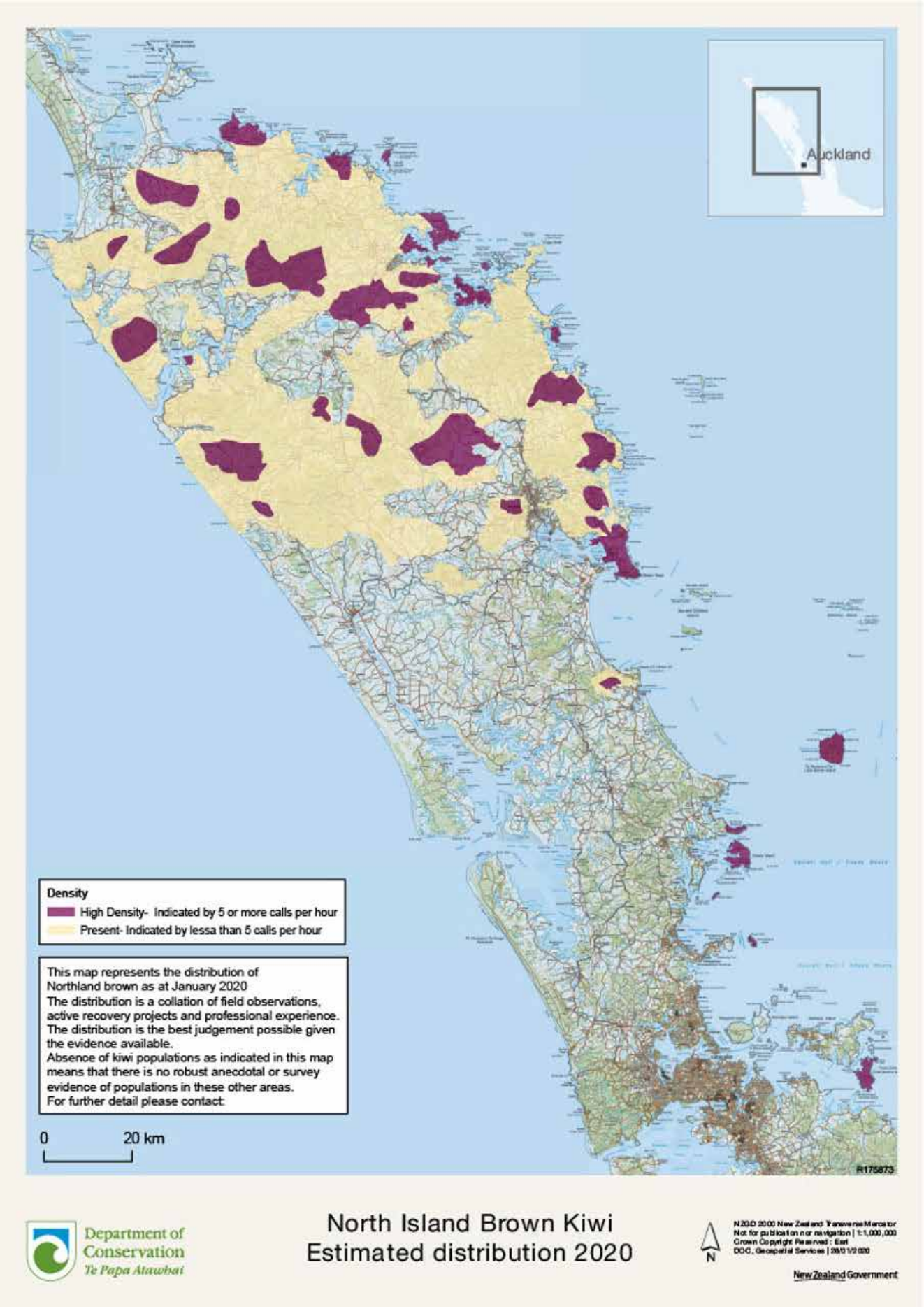
Northland is a stronghold for North Island brown kiwi. Nationally, brown kiwi numbers are estimated at >25,100 birds, of which 34% (or 8,600) are estimated to be in the Northland region as of 2018 (Germano et al., 2018).

The rapid decline in North Island brown kiwi populations over the past 100 years appears to have reversed in recent times. The national threat classification status of North Island brown kiwi was downgraded from Declining to Not Threatened in 2021, which reflects the outstanding recovery efforts that have been conducted by many stakeholders in the Northland region over the past few decades.

Adult brown kiwi can have a lifespan of 30–40 years, however, in Northland, the average lifespan is only 13–14 years, largely due to dog attacks. While the overall population of brown kiwi is increasing in Northland, numbers in unmanaged areas are thought to be decreasing with some localised extinctions (Germano et al., 2018). Stoats (*Mustela erminea*), rats (*Rattus sp.*) and feral cats (*Felis catus*) also pose a significant threat to kiwi eggs and juveniles. Without predator control, the survival rate of kiwi chicks is about 6%. However, this can be as high as 60% when predator control is undertaken (Germano et al., 2018).

Over 200 community-led conservation groups are working towards increasing kiwi numbers by undertaking predator control activities (Sullivan, 2022). For example, the Whangārei Heads community, with pest control groups represented by the Whangarei Heads Landcare Forum (WHLF) and Backyard Kiwi, have increased their kiwi population from 80 birds to over 1,100 in the past 21 years (Hamilton, 2022).

North Island brown kiwi.



North Island (Northland) brown kiwi estimated distribution 2020, (Department of Conservation, 2020).

He aha ngā pāpātanga?

What are the issues?

Northland's mild subtropical climate creates ideal environmental conditions for exotic pest plants species to establish and thrive. Introduced animals have no natural predators in New Zealand which means their populations can quickly increase. There are a number of introduced pest species in Northland, which have a significant impact on the environment, taonga, economy, health, and social well-being of Northlanders.

Pest plants and animals

Invasive plants like wilding pines (*Pinus sp.*), Manchurian wild rice (*Zizania latifolia*), climbing asparagus (*Asparagus scandens*), wild ginger (*Hedychium sp.*) and others, have become well established in many areas of Northland and are becoming more widespread and increasingly difficult to manage and control.

Introduced invasive mammalian predators like possums (*Trichosurus vulpecula*), rats, stoats, and feral cats are an ongoing threat to Northlands' native flora and fauna by predating on birds, insects, lizards, and plants. Feral pigs (*Sus scrofa*), goats (*Capra aegagrus hircus*) and deer (*Cervus* and *Dama spp.*) are impacting Northland's forest ecology by browsing palatable forest species and can act as a vector for spreading introduced pathogens such as kauri dieback disease (*Phytophthora agathidicida*).

Uncontrolled dogs are now the biggest threat to kiwi populations (and several other ground-based native species) in many areas of Northland.

Northland's biodiversity is also threatened by several pest invertebrate and lizard species which, left uncontrolled, can drive native species from existing habitats and compete directly for resources.

Myrtle rust is a serious fungal disease of plants in the myrtle family, including mānuka and pōhutukawa, spreads easily and is now found across Northland in at least 11 species. Myrtle rust is a significant threat to Northland's biodiversity.

Moth plant (Araujia hortorum) is an evergreen vine that has rapid growth up to forest canopies and can smother native vegetation below with its dense growth habit.

Kauri protection

Kauri dieback is a fungus-like organism that affects the ability of kauri trees to transport their water and nutrients. It is fatal to all kauri, from small saplings through to large, old trees. Kauri are one of the longest-living tree species in the world, living between 1000–2000 years (Biosecurity New Zealand, 2023).

The disease can take years to show symptoms, with initial signs of infection being the yellowing of leaves. Eventually branches starve and die before the whole tree dies. Trunk lesions, which look like bleeding gum from the trunk, can also occur, although not all infected trees show these (Biosecurity New Zealand, 2023).

Unfortunately, due to significant numbers of kauri trees and large tracts of kauri forest in Northland, the disease is relatively widespread throughout the region. Despite research efforts, an effective treatment or cure is yet to be found.

Kauri is a keystone species, playing an important role in the type of plants and animals that reside in kauri communities. The long-term impacts of kauri dieback on these ecosystems are unknown and more research is planned to help guide future management options.

Clockwise from top left: infected kauri tree in Waipoua Forest that succumbed to kauri dieback disease; healthy kauri tree; Stella Kake-Schmid (Biodiversity) and her dog Oi teach tamariki (children) about how the smallest of animals can transport kauri dieback.

He aha ngā mahi hei whakatika?

What is being done?

The Northland Regional Pest and Marine Pathways Management Plan 2017–2027 (RPMP) provides a strategic and statutory pathway for the eradication or management of specified pest species (or groups of pests) in the Northland region. The RPMP describes the rules and the biosecurity activities that will be undertaken throughout Northland and outlines the management actions for specific organisms and/or marine pest pathways.

The RPMP aims to:

- minimise the actual or potential adverse or unintended effects associated with these organisms and/or pathways, and,
- maximise the effectiveness of individual actions in managing pests or pathways through a regionally coordinated approach.

Northland's RPMP contains 143 pest species (Table 3), each of which is managed under the following types of programmes:

Exclusion Programme
Prevent the establishment of the subject, or an organism being spread by the subject, that is present in New Zealand but not yet established in an area.

Eradication Programme
Reduce the infestation level of the subject, or an organism being spread by the subject, to zero levels in an area in the short to medium term.

Progressive Containment Programme
Contain or reduce the geographic distribution of the subject, or an organism being spread by the subject, to an area over time.

Sustained Control Programme
Provide for ongoing control of the subject, or an organism being spread by the subject, to reduce its impacts on values and spread to other properties.

Table 3: Number of species listed under each programme of the Northland Regional Pest and Marine Pathway Management Plan 2017-2027.

	Exclusion	Eradication	Progressive Containment	Sustained Control	Banned from sale or distribution	Total
Plants	13	22	5	18	35	93
Animals	11	3		12		26
Diseases				1		1
Freshwater	3	8	3	2		16
Marine				7		7
Total	**27**	**33**	**8**	**40**	**35**	**143**

Under the RPMP, the Northland Regional Council achieves practical pest management by:

- Requiring landowners, occupiers, or other persons to adhere to pest or pathway management rules (e.g., pests controlled, pathways managed, management plans prepared, and the presence of pests reported),
- Undertaking inspections of properties and places for a variety of outcomes (e.g., to determine whether pests are present, that rules and management programmes are being complied with and monitoring effectiveness of control),
- Carrying out direct control (service delivery) of high-threat pests where council is best placed to coordinate control efforts (e.g., control of pests that occur in low incidence in the region, distribution of biological control agents, traps and herbicides, and work on a user pays basis).
- Promoting awareness and education on what good management looks like. To help occupiers and communities control pests the council provides practical advice and advocacy material around the impacts of pests and the pathways of pest spread. This includes working cooperatively with other agencies and stakeholders, contributing to research, cost sharing with others and promoting 'good practice' guidelines to control pests,
- And supporting community led pest management activities through non-regulatory approaches such as council's biosecurity partnerships.

Pest plant management

There are 93 pest plant species identified in the RPMP. Approximately 78% of key performance measures were partially or fully achieved across the 2019-2020 and 2020–2021 operational plans (where data was available).

Reasons for not achieving performance measures in some areas were staff capacity and resourcing shortages, as well as the impact of COVID-19 restrictions, which significantly impacted property inspections by staff and contractors.

Batwing passionflower *(Passiflora apetala)* – Eradication species

Batwing passionflower is an attractive climbing vine that can grow into the canopy of large trees where it strangles and smothers other plants, often killing large trees. This climber has the potential to create deep shade, restricting the ability of native seedlings to establish in a forest environment (Northland Regional Council, 2018).

Under the RPMP, batwing passionflower is an eradication species, which means the plant is present in low numbers in Northland but has the potential to establish widely in the region, causing adverse effects on environmental, economic, social, or cultural values of the region. The sale, propagation, breeding, or distribution of the plant is an offence under the Biosecurity Act 1993 and persons who see or suspect the presence of the plant are obligated to report it to NRC.

In the 2020-2021 financial year, 272 identified sites in Northland contained batwing passionflower, an increase of 39 sites from the previous year. Of the 272 sites, 42 were considered to contain mature plants (Northland Regional Council, 2021).

Batwing passionflower with its distinctive leaf patterns and shape.

From left: Seedling; batwing passionflower climbing through vegetation; size of batwing passionflower leaves – shoe for scale.

Wilding pines – Sustained control species

Wilding pines are a number of invasive tree species that are a national biosecurity issue, threatening to overwhelm our native landscapes (Biosecurity New Zealand, 2021). Left unchecked at their current rate of spread, wilding pines will invade 25% of New Zealand within the next 30 years (Northland Regional Council, 2021). The three main species of concern in Northland are *Pinus radiata, P. pinaster* and *P. contorta*.

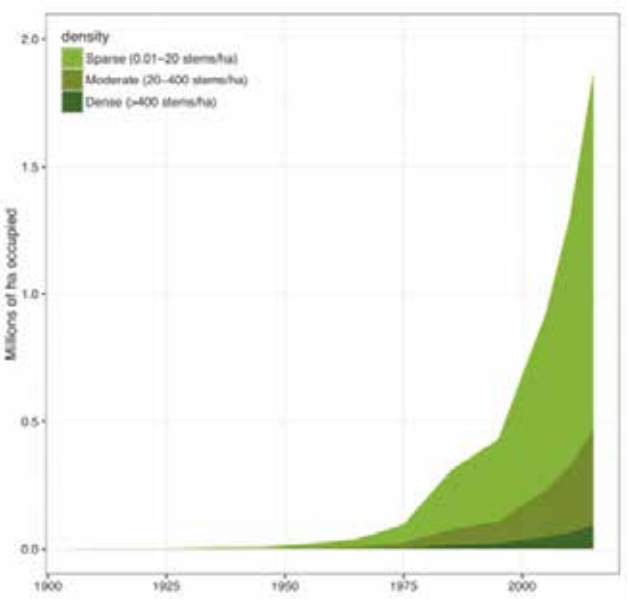
Wilding pines grow very densely, shading out other plants and out-competing native species for resources like space, nutrients, and food (Biosecurity New Zealand, 2021). Their needles also smother native species on the forest floor and discourage regeneration (Northland Regional Council, 2021). When wilding pines mature, seeds are easily distributed by wind, which leads to rapid infestation throughout vulnerable landscapes in New Zealand, including Northland.

Wilding pines on the Poutō Peninsula

Wilding pines are managed under the RPMP sustained control programme as they are widespread throughout Northland and cause adverse effects on the region's environmental, economic, or cultural values.

Ongoing support from the National Wilding Conifer Control Programme (Ministry for Primary Industries (MPI)) and COVID-19 relief funding have enabled the development of new management programmes with iwi, hapū, and communities, creating local employment and upskilling opportunities while managing the impacts wilding pines are having on Northland's native ecosystems.

In the 2020–2021 financial year, approximately 98,000 wilding pines were controlled across 4,800 ha in Northland (Northland Regional Council, 2021).



Clockwise from top left: wilding pine infestations since 1900. Source: Biosecurity New Zealand, 2021; a contractor drills and fills a wilding pine with herbicide; dense growth of wilding pines.

Below: Wilding conifer spread in Mid-Dome, Southland, first in 1998, then 2004 and 2015. Image: Environment Southland.

Pest animal management

Community pest control programmes

There are hundreds of community-led pest control initiatives (known as Community Pest Control Areas or CPCAs) underway in Northland aiming to reduce the impacts of introduced pests. These groups are varied in makeup, with private landowners, iwi and hapū, commercial pine growers, Māori land trusts, and Department of Conservation (DOC) owning areas under pest control. Many of the CPCAs focus their efforts on controlling pest mammals like possums, stoats, and rats to protect wildlife like kiwi and pāteke (brown teal; *Anas chlorotis*). Wetland and forest protection and/or enhancement are important focus areas for many community groups, with pest weeds a common problem.

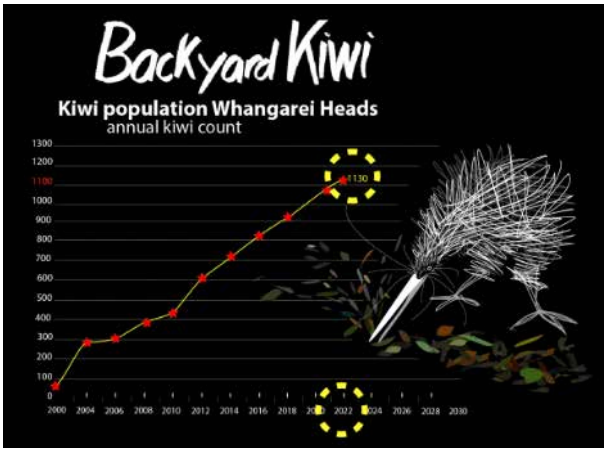
Clockwise from top left: members of the Piroa-Brynderwyn Landcare Group resetting a Steve Allan SA2 trap; community weeding at Whangārei Heads; a ferret (centre) caught as part of the Mid-North/Bay of Islands High Value Area pest control work.

Kiwi Coast

Kiwi Coast is a collaborative initiative that links over 200 community-led conservation projects, iwi and hapū, schools, forestry companies, government agencies, and organisations in Northland with the shared vision of restoring the health of our native forests, helping native wildlife thrive, and increasing Northland kiwi numbers.

In 2017, Kiwi Coast formed a charitable trust and took the next step of consolidating an already strong working relationship with NRC into a formal partnership. By working together, Kiwi Coast and the Council ensure gains made to date are not lost and momentum can continue successfully. The partnership also allows both Kiwi Coast and Council to leverage further funding and implement a strategically coordinated regional approach.

Kiwi Coast trapping data shows 591,584 animal pests were removed from Kiwi Coast areas between 2012–2021.



Clockwise from left: infographic from the Kiwi Coast Annual Report 2022 showing the number of mammalian pests removed from Kiwi Coast areas in Northland from 2012–2021; graph showing the increasing number of kiwi at Whangārei Heads (based on call counts) as a result of extensive pest control efforts and education within the community. Source: Hamilton, 2022; North Island brown kiwi.

Feral deer

In Northland there are three known species of feral deer: red deer (*Cervus elaphus scoticus*), fallow deer (*Dama dama*) and sika deer (*Cervus nippon*). Northland has relatively few populations of feral deer compared to other regions in New Zealand. All three species can potentially cause significant ecological damage to native forests by eating shrubs and seedlings. Feral deer also spread bovine tuberculosis (TB; *Mycobacterium bovis*) – a threat to Northland's agriculture sector – and kauri dieback disease.

Feral deer are an eradication species under the RPMP, and a Northland Wild Deer Response programme has been established to eradicate feral deer in Northland. The plan has two primary objectives, to:

- Eradicate low densities of wild deer in Northland through deer farmer liaison, fence inspections, surveillance, wild deer response activities and statutory management with the aim to prevent the successful establishment of wild deer populations.

- Increase community awareness of the risks and environmental consequences of feral deer establishing in Northland to gain wide community support for the vision of no feral populations of deer in Northland.

A key part of the response programme revolves around maintaining an incident response and investigation team that can respond quickly to any feral deer sighting. Since 2018, more than 24 feral deer incidents and investigations have been undertaken in Northland, with various surveillance techniques to detect and control feral deer populations used, including ground hunting, trail camera detection, thermal surveillance, and listening devices.

In 2021, contracted deer hunters collected sika scat from within and around the Russell Forest for DNA analysis. The analysis can determine the population size, sex ratio and home range within a 700 ha area of the Russell Forest, and this data can help implement eradication programmes. Without control, the sika deer herd has the potential to double in size in three years (Northland Regional Council, 2021).

Left: contractors collect sika deer scat from Russell Forest for DNA analysis; right: sika deer (source: unknown).

Predator Free 2050 (PF2050)

Predator Free Te Taitokerau/Northland

Northlanders have developed a Predator Free Te Taitokerau Pathway Plan 2021–2026, to help guide a pathway towards the eradication of possums, mustelids, and rats by 2050.

DOC has a specific role to develop and deliver the PF2050 strategy. NRC has identified and invested in PF2050 as a goal for the region, with the support of ratepayers via the current Long-Term Plan. However, both agencies acknowledge that for this movement to grow, the leadership and commitment must come from tāngata whenua, sector leads, agencies, and communities across the region (Predator Free 2050, 2021).

The plan identifies five key areas of focus to enable progression towards the long-term goal of becoming predator free in Te Taitokerau by 2050, these include:

1. Growing the PF2050 movement
2. Regional communications and engagement
3. Knowledge sharing
4. Working with tāngata whenua
5. Resourcing

The Predator Free Te Taitokerau Pathway Plan is a starting point that is enabling conversations, long term planning, and ongoing support to communities that align with the overall goal of becoming predator free by 2050.

Landscape scale predator free projects in Northland

Three large landscape-scale predator eradication projects are currently funded by Predator Free 2050 in Northland. These projects are Predator Free Kaipara, Predator Free Whangārei, and Predator Free Pēwhairangi Whānui (Bay of Islands). These projects have secured a combined initial investment from Predator Free Ltd of approximately $12 million. Each project has a core objective of completely removing at least one predator species from the project area (Predator Free 2050, 2021).

*Protecting ōi/grey-faced petrel (*Pterodroma gouldi*) habitat by trapping introduced pests on the coast.*

Predator Free Whangārei

Predator Free Whangārei aims to protect, restore, and enhance thousands of hectares of native forests, coastal habitats, and wetlands in the Whangārei area, allowing for greater protection and enhancement of threatened species of native fauna and flora. The primary objective of the project is to completely remove possums from the Whangārei Heads Peninsula (9,000 ha).

The project is coordinated by Council over five years, with a commitment to work in collaboration with DOC, Kiwi Coast, tāngata whenua, Whangārei District Council, Backyard Kiwi, QEII National Trust, Bream Head Conservation Trust, Whangārei Heads Landcare Forum, Tiakina Whangārei, Pukenui Western Hills Forest Trust, Tūtūkākā Landcare Coalition, Friends of Matakohe Limestone Island, and numerous other community groups.

Predator Free Pēwhairangi Whānui (Bay of Islands)

Predator Free Pēwhairangi Whānui (Bay of Islands) is an ambitious community-led predator control and eradication project undertaken in partnership with Bay of Islands iwi, hapū, landowners, community land care groups, organisations, and other agencies. The project works primarily across the three main peninsulas within the Bay of Islands; Purerua Peninsula (7,600 ha), Russell Peninsula (3,000 ha), and Cape Brett/Rākaumangamanga (3,000 ha) to establish a pathway to predator eradication, and suppression of predators in the wider Bay of Islands landscape (81,300 ha).

Predator Free Kaipara

Predator Free Kaipara aims to eradicate possums, rats, mustelids, and feral pigs, over an area that extends south of Whangārei to Helensville, including much of the west coast in between. It initially focuses on 105,000 ha around the peninsula and harbour areas, eventually expanding to 640,000 ha. The project is being implemented by Te Uri o Hau Settlement Trust through their environmental arm Environs Holdings Ltd and is a collaborative, multi-stakeholder partnership for the purpose of achieving a 'healthy and productive Kaipara Harbour'.

Chatting pest control in Pēwhairangi Whānui (Bay of Islands).

Pest management – kauri protection

The Tiakina Kauri programme is a national kauri protection programme coordinated by Biosecurity New Zealand within MPI. The programme's role is to:

- Lead and invest in key kauri protection activities in partnership with mana whenua and collaborating agencies including DOC and regional councils across kauri lands – primarily the upper North Island, where kauri naturally grows.

- Implement a National Pest Management Plan (NPMP) with our partners, collaborating agencies and territorial local authorities to help protect kauri from the disease caused by the pathogen *hytophthora agathidicida*.

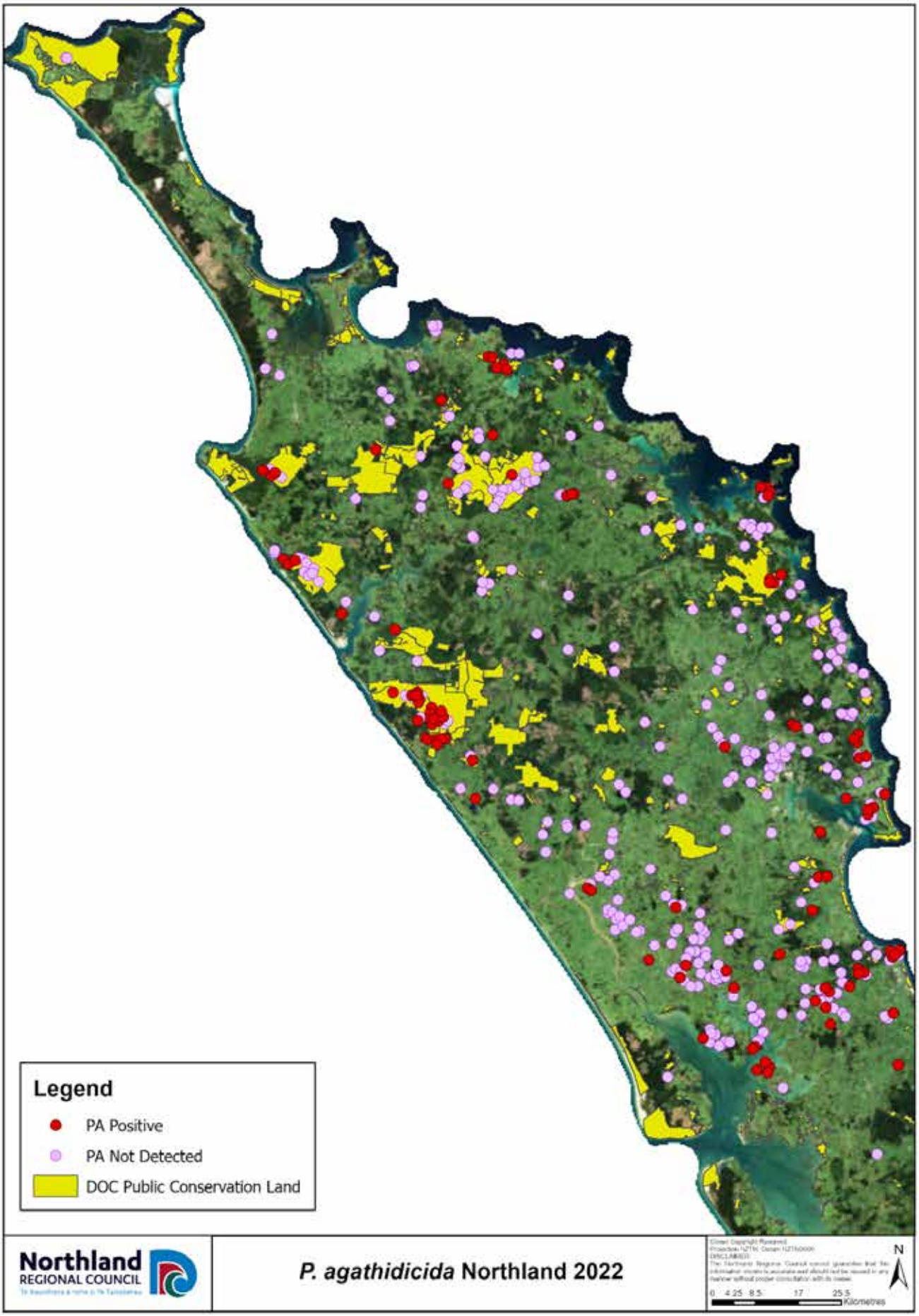
In Northland, DOC has responsibility for managing kauri protection on conservation land, which includes many of New Zealand's most significant kauri forests. Regional council also has a vital role in managing kauri protection activities in Northland. Council supports kauri protection activities through various initiatives, such as upgrading of track networks and engaging with landowners and local communities to help prevent the spread of kauri dieback. District councils in Northland also play an important role because they often administer local parks and reserves containing kauri, and they set rules governing land use activities under their district plans.

NRC, Tiakina Kauri, and programme partners undertake a range of activities to prevent the spread of kauri dieback disease to reduce impacts on biodiversity, cultural, and economic values in Northland. These include undertaking soil sampling of symptomatic stress and risk sites, developing risk management plans, providing mitigation advice to landowners, providing hygiene equipment, and engaging with the community.

Since 2018, over 331 sites have had soil samples taken to determine the presence of kauri dieback disease in Northland, and 55 out of 60 high risk properties have had management plans developed to mitigate the risk of kauri dieback spreading. Council has also provided mitigation advice plans to 144 landowners with sites that have tested negative for kauri dieback disease or deemed low risk since 2018.

In 2020, Northland received a $2 million grant from the Provincial Growth Fund to upgrade sections of the Te Araroa Trail and other public tracks on private land in Northland to protect kauri. The project aims to upgrade over 13.89km of tracks in Northland (Northland Regional Council, 2021).

Biosecurity staff walk through a kauri dieback cleaning station at AH Reed Memorial Park, Whangārei.



Location of soil samples taken to detect kauri dieback disease from 2018–2022. The red dots indicate locations where the disease was detected, while the purple dots were clear of the disease.

CoastCare

A large proportion of Northland's original dune land has been converted to forestry and pasture (Northland Regional Council, 2023). Remaining natural dunes are under threat from pests and weeds and from direct human impacts such as inappropriate vehicle use. It is crucial to protect and restore our remaining dunes wherever possible. Coastal dunes not only hold important ecological value, but they also provide a natural defence against coastal hazards such as storm surge and tsunami.

The CoastCare programme aims to protect and restore and protect the region's dunes and beaches through partnerships between community, iwi/hapū, district councils, DOC, and the Northland Regional Council. CoastCare dune restoration work has been undertaken at 33 sites around Northland's coast between 2015 and 2022, with 81,183 native plants planted. Ongoing restoration work includes planting, fencing and plant and animal pest control. Education and advocacy are an integral part of the CoastCare programme with most of the planting and other work undertaken by volunteers and a large involvement from schools.

A dune monitoring programme is run to assess and track dune health. Dune vegetation transects are set up at 13 sites around Northland, most of which are measured annually. Drone images captured at each monitoring site demonstrate changes over time and can be used to create a digital elevation model of the dune, providing information about dune shape and profile. In addition, we are starting to assess dune fauna. A pilot study is underway in the Bream Bay area, in collaboration with Patuharakeke Te Iwi Trust Board. This is aligned with the vegetation monitoring to provide a fuller understanding of dune health and the relationships between plants and fauna in the dunes and will inform advocacy and dune management work in the area.

CoastCare planting day with Pouto School at Poutō Point

Ruakākā dunes with spinifex (Spinifex sericeus) and pīngao (Ficinia spiralis), native sand-binding species, key to dune function

He rangahau whakapūaho tuatahi

CASE STUDY 1

Waipū Cove dune restoration

Waipū Cove is an exposed beach on Northland's east coast, within Bream Bay, south of Whangārei. The area is popular for campers, surfers, and beachgoers and is home to the Waipū Cove Surf Lifesaving Club and Camp Waipū Cove.

A number of methods have been trialled in the past to reduce the erosion of the reserve. These included laying rubble, telephone poles, and other materials along the dunes, and later, sand was pushed up to the erosion scarp but was ultimately washed away.

Beginning in 2008, the bank was earth-worked to form a more natural dune shape and replanted. Old structures and fill were removed, and the newly shaped dunes were planted with native sand-binding plants spinifex and pīngao. Early sections were too narrow and so were prone to erosion. In 2014, the section north of the Surf Lifesaving Club was reshaped landward from the erosion scarp – much wider than previous sections – and has proved much more resilient to storm erosion. The width of the recreation reserve was maintained by pushing it landward.

The work of the Waipū Cove Reserve Board and local community has restored a natural defence against coastal hazards while enhancing the ecological and social values of the area. The work to maintain this is ongoing. The camp maintains fencing, accessways, and signage to keep people off the dunes, and weed control is undertaken regularly. The Board is currently considering moving the fence back to allow for more landward planting to create a buffer between the mown lawn and the foredune and to give more space to allow the dune to move landward with sea level rise.

In 2017, the project was honoured with the title 'Best Coastal Restoration Project' by the New Zealand Coastal Restoration Trust. The award recognises the time and money invested into dune restoration that provides an improved shared environment for visitors and locals.

Waipū Cove, north of the Surf Lifesaving Club showing the work undertaken in 2014 and the established dune in 2016.

He aha kei tua?

What is the outlook?

The Northland landscape is changing. There is increasing pressure from pest plants, pest animals and new diseases and, whilst overall livestock numbers have decreased, farming systems have intensified causing their own associated pressures on ecosystems, especially freshwater and coastal.

Conversion of pastoral farms with intensification to horticultural purposes is a current change, for example, the expansion of avocado orchards in the Far North.

Population growth has increased pressures on biodiversity at urban fringes. Fragmentation is a significant feature of Northland habitats compared with most other regions. There are a vast number of smaller natural habitats and comparatively few major forest tracts.

Today, impacts on biodiversity are generally less about clearance and destruction of original land cover, and more about degradation.

Climate change

Northland climate change overview

A report on our climate stated Northland is likely to warm significantly to a more subtropical climate (Pearce et al., 2016). A summary of the report's findings is presented below:

- Northland is likely to warm significantly to a more subtropical climate in the future. Rainfall may decrease for some seasons with a higher risk of drought.
- Annual hot days (>25°C) in Northland may increase from 25 days now to 99 days by 2090.
- Frosts may decline from one every two years at present to one every 10 years by 2090 (all of Northland).
- Rainfall changes are small by 2040, with up to 10% less rainfall for some areas in spring.
- By 2090, more significant spring rainfall reductions and autumn/summer increases.
- Rare, large extreme rainfall events are likely to increase in intensity due to more moisture being held in a warmer atmosphere, but the future impact of ex-tropical cyclones is uncertain.
- Increase in drought risk is highest for east and west coasts and southern inland areas.
- Whangārei has experienced about 2.2mm per year of sea-level rise since the 1900s.

Marsden Cove Marina during a king tide. With sea levels rising due to climate change, water levels like this could soon be the norm.

Boat sheds along Riverside Drive, Whangārei, near the Whangārei Cruising Club during a king tide.

Climate change implications and opportunities for biosecurity/biodiversity

Predicting how Northland's indigenous species and ecosystems will respond to climate change is difficult because a number of species are at their northern or southern limits or occupy relic distributions because of land clearance or disturbance. However, climate change is predicted to have a major effect on Northland's environment in the future and must be considered during decision making.

Addressing the impacts of climate change on biodiversity and biosecurity will require a long-term effort and new ways of thinking. This may include the development of a regional climate adaptation plan with priorities identified for biodiversity and biosecurity adaptation to climate change.

Snapshot of climate change impacts of biodiversity and biosecurity

- More heat-tolerant pests may impact Northland's primary industries and natural habitats.
- The risks weeds pose will increase as a warming climate increases the area over which many of them can spread.
- *Pinus radiata* is likely to become even more vigorous in a warmer Northland due to increased carbon dioxide.
- 'Sleeper' pests currently in New Zealand may affect primary industries due to change in host-pest relationships (e.g., increase in different pasture grass species, more heat-tolerant pests favoured).
- Days of very high and extreme forest fire danger are projected to increase by 40–50% by 2100.
- Increased chance of droughts which put pressure on marginal ecosystems (e.g., Bream Head – a steep, rocky substrate, with minimal soils and minimal water supply).
- Coastal erosion will increase with sea level rise and increasing storm intensity affecting coastal infrastructure and biodiversity. Natural defences, such as dune systems, will play an increasingly more important role and consideration should be given to allow sufficient space for dunes to migrate landwards.
- Councils and managers of ecosystems will need to increase the number and area of habitat connections to sites with fresh water supply and increase funding/support of foliar browsing animal control. These restoration measures may be vital in retaining forest canopy protection of food/water resources for native species within Te Taitokerau as climate change effects intensify.

Climate change activists outside the NRC Water Street building.

National policy direction

The Government is undertaking a comprehensive review of the resource management system. This review is examining the broader and deeper changes that are needed to support the transition to a more productive, sustainable, and inclusive economy.

As the review is currently underway, it is difficult to provide clarity about how biodiversity management and the National Policy Statement for Indigenous Biodiversity (NPSIB) will fit into the future resource management system. However, it is intended that the policy intent of existing national direction will carry over to the new system, including the proposed NPSIB.

National Policy Statement Indigenous Biodiversity

The proposed National Policy Statement for Indigenous Biodiversity (NPSIB) is a draft policy set by central government to guide councils on how best to protect indigenous biodiversity, which includes ecosystems, birds, plants, insects, and other species that are native to New Zealand. The NPSIB will seek to protect, maintain, and restore indigenous biodiversity in a way that recognises tāngata whenua as kaitiaki and provides for the social, economic, and cultural wellbeing of people and communities.

The NPSIB contains objectives and policies to identify, protect, manage, and restore indigenous biodiversity, and specifies what councils must do to achieve this. These objectives will help to protect, maintain, and restore biodiversity in Northland.

NPSIB Objectives:

- Improve biodiversity outcomes.
- Partner with tāngata whenua.
- Grow existing relationships with stakeholders and councils.
- Support and incentivise biodiversity protection.
- Integrate biodiversity actions with other national direction.

A draft implementation plan has been developed that provides information on timeframes, roles and what support measures are available to support implementation of the NPSIB. The purpose of the draft is to outline expectations for implementation and provide a starting point for further discussions and work with iwi/Māori and stakeholders through the NPSIB exposure draft period and beyond (Ministry for the Environment, 2022).

2 Ā-wai māori
Freshwater biodiversity and biosecurity

Te tirohanga whānui
Overview

Northland's lakes, rivers and wetlands provide habitat for native birds, fish, invertebrates, and aquatic plants. However, not all are healthy, and many have problems caused by increased nutrient and sediment levels, stock access, invasive pests, recreational use, and land development.

Freshwater biodiversity is measured by the abundance and diversity of indigenous species and the health of their ecosystems. Introduced species can negatively affect indigenous biodiversity and make freshwater unusable. Biosecurity actions, which help prevent introduced species entering our region or control their spread and abundance, are important for the health of our freshwater ecosystems.

E pēhea ana te ora ināianei?

What is the current state?

Wetlands

Historically, more than 35% of Northland was wetland, with vast swamps and gumlands throughout most of the landscape (Clarkson & Price, 2022). However, due to historical drainage and vegetation clearance, less than 3.2% of the original extent of wetlands in Northland remain (Table 4), well below the estimated 10% remaining nationally (Ausseil et al., 2008). The remaining wetlands are mostly swamps and gumlands, predominantly found on Aupōuri Peninsula, north of Kaitāia and Poutō Peninsula, south of Dargaville (Figure 1).

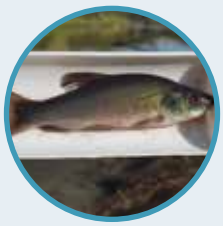
Gumlands, home to many rare plants and animals, are classed as a Critically Endangered wetland ecosystem (Holdaway et al., 2012), with almost all of New Zealand's remaining viable gumlands found in Northland. Gumlands are extremely low fertility wet heathland habitats which formed in areas where generations of kauri forest grew, followed by disturbance and fires. Once common, gumlands are on gentle hillslopes so most have been cleared and developed. Weed invasion, especially by wildling pines, is also an issue.

Table 4: Historic (c. 1840) and current area of wetlands in Northland (source Clarkson & Price, 2022).

Wetland type	Total area (ha)		Proportion remaining
	Historic	Current	%
Bog	16,253.5	881.5	5.4
Fen	8,463.6	43.4	0.5
Marsh	34,988.4	1,045.8	3.0
Pakihi & Gumland	133,622.9	2,774.4	2.1
Seepage	NA	25.8	-
Swamp	259,922.1	9,520.4	3.7
Total	**453,250.6**	**14,291.2**	**3.2**

10
known pest species of freshwater fish

6,100
tench removed from Lake Kapoai over 3 years



88%
of targets for freshwater pest management achieved

Figure 1: Predicted pre-human extent of wetlands in Northland in red (left), compared to current day (2008) extent of wetlands (right). Source: Ministry for the Environment & Forest and Bird.

Remaining wetlands are in varying states, with many under pressure from surrounding land use (see pressures and impacts section in this chapter (Chapter 2). However, wetland condition has improved for some wetlands, resulting from fencing to exclude stock and pest control by landowners, supported through the NRC's Environment Fund. These changes are captured through our wetland monitoring programme, which has continued to expand as of December 2022 to a total of 32 wetlands with 48 plots monitored.

Of 28 wetlands routinely monitored by council since 2011, most have either improved their condition or stayed stable. Wetland Condition Index (WCI) scores are based on an assessment of the degree of modification across five key wetland indicators; hydrology, soils, ecosystem intactness, and impacts from introduced animals and plants. The highest possible WCI score is 25, which is a wetland with no or very little modification, i.e., in excellent condition. The average WCI score for the 28 monitored wetlands has improved from 18 in 2011 to 20 in 2019 (Figure 2).

Other aspects of the wetland condition monitoring include an assessment of vegetation cover and composition in representative plots and an assessment of pressures that threaten the future wetland condition. The maximum possible score for vegetation condition is 20, which is a wetland with no or very little introduced plant species and a healthy native plant community in the sampled plots. The average vegetation condition score has increased slightly from 14 to 15 (Figure 2).

The highest possible pressure score is 30, which is a wetland under very high pressure and most at risk of becoming degraded. The average pressure score has also improved, dropping from 13 to 12 by 2019. Improvements in wetland condition were greatest for the wetlands that had been fenced to exclude stock, as can be seen in the Whananaki wetlands case study (Case Study #2). Wetlands can help reduce sediment and nutrient inputs into downstream waterways and coastal areas, as well as providing important habitat for threatened species, such as black mudfish (*Neochanna diversus*), Northland mudfish (*N. heleios*), Australasian bittern (*Botaurus poiciloptilus*) and, in open water, New Zealand dabchick (*Poliocephalus rufopectus*).

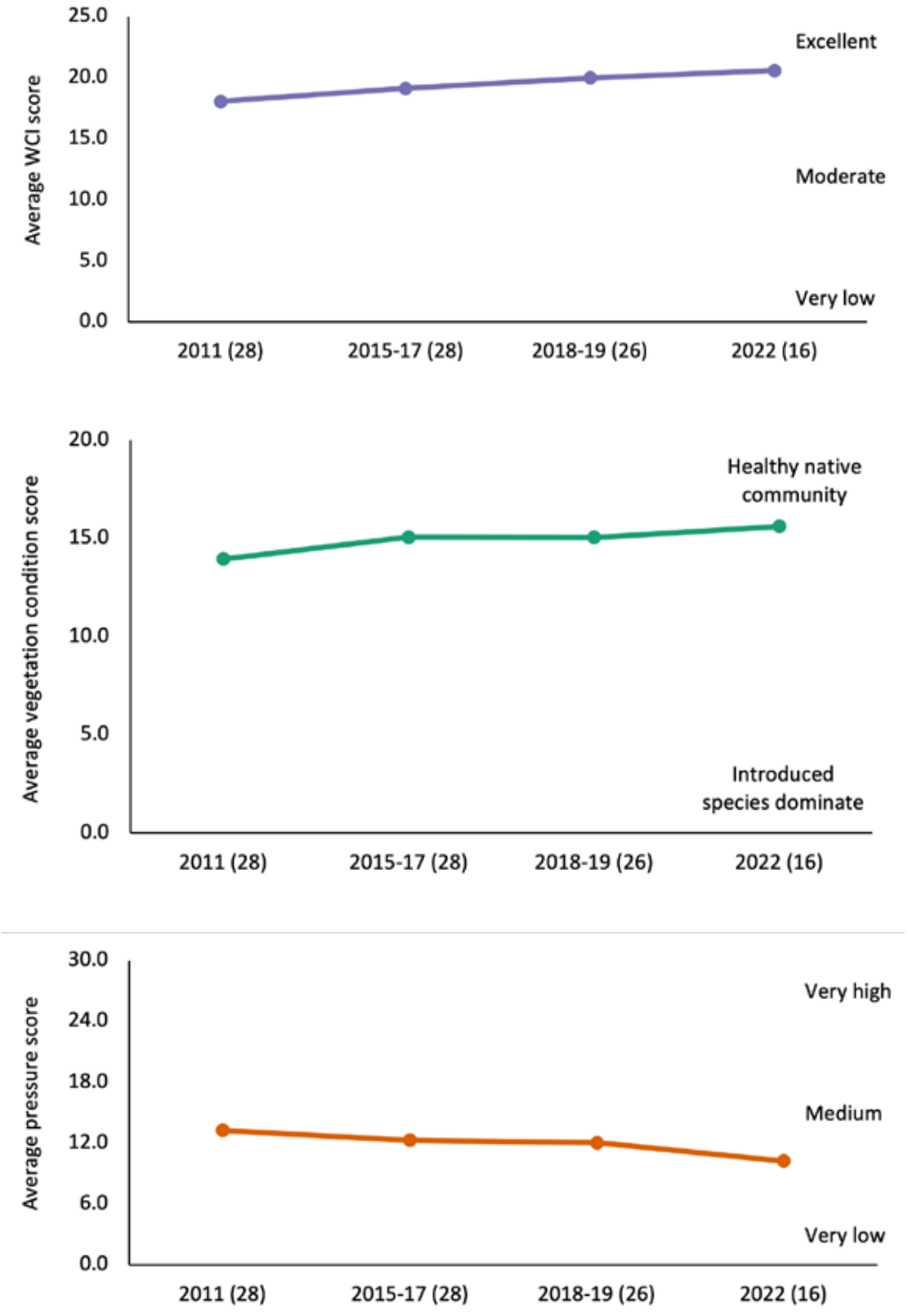


Figure 2: Average Wetland Condition Index (WCI) score (top), vegetation score (middle) and pressure score (bottom) for 28 routinely monitored wetlands in Northland. Number of wetlands assessed shown in brackets (note that only 16 wetlands had been assessed in 2022 at time of publishing).

He rangahau whakapūaho tuarua

CASE STUDY 2

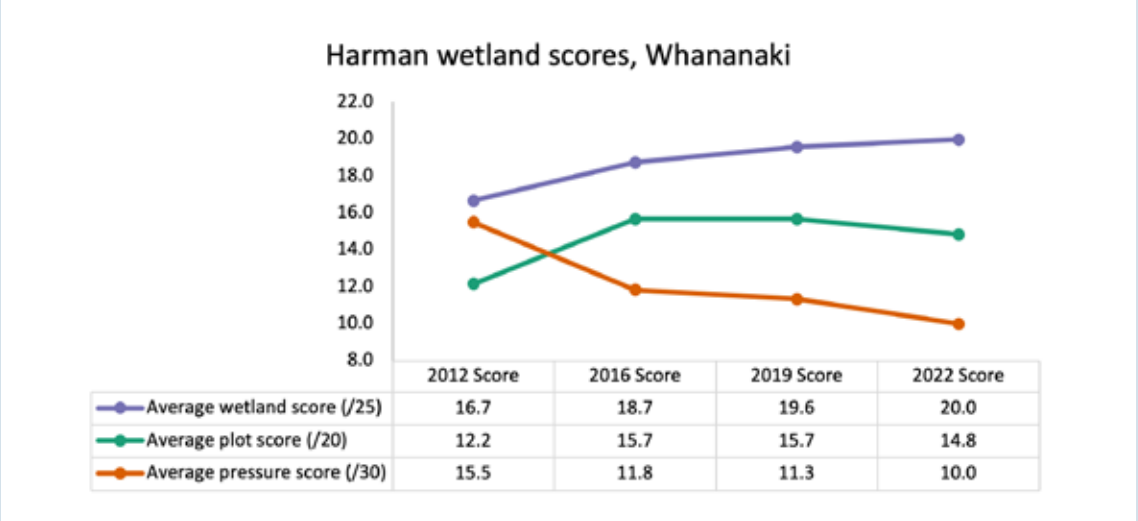
Wetland protection in action in Whananaki

Many landowners throughout Northland have taken advantage of Northland Regional Council's Environmental Fund over the years to fence off wetlands and streams to exclude stock.

Owners of a large, hilly farm in Whananaki used the Environment Fund to fence streams, wetlands, and bush on their property. Three wetlands were fenced to exclude stock between 2012 and 2014, with weed control completed before fencing. These wetlands have been routinely monitored by the Council and show a substantial improvement in all three indicators (vegetation control, pressure, and overall wetland condition) from 2012 to 2016 following fencing, then steady improvement since (Figure 3).

More recently they have been awarded Environment Funding to fence about 4km of Te Wairahi and Taupari Streams, including associated wetlands, saltmarsh, and forest habitat, which flow into the Whananaki Estuary. The landowner's goal is to fence off all streams and wetlands on their property, which will reduce sediment, nutrients, and bacteria entering the estuary. This fencing, along with weed and pest control, will do wonders for creating and connecting habitat for wetland birds, such as pāteke (brown teal) and Australasian bittern, and the whitebait that live in and migrate up the streams each year.

Figure 3: Average WCI score (purple), vegetation plot score (green) and pressure score (orange) for three Whananaki wetlands.



	2012 Score	2016 Score	2019 Score	2022 Score
Average wetland score (/25)	16.7	18.7	19.6	20.0
Average plot score (/20)	12.2	15.7	15.7	14.8
Average pressure score (/30)	15.5	11.8	11.3	10.0

Harman wetland showing changes in wetland vegetation between 2014, 2016 and 2019. The area was sprayed in 2014 to remove the major weeds present but showed improvement by 2016. In 2019, the wetland vegetation was much more established and the average wetland score had improved from 16.7 in 2014 to 19.6 in 2019.

Lakes

While some lakes are degraded because of surrounding land use and impacts of invasive species, many Northland lakes are still in good ecological condition.

The lake Submerged Plant Indicator (LakeSPI) is used to assess the ecological condition of Northland lakes, which is based on the submerged aquatic vegetation structure and composition, including native and exotic vegetation (NIWA, 2023).

Of the 53 Northland lakes assessed, 58% have LakeSPI index scores that indicate that they are in high or excellent ecological condition (Figure 4). This is an improvement from 2012, when 52% of Northland's 46 assessed lakes were classed as high or excellent. Northland has a greater proportion of lakes in high to excellent condition, compared to elsewhere in New Zealand (38% of the 307 lakes assessed nationally). Dune lakes are rare internationally and Northland dune lakes represent a large proportion of lowland New Zealand lakes with relatively good water quality and limited pest impacts.

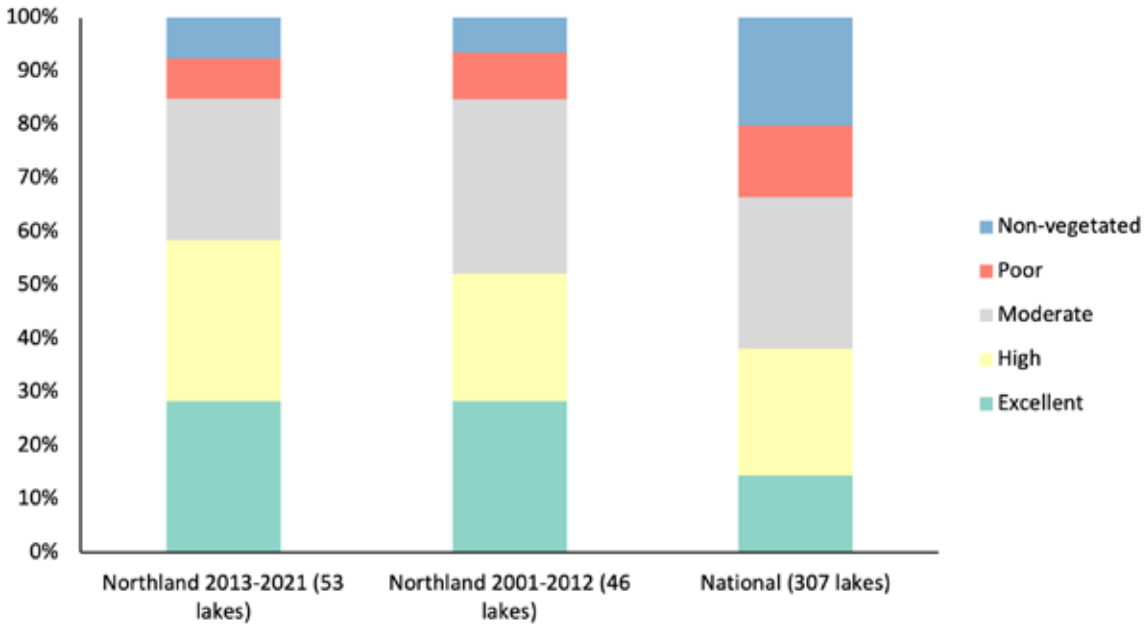


Figure 4: Most recent LakeSPI status for lakes surveyed in Northland and New Zealand. Source: NIWA 2022.

Of the 31 lakes surveyed since 2012, LakeSPI status has improved for 12 lakes and declined for 10 lakes (see Table 4-2 in Champion, 2021). The likely reasons for decline vary by lake, and include nutrient enrichment from surrounding pastoral farming, increased impacts of invasive aquatic plants (e.g., *Egeria densa* and *Utricularia gibba*), impacts from forestry harvesting, and nutrient inflows from unknown sources.

An index of lake ecological value has been developed, known as the Lake Ecological Value Score (EVS). The following is used to calculate EVS: habitat size (area and depth), buffering (native, wetland, and emergent vegetation cover), water quality, aquatic vegetation diversity (species richness), submerged vegetation integrity (Native Condition Index of LakeSPI), presence of species including threatened species and the ecologically important torewai/kākahi (freshwater mussel; E*chyridella menziesii*), and connectivity (proximity to other water bodies) (Champion, 2021).

As of January 2021, the EVS for 110 Northland lakes has been assessed (Champion, 2021). Of these 110 lakes, 14 (12.7%) have Outstanding ecological value, with a further 25 (10%) lakes in the High or High to Moderate (12.7%) EVS categories (Figure 5).

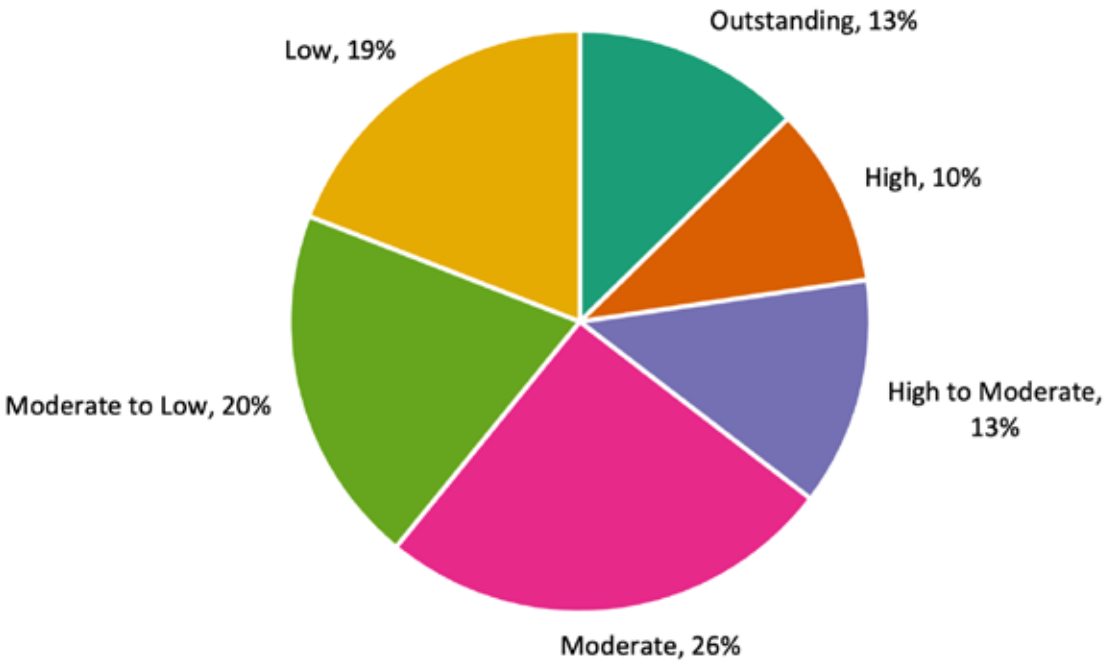


Figure 5: Ecological Value Score (EVS) for 110 Northland lakes as of January 2021 (Champion 2021).

The EVS has been assessed twice for 68 lakes; prior to 2012 and post 2012. Of these 68 lakes, the EVS have not changed for 30 lakes, have improved for 25, and deteriorated for 13 lakes. The majority of the 25 lakes with improving ecological value are in the three highest categories (Outstanding, High, or High to Moderate), while the 13 lakes with deteriorating ecological value, are more in the lowest categories (Moderate, Moderate to Low, or Low). The ecological value of several lakes has declined following forestry harvesting in the catchment, including for Lakes Waingata (Waipoua), Te Kahika and Morehurehu (Far North). Most others have deteriorated due to the increased impact of an invasive plant or pest fish species.

Some lakes with degraded water quality still have the High ecological condition. For example, Lake Waiporohita has excellent LakeSPI native condition, whereas it is a eutrophic lake (Lake TLI). Other examples are Lakes Karaka, Mokeno, and Rototuna, all of which have good LakeSPI score but eutrophic water quality. The reason behind degraded water quality (i.e., high TLI score) could be high nutrient loads (mainly internal) with moderate to low water clarity.

Pāteke (*Anas chlorotis*)

Pāteke (brown teal), New Zealand's rarest native duck, was once widespread throughout the country's freshwater systems before humans arrived. They are now primarily found in Northland, Coromandel, and some offshore islands (Williams, 2022). With the human-induced loss of much of Northland's wetlands, pāteke have been observed using agricultural environments like stock ponds for breeding and feeding (Hicks, Campbell, & Atkinson, 2001).

Male pāteke (left) at AH Reed Park, Whangārei, and female pāteke with chicks (right).

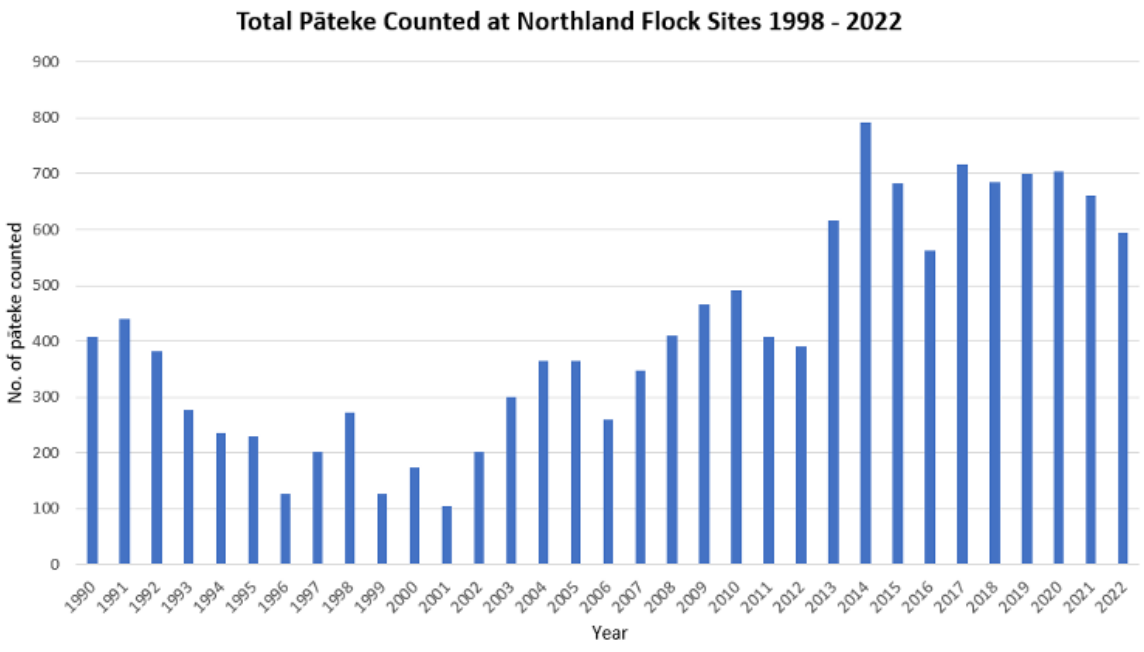


Figure 6: Total pāteke counted at Northland flock sites 1990–2022. Source: Sullivan 2022 (DOC 2022).

He aha ngā pāpātanga?

What are the issues?

Climate change

With about half of Northland in pastoral farming land use (47%) or horticulture (1%) and another 14% in exotic forestry, there are widespread pressures on freshwater ecosystems, ranging from nutrient enrichment and increased sediment loads from point source discharges and diffuse surface run-off to stock access to lakes, rivers and wetlands, and illegal wetland drainage.

While livestock numbers have decreased in recent times, farming systems have intensified with associated pressures on ecosystems, especially freshwater. Another recent change is conversion of pastoral farms into typically more intensive horticultural land uses. There are also pressures on freshwater ecosystems associated with urban growth and development, with a 1,542 ha (19%) increase in urban areas in Northland between 1996 and 2018.

Pest plants and animals

Freshwater ecosystems face many pressures from surrounding land use, which can make them even more vulnerable to invasion by animal and plant pests and therefore result in habitat loss. Aquatic pests can be hard to detect, more so than pests on land, and can easily spread throughout connected waterways. Controlling freshwater pests once they are established is challenging and there are limited management tools currently available. Many freshwater pests are easily spread by the activities of people.

What are the main aquatic pest plants?

Freshwater weeds are usually fast growing, robust, and able to tolerate a range of environmental conditions and habitats. Most can form dense mats that choke waterways and degrade freshwater ecosystems. These mats can smother native plants, obstruct drains (leading to flooding), and impact recreational activities and cultural values. In Northland's shallow dune lakes, oxygen weeds like hornwort (*Ceratophyllum demersum*) can grow rapidly to fill up the entire waterbody. During hot summers, dense weed beds may rot causing deoxygenation which releases nutrients from the sediment and drives algal blooms which may be cyanobacterial and sometimes toxic. This can lead to a collapse where the lake can no longer support submerged plant beds. Many freshwater weeds grow from small pieces of stem and are easily transported to new places by people, equipment like diggers, boats and trailers and fishing equipment – especially eeling nets.

Diggers are a vector of spread for aquatic pests if they are not thoroughly cleaned before transferring between waterways.

Clockwise from top left: the four worst aquatic weeds: hornwort, egeria, elodea and *lagarosiphon; a handful of hornwort from Lake Egg, Poutō – note the surface-reaching hornwort in the background; a NIWA diver hauls a load of hornwort from Lake Karaka during a survey; surface-reaching hornwort in Lake Tutaki, Poutō; NIWA diver surveys hornwort in Lake Roto-otuauru/Swan, Poutō, in 2009 prior to grass carp (Ctenopharyngodon idella) introduction for its control – note the density at which this weed grows.*

The 10 main aquatic pest plant species of concern in Northland are listed in Table 5 below. Many of these are already widespread throughout the region, however, some are nearing eradicated status (e.g., nardoo (*Marsilea mutica*).

As of January 2021, at least one of the four worst submerged pest plants occur in 16 of the 110 Northland lakes surveyed (Champion, 2021).

Table 5: Main aquatic pest plants in Northland.

	Species	Image	Distribution in Northland	Impacts
Four worst aquatic weeds	**Hornwort** *(Ceratophyllum demersum)*		Found in many river systems and lakes in Northland	Displaces all submerged vegetation, including other weed species. Grows deeper than other species and does not attach to bottom. Can cause lake collapse.
	Oxygen weeds *(Egeria densa, Lagarosiphon major, Elodea canadensis)*	 *Egeria densa*  *Lagarosiphon major*  *Elodea canadensis*	Found in many river systems and lakes in Northland	Can grow over the entire shallow water body, eventually collapsing and switching the lake from a macrophyte-dominated to an algal-dominated lake.
	Bladderwort *(Utricularia gibba)*		Widespread throughout region. Prefers shallower (rarely grows deeper than 3m), less exposed water bodies, e.g., dune lakes.	Free-floating, forming thick submerged mats, that smother other plants.

Species	Image	Distribution in Northland	Impacts
Nardoo *(Marsilea mutica)*		No known active sites, 1 monitored site.	Can form dense floating beds of vegetation that can block dams and waterways, impede drainage and effect recreational activities.
Salvinia *(Salvinia molesta)*		7 treatment sites, 11 monitored sites. Managed by MPI.	Can form large dense floating mats, which will quickly kill off native plants, block dams and waterways, impede drainage and disrupt recreational activities.
Senegal tea *(Gymnocoronis spilanthoides)*		One active site known.	Grows rapidly, so can cover water bodies with a floating mat quickly, displacing native plants.
Gypsywort *(Lycopus europaeus)*		One active site known	Invades wetlands, margins of lakes and rivers and blocks drains. Floating seeds
Water hyacinth *(Eichornia crassipes)*		3 treatment sites, 18 monitored sites. Managed by MPI. Prefers still or slow-moving freshwater, such as ponds, swamps, and dams.	Forms dense mats, completely smothering waterways and reducing water quality.

What are the main animal pests?

The negative impact of invasive freshwater fish on Northland lakes and waterways can have environmental, economic, and social implications. For example, some pest fish species can degrade water quality by stirring up sediment, increasing the chance of algal blooms, and increasing nutrient levels. In addition, pest fish can compete with native species for food sources and eat native fish and their eggs. Pest fish are usually introduced by people, are difficult to eradicate and usually have long term and serious effects on water quality. Catchment actions to improve water quality such as fencing or planting will often be ineffectual if a waterbody is infested with pest fish.

There are ten known exotic fish species in the Northland region, with gambusia (*Gambusia affinis*) and goldfish (*Carassius auratus*) being the most recorded (Figure 7). There has been a notable increase in tench (*Tinca tinca*) occurrences since 2013.

Other exotic species include rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*), koi carp (*Cyprinus rufrobrofus*), rudd (*Scardinius erythrophthalmus*), brown bullhead catfish (*Ameiurus nebulosus*) and perch (*Perca fluviatilis*). Although many of these species are thought to be present in small quantities, there is the potential for some species, like perch, to become more problematic (Rowe, 2014). Where more than one species of exotic fish is present, their combined effect may be more serious than the collective impacts of each species.

The primary reason for the spread of exotic freshwater fish is their deliberate and accidental release into Northland waterways by people. However, some species may have spread through natural causes.

An eel (centre of image) is released back into Lake Kapoai after being caught in a fyke net during tench removal work. The entire lake margin has been fenced to exclude stock, however, the green algal bloom shown here is an example of the impact pest fish can have on lake water quality.

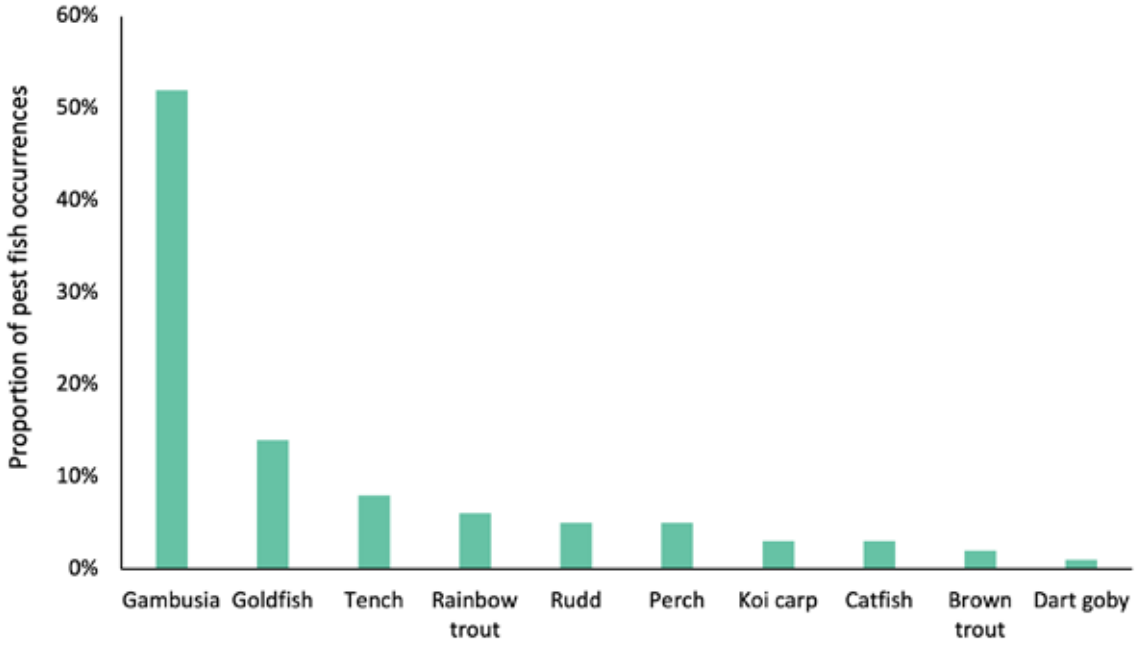


Figure 7: Occurrences of freshwater pest fish species in Northland from records in NIWA's New Zealand Freshwater Fish Database up to August 2021 (NIWA, 2016).

Rudd of the ornamental variety, as evidenced by its orange colour, caught from Lake Rototuna.

He rangahau whakapūaho tuatoru

CASE STUDY 3

Lake Kapoai tench removal

Lake Kapoai is one of eight Northland lakes prioritised for exotic fish removal through the Freshwater Improvement Fund (FIF) Dune Lakes project, administered by the Ministry for the Environment. Lake Kapoai is a 2.6 ha dune lake situated on the west coast of Northland, south-west of Dargaville, and is one of four sites in Northland where the invasive fish tench occurs (Rowe, 2014).

Tench have high reproductive rates and relatively long lifespans (McDowall, 2000). They are predators eating a range of fish eggs, snails, and other invertebrates, competing directly with native fish. Tench are classed as a progressive containment species under the Regional Pest Management Plan (Northland Regional Council, 2018) and therefore the focus is on containing and reducing the spread of tench and, where possible, eradication.

NRC has undertaken several tench removal operations in Lake Kapoai since 2019. Between 2019 and 2022, over 6,100 tench were captured and removed using a combination of fyke, Gee minnow, trammel, and multi-panel gill nets. Over 5,900 were juveniles (<75 mm). The removal of juveniles and to a lesser extent spawning adults, has likely reduced the impacts of the tench population in the short term. However, due to the high reproductive rate and behaviour of tench, eggs may be released over several spawning events (Sanchez-Herrera, Gallardo, Ceballos, Perez, & Dominguez, 1997), ongoing removal is required to continue to maintain and reduce the population.

Adult and juvenile tench captured using trammel and fyke nets in Lake Kapoai during the 2022 netting operation

Several techniques used successfully in other lakes for the control of koi carp (*Cyprinus rubrofuscus*) may be suitable for tench management in Lake Kapoai, such as electrofishing, radio telemetry tracking of tagged Judas individuals to identify spawning habitat, and lime treatment of spawning areas to increase the pH to lethal levels for developing eggs (Norris, Hutchison, Chilcott, & Stewart, 2014). However, further investigation into their effectiveness, cost and resource demands is needed.

Lake Kapoai from the southern embankment, 26 May 2022.

He aha ngā mahi hei whakatika?

What is being done?

Dune lake restoration and protection

Lake Management Plans have been prepared and are being implemented for 12 regionally Outstanding lakes. The lakes are: Morehurehu, Wahakari, Waihopo, Waiporohita, and Ngatu (Far North), a combined plan for the three Kai Iwi Lakes, and Humuhumu, Mokeno, Rotokawau, and Kanono (Poutō).

The management plans outline each lake's ecological and social values, land use in each catchment, and water quality monitoring currently undertaken by Council. Each lake plan suggests work to reduce any further deterioration, as well as for the enhancement of ecological condition. Ongoing work at the lakes include, but is not limited to, monitoring, pest plant and animal control or eradication, fencing and native planting in riparian areas, and sediment control. Much of this work is funded by Council or via council-coordinated funding sources.

Examples of externally co-funded work include the FIF Dune Lakes Project secured by Council to improve lake water quality in around 30 lakes. This also includes education programmes in partnership with mana whenua hapū and iwi. Other actions include aquatic weed, pest fish and grass carp removal, fencing, planting, sediment control, and partnership work with mana whenua. NRC also secured funding from the National Wilding Conifer programme to remove wilding pines from the Aupōuri Peninsula, around Lake Ngatu, and around Kai Iwi Lakes. This work was undertaken with support from local communities, schools and iwi/hapū.

Lake Midgley, Ōmāmari, before fencing and grass carp removal under the FIF Dune Lakes project.

Pest management

The Northland Regional Pest and Marine Pathway Management Plan 2017–2027 incorporates 7 freshwater plant pests and 9 freshwater animal pests (Table 6). These are categorised on whether they are currently found in the region and how widespread they are. This helps guide the objectives, operational plans, and management programmes for each pest. The main pest management methods include education, surveillance, and response.

Table 6: Freshwater pests covered by Regional Pest and Marine Pathway Management Plan 2017-2027.

Category	Number of pest plants	Number of pest animals	Examples
Exclusion	2	1	Water poppy, orfe
Eradication	5	3	Salvinia, eastern water dragon
Progressive containment		3	Koi carp, perch
Sustained control		2	Brown bullhead catfish, rudd
Total	**7**	**9**	

In 2019–2021, 88% of the key performance measures for freshwater pest management were achieved, with remaining targets planned for completion by the end of the project in 2023. These include site visits and management, response to reported sighting, and community engagement. The main barriers to not fully achieving all performance measures were staff capacity and resourcing shortages, as well as the impact of COVID-19 restrictions.

Freshwater pests are often difficult to detect and have limited options for control methods, so are difficult to remove once established. However, preventing the introduction, or minimising the spread of, freshwater pests is the best way of protecting Northland's freshwater ecosystems.

For most freshwater pests the main means of spread are through transportation to new places by people, diggers, boats, and equipment.

The Check Clean Dry awareness campaign aims to prevent the spread of freshwater pests through advocacy at community events and surveys and from 2019 to 2023 Check, Clean, Dry has attended 19 events. Northland's annual council Check, Clean, Dry campaign is co-funded by MPI and delivered by Council.

For example, red-eared slider (*Trachemys scripta elegans*) and snake-necked turtles (*Chelodina longicollis*) are both eradication pests. These species can be held in captivity, but it is illegal to release them into the wild and any sightings should be reported to NRC.

Juvenile tench caught at Lake Kapoai.

Weed eradication and surveillance programme

In addition to work undertaken under the RPMP, other programme funding was used to eradicate African oxygen weed (*Lagarosiphon major*) from Lake Phoebe in 2012 and Lake Ngakapua in 2019, using the herbicide Endothall. A core component of the FIF Dune Lake project has been the eradication of invasive pest plants from several Northland dune lakes, also using Endothall. African oxygen weed has not been recorded in Lake Ngatu since Endothall application in a whole lake treatment by airboat in 2020 (Figure 9). If the lake remains weed-free, eradication will be declared in 2025.

- Grey willow (*Salix cinerea*) was removed from Lake Rototuna (Poutō) using a combination of hand removal and herbicide application.

- The regional council has helped with delimitation and removing gypsywort (*Lycopus europaeus*) from Te Ketekete in partnership with iwi, DOC and Fish and Game.

- Grass carp are being removed from Lakes Heather (Awanui), Midgley (Ōmāmari), Roto-otuauru and Waingata (both in Poutō) after being used as biocontrol agents to eradicate hornwort and oxygen weed (*Egeria densa*).

- Curled pondweed (*Potamogeton crispus*) was removed by hand from Lake Waikare, and Christmas berry (*Schinus terebinthifolius*) from Lake Ngatu (Champion, 2021).

The lake ecological monitoring programme and Council's annual weed surveillance of public lakes is key to finding incursions at an early stage where they can be dealt with promptly and effectively to limit further spread and serious impacts to water quality and lake health. Annual surveillance for pest plant incursions was conducted on six high-risk lakes (Ngatu, Waiporohita, Waikare, Taharoa, Kai Iwi and Humuhumu) until 2018. Since then, annual surveillance has continued for Lakes Waikare, Taharoa and Kai Iwi, with public access to Lakes Ngatu and Humuhumu more restricted – refer to the case study #4 for more information on Lake Ngatu.

He rangahau whakapūaho tuawhā

CASE STUDY 4

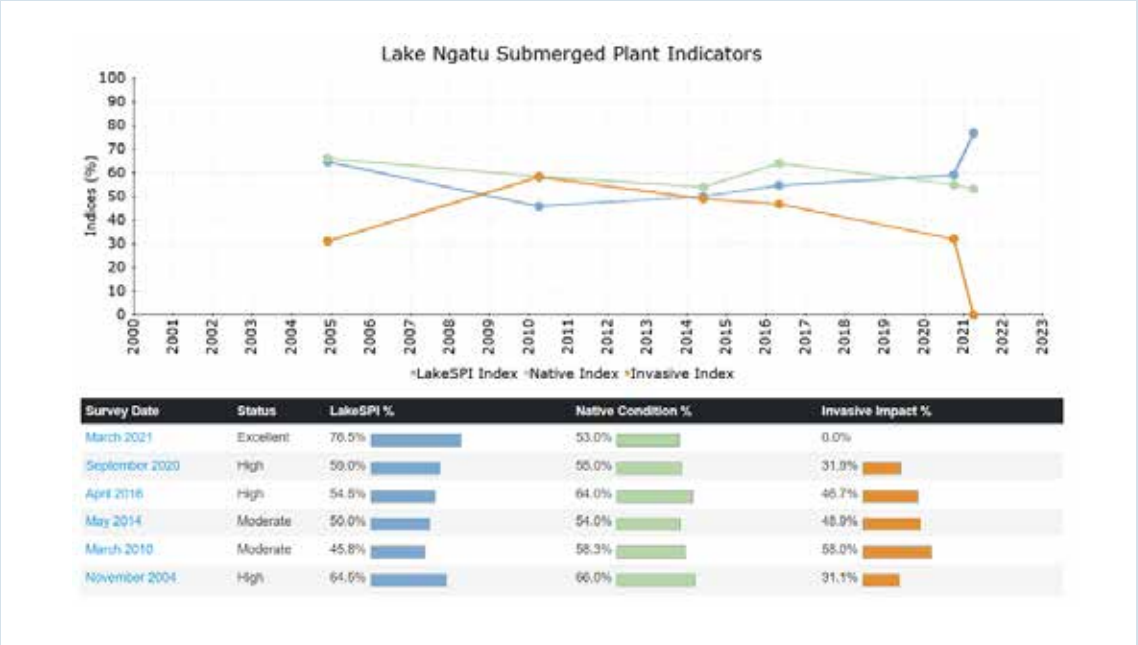
Restoration of a dune lake in the Far North

Lake Ngatu is one of twelve dune lakes ranked as having Outstanding ecological values. Situated at the southern end of the Aupōuri Peninsula near Awanui, Lake Ngatu is one of Northland's larger dune lakes with an area of 55 ha, but is relatively shallow with a maximum depth of 6.3 m (LAWA, 2022).

The 178 ha catchment of Lake Ngatu is predominately in pastoral farming and wetlands, with small amounts of cropland, orchard, and residential areas (Northland Regional Council, 2018). The lake supports a range of native plant species, including five considered rare. Native fish species, such as common bully (*Gobiomorphus cotidianus*) and īnanga (*Galaxias maculatus*) are present in the lake. The lakebed is owned by, and managed primarily by, NgāiTakoto iwi.

As part of ongoing monitoring, LakeSPI surveys have been regularly conducted in Lake Ngatu. There has been a steady improvement in LakeSPI since 2010, with a sharp improvement between surveys conducted in 2020 and 2021 (Figure 8), due to the elimination of *Lagarosiphon major* using Endothall herbicide under the FIF Dune Lake Project. The project also funded a number of swales and sediment traps to reduce sediment entering the lake.

Lake Ngatu. Source: DOC.



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
March 2021	Excellent	76.5%	53.0%	0.0%
September 2020	High	59.0%	55.0%	31.8%
April 2016	High	54.5%	64.0%	46.7%
May 2014	Moderate	50.0%	54.0%	48.9%
March 2010	Moderate	45.8%	58.3%	58.0%
November 2004	High	64.6%	66.0%	31.1%

Figure 8: Lake SPI results for Lake Ngatu from November 2004 to March 2021. Source NIWA, 2022.

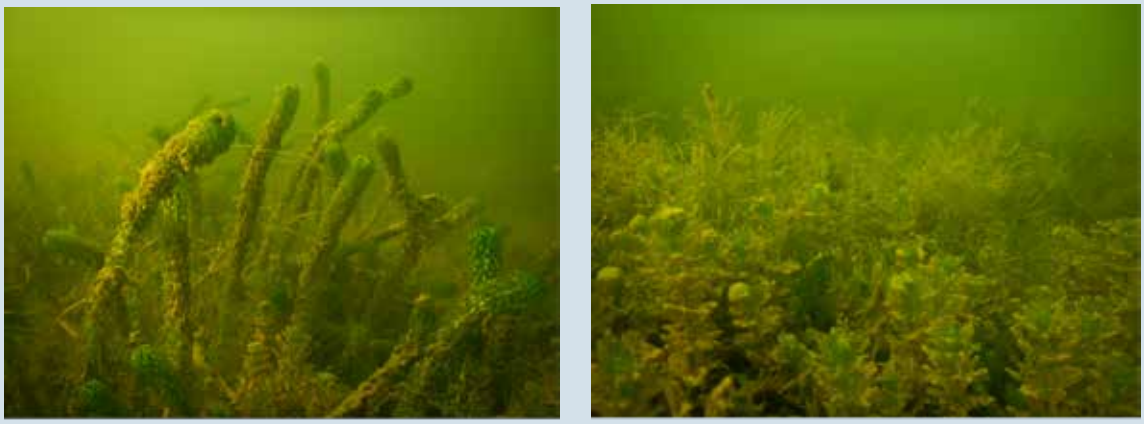


Figure 9: Oxygen weed (*Lagarosiphon major*) in submerged vegetation of Lake Ngatu (September 2020 left), and native charophytes growing in the same area following herbicide application (March 2021 right) (Tracey Burton 2020, Aleki Taumoepeau 2021).

Restoration and active management of Lake Ngatu is a collaborative approach. Groups including NgāiTakoto, DOC, The Bushlands Trust, NRC, Far North District Council, local schools, and landowners, work together to care for the lake. Some initiatives include limiting powerboat access by installing a locked gate and bollards along the lake margin, which also prevents the washing of vehicles in the lake that come from nearby Ninety Mile Beach and removing wilding pines from the surrounding catchment. Riparian planting has also been underway for several years around the lake margins.

Trithuria inconspicua is a tiny, fan-shaped aquatic plant related to waterlilies that only occurs in Northland and lives in the sandy sunlit shallows of clearwater dune lakes (Figure 10). Evidence consistently puts *Trithuria* in the oldest flowering plant lineage. It has died out in seven out of 13 lakes across its range, mainly due to deteriorating water quality, and is now listed as Threatened - Nationally Critical (de Lange et al., 2018). Only Lake Rotokawau on the Poutō Peninsula, the three Kai Iwi Lakes, and Lakes Ngatu and nearby Rotoroa now support populations of *Trithuria inconspicua*. A series of drought summers saw lake levels fall, exposing *Trithuria* beds which resulted in a significant decline at Lake Ngatu. However, good rainfall over summer 2020 resulted in a flush of healthy young plants. This illustrates the sensitivity of some lake species and the risk that climate change poses to the biota of our northern dune lakes.

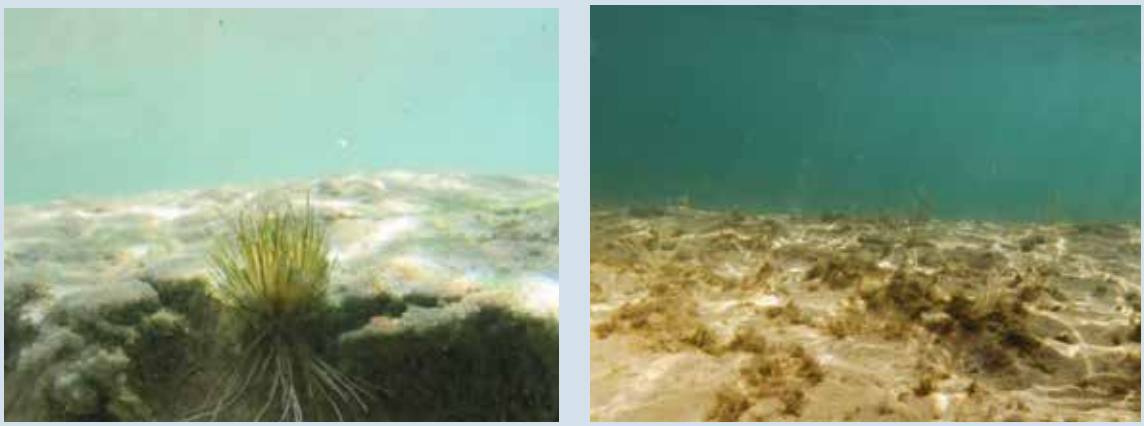


***Figure 10: Trithuria inconspicua* in situ at Lake Taharoa of the Kai Iwi Lakes**

Education

In addition to Check, Clean, Dry events, NRC have held 'Get to know your dune lake' events for students from local schools and their communities. These education days include hands-on learning sessions looking at lake biota and water quality. Since 2019, education events have been held at 12 dune lakes, including Waikare, Kanono, Waiparera, Waiporohita, Ngatu, Waimimiha, Ngakeketo, Ruakākā, Black and Humuhumu Lakes. These events were carried out in partnership with the Enviroschools and Te Aho Tu Roa programmes and involved 97 schools and about 1,000 students.

Students investigate fish, plants, and water quality testing at Lake Ngatu during a 'Get to know your dune lake' event.

He aha kei tua?

What is the outlook?

Climate change

Human-induced climate change relates to the impact of increased greenhouse gas emissions in the atmosphere, not the fluctuations seen in climate with natural cycles such as the El Niño Southern Climate Oscillation. The predicted effects of climate change in Northland relevant to freshwater biodiversity, include increased air temperatures, reduced rainfall, more frequent and longer-lasting droughts, increased fire risk, and sea-level rise (Champion, 2021).

These predicted climate change effects are going to increase the pressure on Northland's freshwater ecosystems, with most wetlands, dune lakes, and rivers highly sensitive to these effects. The potential impacts range from lower water levels because of increased water temperatures, reduced rainfall and increased water supply demands, saltwater intrusion, through to increased spread and number of invasive pest species (some may reduce in number and extent), and the potential for new species to establish. There are rare species of freshwater plants and animals at risk of further decline or extinction due to climate change effects such as climate warming, drought, and heavy rainfall events.

Lake Taharoa with low water level, May 2021

New organisms

The ongoing risk of new pest plants, animals, and diseases being introduced from other regions continues and is likely to increase with climate change and increased population. Highly problematic plants not yet found in Northland have been recorded in Auckland, like fanwort (*Cabomba caroliniana*). Many risk plants are available as ornamental aquarium plants, so there is a risk of either accidental or intentional introduction into Northland's freshwater ecosystems.

The use of environmental DNA techniques to determine the biota present in water has increased in recent times. While further research and development is needed to refine the sampling method, especially for large lakes to improve detectability, this is already proving to be a promising method for identifying possible incursions of invasive organisms and for detecting evidence of threatened species.

eDNA sampling in Lake Waikare (Kai Iwi Lakes) following a potential koi carp incursion.

Legislative changes

Several national policies relevant to freshwater ecosystems have been released in the last five years, including the National Policy Statement for Freshwater Management (NPS-FM), National Environmental Standards for Freshwater and the Resource Management (Stock Exclusion) Regulations in 2020, as well as the National Environmental Standards for Plantation Forestry in 2017. These policies place additional monitoring and management requirements on the regional council that will assist in managing and reporting on the state of freshwater biodiversity in Northland. They also regulate activities near wetlands, lakes, rivers, and significant natural areas, which should result in improvements in freshwater biodiversity in the long-term.

Further changes are expected over the next five years with Resource Management Act (RMA) reforms currently underway. As part of these reforms, the Government plans to replace the RMA with a Natural and Built Environment Act 2022 and Spatial Planning Act 2022, which was released by the Parliament at the end of 2022, as well as a Climate Adaptation Act in 2023. When enacted, this new legislation will require significant changes to Northland's policies and plans. While these changes will place huge demands on councils, mana whenua, and other agencies involved in resource management, it also provides an opportunity to address ongoing environmental degradation issues.

Wetland monitoring and mapping

With the loss of much of Northland's wetlands and their associated biodiversity, it is important to monitor the state of remaining wetlands. Government reform in 2020 included rules and regulations that focus on restoring and protecting wetlands and require that regional councils map wetlands, undertake wetland monitoring, and enforce compliance with rules. A report from Manaaki Whenua – Landcare Research sets out a framework of sites for monitoring Northland wetlands (Clarkson & Price, 2022).

The report recommends routine monitoring of 61 of Northland's wetlands, in partnership with DOC. This number includes a range of wetland types and are distributed throughout the region, with 12 wetlands monitored yearly on a five-year rolling cycle.

A project is underway to map wetlands across the region accurately.

Example of wetland polygons (blue) overlaid to wetland locations in Photoblique. Source: BioSpatial Ltd (looking east towards Mahurangi River and Kawau Bay).

3 Ā-moana
Marine biodiversity and biosecurity

Te tirohanga whānui
Overview

The Northland peninsula boasts an impressive 3,200 km of coastline that is home to a diverse range of marine life. No part of Northland is more than 40 km from the coast, highlighting the strong connection that Northlanders have with their marine environment. The coastline supports a vast array of cultural, economic, environmental, and social values that make up Northland's history and way of life. Northland harbours play a vital role in supporting activities such as fisheries, tourism, recreation, commercial shipping, aquaculture, are a vital source of kai moana (seafood) and provide a gateway to the rest of New Zealand and internationally.

Northland estuaries are particularly important for their role in supporting extensive seagrass (*Zostera muelleri subsp. novazelandica*) meadows and shellfish beds that offer crucial nursery habitats for fish, and roosting and feeding areas for coastal birds, including many threatened migratory species.

Overall, Northland's stunning coastline, diverse marine life, and rich estuarine systems make it a prized destination for locals and visitors. The economic, social, and cultural significance of our moana (ocean) underscores the need for its protection and preservation for future generations to enjoy.

Northland's coastlines, harbours and estuaries are highly valued by the community for their cultural, recreational, and natural values. The state of our coastal and marine environments is strongly affected by how we use our land and freshwater resources. Marine pests continue to be a problem with demonstrable impacts on Northland's marine biodiversity and/or economy.

E pēhea ana te ora ināianei?

What is the current state?

Kaipara Harbour – the largest estuarine harbour on the west coast of New Zealand – receives water, nutrients, and sediment from about 640,000 ha of land (Daigneault, Dymond, & Basher, 2017).

Northland's marine environment is used for a range of activities, including fisheries, tourism, recreation, commercial shipping, and aquaculture, all of which may have effects on marine biodiversity. A major pressure on harbours and estuaries is run-off and discharge of contaminants from land, particularly sediment and nutrients. Sources of contaminants include agriculture and forestry activities and the direct discharge of contaminants from municipal wastewater plants, stormwater systems and industrial sites.

Increased sediment inputs can have a number of impacts on biodiversity. Sediment can restrict light transmission in the water column which affects plant growth and the ability of animals to find prey and avoid predators. Sediment also smothers marine plants and animals and clogs the feeding structures of suspension-feeding animals like plankton, and the gills of fish. NRC has undertaken investigations of sediment accumulation rates in the Bay of Islands, Whangārei, Kaipara, and Far North Harbours to determine how quickly our estuaries and harbours are infilling with sediment (for more information on our research into sedimentation please refer to 'Our coast' and visit **www.nrc.govt.nz/coastalresearch**).

Increased inputs of nutrients that are contained in the sediment via additional plant material and organic detritus may initially stimulate marine ecosystems because of the increased food available. However, as primary production increases, the water column and seabed can become oxygen depleted and animals may die or migrate from affected areas. The ecosystem may then become less diverse as it is recolonised by a few opportunist species that are more tolerant of low oxygen conditions.

Other contaminants such as heavy metals and polycyclic aromatic hydrocarbons (a group of more than 100 different chemicals that are released from burning coal, oil, gasoline, trash, tobacco, wood, or other organic substances such as charcoal-broiled meat) can have lethal and sub-lethal effects on marine organisms (reference?). In contaminated environments the diversity and species richness may decrease as the community becomes dominated by a smaller number of more tolerant species, which are able to survive and reproduce in these conditions. Council currently monitors coastal water quality at 44 sampling sites. Sites are located in the four coastal management units identified in the Proposed Regional Plan for Northland (Northland Regional Council, 2019) and in four coastal hydro system types identified by Hume et al. (2016), (more information on our sediment surveys and our findings can be found in 'Our coast' and on our website **www.nrc.govt.nz/coastalresearch**).

The drainage of saltmarsh and reclamation of the coastal environment is another issue for marine biodiversity. Large areas of Northland's saltmarsh, mangrove and inter-tidal mud flat habitat have historically been reclaimed for agriculture, urban and infrastructure developments. The proliferation of coastal structures, and in particular hard coastal protection such as rock revetments (that is, sloping structures placed on banks or cliffs to absorb the energy of incoming water) and seawalls, is a further threat for the remaining inter-tidal habitat, such as saltmarsh (Northland Regional Council, 2017). Much of the remaining saltmarsh habitat is now trapped by a fixed landward boundary, such as a seawall or road, as well as rising sea levels and the expansion of mangrove habitat.

Another issue affecting marine diversity is stock access to the coast. Stock with access to the coast can trample and browse estuarine plants, crush shellfish, and defecate in areas where fish breed and people collect seafood (Northland Regional Council, 2017). From 1 July 2009, under the rules of the Regional Coastal Plan for Northland, access to and use of the coastal marine area by stock became a prohibited activity and landowners are now required to place some form of fencing or barrier to prevent their stock from accessing this area. NRC, through its Environment Fund, has provided financial assistance to landowners to fence their property and protect the coastal marine area from stock.

A growing global problem with the potential to impact marine biodiversity is the proliferation of litter and rubbish reaching the coastal environment. Plastics are now one of the most common pollutants of our oceans and because they biodegrade extremely slowly, they have the potential to cause problems for thousands of years (Warner, 2020). Animals can become entangled in plastic bags, rope, and discarded fishing equipment while other species mistake small pieces of litter and plastic for food, ingesting toxic substances that cause liver and stomach problems in fish and birds. It has been estimated that more than one million birds and 100,000 marine mammals die each year from becoming entangled in or ingesting marine litter (RefillNZ, 2023).

Dr Manue Martinez with the contents of a LittaTrap – a device installed in stormwater drains in urban Whangārei to prevent rubbish entering drains.

3,200 km of coastline

17 harbours and major estuaries

4 high movement ports

8 marinas

124 non-indigenous marine species

90% of marine pests introduced through bio-fouling

Marine pest plants and animals

Northland's marine and estuarine environments are under constant risk from marine non-indigenous species because of increasing rates of human-mediated transport associated with marine recreational activities, maritime transport, aquaculture, and the live marine species trade (Northland Regional Council, 2018). Once established, if these species are recognised as having negative impacts on environmental, economic, cultural and/or social values they are referred to as "marine pests". Marine pests generally exhibit 'weedy' characteristics such as being fast growing, easy to spread, and quick to reproduce.

Non-native Undaria seaweed/wakame (Undaria pinnatifida) is an invasive seaweed which thrives in our marine environment and is easily spread as fouling on vessels.

There have been 377 non-indigenous marine species identified in Aotearoa New Zealand, with 124 reported to be established in Northland (Biosecurity New Zealand, 2023). Many of these species, although non-indigenous, are not considered pests and have minimal recognised impacts. NRC's Regional Pest and Marine Pathway Management Plan has identified seven marine pest species with demonstrable impacts to Northland's marine biodiversity and/or economy (Table 7).

Table 7: Marine pest species in Northland.

Species	Description	Northland distribution
Mediterranean fanworm *(Sabella spallanzanii)* 	Mediterranean fanworm is a large tube-dwelling bristle worm that is typically found in estuaries and sheltered sites up to depths of around 30 metres. It has a tube up to 80 centimetres tall, which is anchored to a hard surface, topped with a single, spiral fan	Whangārei Harbour and Ōpua Basin. Note, only found in sporadic, low densities in the Ōpua basin due to an on-going eradication programme.
Undaria seaweed/ Wakame/ Asian Kelp *(Undaria pinnatifida)* 	Undaria is a large seaweed that grows to 1-2 metres long. Mature plants are golden brown or green brown in colour, crinkly in appearance and have a distinct midrib. Undaria plants have a holdfast, a stem and a sporophyll at the base of the stem (a frilly-shaped reproductive structure which produces spores).	Houhora and Pārengarenga Harbours
Styela Sea Squirt/ Clubbed Tunicate *(Styela clava)* 	Styela sea-squirt has a long, club-shaped body and uses a short, tough stalk to attach to substrate. Its surface is leathery and usually brown in colour. Styela sea squirts grow attached to hard artificial and natural surfaces and are frequently transported as biofouling on vessels and other mobile marine structures.	Whangārei, Tutukākā, Bay of Islands, Whangaroa, Houhora, Kaipara and Mangonui Harbours
Australian droplet tunicate *(Eudistoma elongatum)* 	The Australian droplet tunicate is a type of sea squirt. It forms large colonies that look like clusters of white or cream-coloured cylindrical tubes. The Australian droplet tunicate is firm and gelatinous to the touch and the cylindrical colonies are generally 5–30 centimetres long.	Whangārei, Bay of Islands, Kaipara, Whangaruru, Whangape, Houhora, Pārengarenga, Whangaroa and Rangaunu Harbours
Pyura Sea Squirt *(Pyura doppelgangera)* 	The Pyura sea-squirt has a sack-like body with a brown, or reddish-brown, leathery skin. Each sea squirt has two siphons or holes for inhaling and exhaling sea water and adults grow up to 15 centimetres or more in height and around 3–5 centimetres in diameter.	Far North including Ahipara, the Bluff, Pārengarenga, Rangaunu harbours and Bay of Islands.
Asian paddle crab *(Charybdis japonica)* 	Asian paddle crabs are relatively large swimming crabs with paddle-like hind legs. The shell can reach 12 centimetres across. Adults have six distinct spines or spikes on each side of the shell below the eyes, and five prominent spines on the upper surface of each claw.	Whangārei Harbour, Tutukākā, Hokianga and Kaipara Harbours
Japanese mantis shrimp *(Oratosquilla oratoria)* 	The Japanese mantis shrimp is a large light grey mantis shrimp that can grow up to 185 millimetres long. Japanese mantis shrimp has red-maroon ridges running down the mid-length of its body, and the outer surface of the tail fan is blue and yellow. Japanese mantis shrimp live in burrows in soft sediments, sand and mud in sheltered bays and estuaries.	Bay of Islands, Whangaroa, Mangonui, Hokianga and Kaipara Harbours

E pēhea ana te ora ināianei?

What are the issues?

Marine pests enter New Zealand by a variety of vectors. In the past 20 years, efforts to control new incursions have focused on well-studied key transport mechanisms such as aquaculture imports, vessel hull biofouling and ballast water. Hull biofouling is recognised as a notable risk and is estimated to have been responsible for 69–90% of New Zealand's historic marine non-indigenous species (NIS) introductions (Cranfield, et al., 1998). In New Zealand it is estimated that up to 90% of new marine introductions are attributed to biofouling with ballast water contributing to most of the remaining introductions (Cranfield, et al., 1998).

Marine pests have modified marine ecosystems in Northland with impacts to native biodiversity being rivalled only by habitat destruction. It was estimated in 2017 that the value of Northland's marine blue economy (Total Economic Value) was $1,777 million (Yeoman, Fairgray, & Lin, 2019). To react to the growing concern about the cultural, economic, and environmental impacts of marine pests, New Zealand has adopted national and international border controls. Currently, New Zealand is the only country to have enacted mandatory craft biofouling regulations (Ministry for Primary Industries, 2018; Georgiades, et al., 2020). Additionally, since 2000, New Zealand has had strict conditions for the management of ballast water, requiring vessels to exchange ballast water mid-ocean prior to discharging in New Zealand. Despite pre border and border controls, incursions of new-to-New Zealand NIS are still being regularly detected.

Successful post-border management and/or eradication requires early detection and a rapid response. Accordingly, since 2002 New Zealand has invested in and implemented a National Marine High-Risk Site Surveillance (NMHRSS) programme (Biosecurity New Zealand, 2023). The selection of high-risk ports and marinas is based on systematic methodology that predicts the relative likelihood of the introduction of a new marine species based of factors like the amount of ballast water discharged and estimated biofouling mass per port. Currently the MHRSS targets 12 of New Zealand's busiest ports and marinas of first entry for international vessels with two of those ports being in Northland - Ōpua and Whangārei.

In addition to the risk of international transfers of marine species, Northland faces increasing risk of domestic introductions from other regions within New Zealand. Once established in New Zealand marine pests predominantly spread domestically via both recreational and commercial vessels – either attached to the vessel surface as biofouling or within the vessel's internal systems (e.g., in ballast water or sea chests). Northland's 17 harbours and major estuaries, eight marinas and four high-movement ports all facilitate the movement of recreational and commercial vessels around the 3,200km of Northland coastlines. In the Top of the North Islands (TON) regions (Northland, Auckland, Waikato, and Bay of Plenty) there are approximately 17,300 recreational vessels, of which approximately 4,500 operate out of Northland and more than 10,000 operate out of the adjacent Auckland area. Additionally, there are at least 936 commercial vessels registered vessels that operate in the TON.

A vessel hauled out for hull inspection for Mediterranean fanworm in the Mangonui Harbour.

He aha ngā mahi hei whakatika?

What is being done?

The primary mechanisms available to regional councils for controlling pests are regional pest management plans which place rules on specific pest species or locations, and regional pathway management plans, which manage the vectors of pests. These plans are developed under the Biosecurity Act 1993 (the Act).

Northland Regional Council's Regional Pest and Marine Pathway Management Plan (RPMP) became operative in 2017 and has a three-pronged approach to manage the risks posed by marine pests:

1. The Marine Pathway Plan to deal with the spread of new marine pests into, and around, Northland before they become established.
2. Sustained control marine pests identified in the Pest Plan to help council and the public manage impacts of marine pests already in the region.
3. Regional Plan provisions to deal with the movement of marine pest species and discharges from in-water boat hull cleaning.

Key elements council has focused on since the implementation of the Marine Pathway Management Plan has included:

- Increase compliance with the pathways plan rules.
- Increase awareness of the risk hull fouling poses to marine pest spread.
- Reduce the rate of spread of established marine pests within Northland.
- Facilitate key stakeholders and coastal marine area occupiers to protect their structures and local marine environments.
- Reduce the impacts and spread of sustained control marine pests.

The RPMP has a multi-pronged approach which has identified and limits the movement of identified high-risk species (species-led approach) as well as addressing the universal vector of spread, hull biofouling (vector management).

Since the adoption of the RPMP in 2017, NRC staff and its contractors have inspected approximately 10,000 visiting and local vessels in Northland waters (currently 2000+ annually). Inspections over this time detected over 100 vessels that had travelled to new destinations carrying a marine pest that was not established in that location. Rapid detection coupled with fast actions to mitigate the release of these species has ensured that a majority of Northland's unique and high-value marine ecosystems are still free of pests like the Asian kelp (*Undaria pinnatifida*) and the Mediterranean fanworm (*Sabella spallanzanii*).

To compliment the hull surveillance programme, council has engaged with a range of communities to promote awareness of marine biosecurity in Northland. By having 'more eyes on the water', and a greater public understanding of what marine pests are, their potential impacts and how to report them, the regional council has been able to increase its capacity to detect new species quickly and respond more effectively. Annually, council hosts approximately three marine pest identification workshops, attends boat shows where staff convey and explain the need for rules, hosts community events (e.g., Sea Week) and guest lectures at local high schools. Additionally, relationship building with hapū is a strong focus with staff facilitating capacity building of mana whenua to enhance monitoring within their rohe moana. The council works with other regional partner councils to develop easily accessible resources to further engage with the public, including a marine biosecurity centric education resource for school children and more technical information for boat owners on how to maintain a clean vessel. The extensive advocacy and education programmes have facilitated a strong behaviour change and realisation among many vessel owners traveling to Northland or between harbours that they need to be vigilant and clean before they move.

He aha kei tua?

What is the outlook?

Proposed National Plan 'Clean Hull Plan'

The Top of the North Marine Biosecurity Partnership (TON) is an alliance between the northern-most regional councils in Aotearoa New Zealand (Northland, Auckland, Waikato, Bay of Plenty, Hawkes Bay, and Gisborne), the Department of Conservation and Biosecurity New Zealand. The partnership has been active in promoting an awareness campaign 'Clean Below? Good to go', supporting national marine biosecurity research and aligning policy and operational procedures.

A key project for the collaboration has been the development of a Pathway Management Plan under the Biosecurity Act – the 'Clean Hull Plan' (CHP). One key criterion for success is that the plan acts as a model for a national approach – that is, it can be expanded to include the remainder of the country in due course as other regions are ready to be brought on board.

The CHP aims to reduce the risk of moving vessels spreading marine pests within New Zealand's waters and builds an established programme that has already delivered increased awareness of marine biosecurity, reduced marine pest spread and increased the standard of hull maintenance across the vast majority of the fleet in the regions involved. The CHP addresses the gaps in the current system, where regulations set by each region target the transport of specific marine pests. Each region has similar but differing rules which can be confusing for boat operators and difficult to enforce, thereby increasing the risk of marine pest incursions. By contrast, the CHP simply requires vessels to meet a specific standard of hull hygiene. As marine pests are primarily carried in biofouling, if a vessel is clean, it cannot be a vector for marine pests.

As part of the CHP an online database of vessel inspection and maintenance activities will be maintained to streamline information sharing between maintenance facilities, marinas, and councils. It will enable vessel owners to track information about their vessel maintenance and risk profile as well as enabling efficient enforcement when vessels are high risk.

An exciting development in 2022 has seen Government committing $5.56 million over the next four years to advance a Clean Hull programme as a pilot in the Top of the North regions, which captures 70% of New Zealand's vessel fleet (Clean Below? Good to go., 2022). Drafting the proposed plan, including the required Biosecurity Act documentation, and a multi-agency management agreement setting out roles and responsibilities for governance and implementation, is ready for public consultation. Early testing with elected members, mana whenua, and key stakeholders has shown strong support for the plan and formal public consultation is expected in 2023.

Ngā rangahau whakapūaho tuarima, tuaono, tuawhitu

CASE STUDY 5

Whangaroa Sabella spallanzanii detection and rapid response

Contract divers conducted a search and destroyed survey for Mediterranean fanworm on vessel hulls, mooring blocks, and marina structures in response to six fanworm being found and reported on oyster farm structures owned by Te Rūnanga O Whaingaroa in October 2021. Resulting diving operations detected an additional 20 individual fanworm on marina structures, one on an adjacent commercial wharf and 2 large clumps of fanworm on the seafloor within the marina (~200 individuals). The large clumps had varying sizes of individuals and was not characteristic of natural settlement with staff and independent advice concluding that they may have been scraped from a vessel or dumped in location. A follow-up comprehensive search of mooring blocks and artificial structures in 2022 resulted in the detection of only one individual on the commercial wharf. While new detections on structures are unfortunate, staff are confident that the correct identification and reporting by the oyster farm has resulted in the marine biosecurity team and Biosecurity New Zealand being able to react quickly and allow successful detection and removal of the source population. Regional council will continue to monitor the area to ensure no recruits have been missed.

Large cluster of Sabella spallanzanii removed from seabed, believed to be the source population of the local recruits.

CASE STUDY 6

Marine Vessel Portal

Marine biosecurity staff continue to collaborate with regional Top of the North partners (Auckland Council, Waikato Regional Council, Bay of Plenty Regional Council, MPI, and DOC) and central Government to develop and populate a marine vessel portal. The portal will facilitate data collection by users, stakeholders, and partner councils, including marinas, haul out facilities, and eventually individual vessel owners empowering them to manage their biofouling and hull cleaning records more easily.

The Marine Vessel Portal is a centralised vessel database that will be crucial to the implementation of the Clean Hull Plan by mapping and recording vessels moving between regional boundaries and allowing members of the public and marinas to access certain information about their vessel or vessels entering their facilities. There are an estimated 20,000 vessels on moorings and marina berths in the Top of the North area (equating to approximately 90% of all New Zealand's vessels). Since the start of the 2022–2023 financial year, the Top of the North collaboration has captured vessel information for over 10,000 of these vessels. In the absence of vessel registration this represents a very valuable tool for New Zealand marine biosecurity.

NRC Marine biosecurity specialist inspects the running gear of a vessel for marine pests.

CASE STUDY 7

Tutukākā Harbour Fanworm eradication

Diver from Marine Environmental Field Services about to enter the water to survey harbour.

In 2015, Mediterranean fanworm was first detected on a vessel within Tutukākā Marina, subsequent dive monitoring revealed the early signs of an infestation in the marina. Biosecurity New Zealand and regional council were swift to develop a joint response that included a programme of dive surveillance of all vessels within the harbour, marina structures, the seabed under the marina and a subset of suitable substrates within the harbour. Six years of annual dive surveys has not detected any additional fanworm in the harbour and now Tutukākā has officially been declared 'fanworm free".

If elimination efforts hadn't been undertaken, this fanworm population would have increased significantly with potentially damaging impacts to Poor Knights Islands and other high value areas.

Ngā Whakatepenga
Conclusions

Te Taitokerau is a special place. Our warm climate, coastal influence, diverse soils and landforms and long geological periods of isolation from the rest of New Zealand has given rise to an array of distinctive ecosystems and biodiversity. The region is recognised as a biological treasure chest with a notably high proportion of the country's uncommon biodiversity as well as containing many rare ecosystems, some of which, like Northland's dune lakes, are of national and international significance.

Within Northland's wider community there are many people who work hard to look after our unique environment and Northland Regional Council is fortunate to be able to support them. Recovery of kiwi populations, success in controlling and eradicating pests over many years and restoration of wetlands, lakes and coastal dune sites is testament to the focus and passion of iwi, hapū, landowners, communities, other agencies, and council staff.

Many parts of our environment are under significant pressure. The proliferation of animal pests and weeds on land and in the freshwater and marine environment and the health of our freshwater ecosystems due to declining water quality is of concern. Although our dune lakes are in good health in comparison to many other lakes in NZ we will need to work hard to maintain and improve them. Emerging threats like effects associated with climate change are real and will be difficult to anticipate and respond to. Through continued action on the ground, strengthened partnerships and a great understanding and use of mātauranga Māori, we intend to protect Te Taitokerau as a region of unique beauty and unrivalled ecological and ecosystem diversity.

Te rārangi tohutoro

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