Our marine environment 2022

New Zealand's Environmental Reporting Series

Ministry for the Environment
Manatū Mō Te Taiao
Stats NZ
Tatauranga Aotearoa

Citation
Ministry for the Environment & Stats NZ (2022). *New Zealand's Environmental Reporting Series: Our marine environment 2022*. Retrieved from environment.govt.nz.

Published in October 2022 by
Ministry for the Environment and Stats NZ

Publication number: ME 1686
ISSN: 2382-0179
ISBN: 978-1-99-102575-3

Cover: Takapuna Beach, Auckland
Photo: truestock

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Introduction

Aotearoa New Zealand's marine environment

New Zealand has one of the largest exclusive economic zones (EEZ) in the world with a diverse range of coastal and marine environments, habitats, and species. As an island nation, our unique marine environment also holds an important place in our national identity. It is central to our economy, wellbeing, recreation, and for gathering kai moana (seafood). For some Māori, the marine environment is central to tikanga Māori (customs and protocols) and mātauranga Māori (Māori knowledge).

Despite this, our marine environment is under pressure from climate change and degradation from our activities on the land and at sea. These pressures have impacts on the things we value as individuals, communities, and as a nation. Efforts are being made to protect and restore New Zealand's marine environment; however, *Our marine environment 2022* shows us that whilst some aspects of the environment display improving trends, others continue to be at risk.

Indicators presented in this report alongside the research literature are based on the best available science and highlight the issues facing the marine environment. However, while our understanding of issues affecting our marine environment has progressed, its size and nature present challenges for monitoring and reporting; the interactions between pressures and the state of the marine environment are inherently complex, and there are gaps in data coverage and consistency.

About Our marine environment 2022

Our marine environment 2022 is the latest in a series of environmental reports produced by the Ministry for the Environment and Stats NZ. It is the third report in the series dedicated to the marine environment, following the 2016 and 2019 reports, and is part of the third cycle of reports released under the Environmental Reporting Act 2015.

In 2019, the Parliamentary Commissioner for the Environment (PCE) released his report, *Focusing Aotearoa New Zealand's environmental reporting system* (PCE, 2019). The report identified how the environmental reporting system can be improved and recommended changes to the Environmental Reporting Act. Implementing these amendments will provide a stronger foundation to ensure we understand our environment and the impacts people are having on it.

Our marine environment 2022 continues the scaled-back format for environmental reports first signalled in *Our air 2021*, providing valuable information while we progress the fundamental changes needed to improve the reporting system in line with recommendations from the PCE (PCE, 2019). This is an information-oriented release, with the primary focus on updating recent indicators and scientific evidence about the marine environment. This report updates some of the indicators reported on in previous years and brings those indicators together with what we know from past reports and insights from the research literature. Interactive graphs and maps can be found on the Stats NZ website (see links to indicator web pages throughout this report).

Report structure

As required by the Act, we use pressure, state, and impact to report on the environment and this forms the basis for the report's structure. The logic of the framework is that pressures cause changes to the state of the environment and these changes may have impacts. The report describes impacts on marine species and ecosystems, infrastructure, te ao Māori (Māori world view), culture, economy, public health, and recreation, and connection to the marine environment to the extent that is possible with the available information. It also identifies information gaps.

The data used in this report came from many sources including Crown research institutes and central and local government. Further supporting information was provided using a 'body of evidence' approach. This body of evidence includes peer reviewed, published literature, as well as mātauranga Māori and observational tools used to identify changes in the ecosystem.

All data used in this report, including references to scientific literature, were corroborated, and checked for consistency with the original source. The report was reviewed by a panel of independent scientists. The indicators related to the marine environment and the date they were last updated are available on the Stats NZ indicators web pages.

Pressures on our marine environment

Our marine environment continues to be affected by a range of individual and cumulative pressures. Increases in greenhouse gas emissions from human activities continue to drive increased ocean acidification, sea-level rise, and sea-surface temperatures. Our activities on land can also have detrimental effects through excess sediment, nutrient, and plastic pollution. At sea, our activities place pressure through commercial and recreational fishing, aquaculture, extraction of natural resources, introduction of non-indigenous species, and coastal development.

Climate change is affecting our marine environment, contributing to increasing ocean acidification, rising sea levels, and increasing sea-surface temperature.

- Human-driven increases in global atmospheric carbon dioxide continue to drive climate change, with Aotearoa New Zealand's average annual temperature rising by 1.13 (+/-0.27) degrees Celsius from 1909 to 2019 (see *Our atmosphere and climate 2020* and indicator: Temperature.
- Global oceans have absorbed approximately 25 percent of total human carbon emissions since the start of the industrial revolution (Friedlingstein et al, 2020). This carbon uptake makes our oceans more acidic and affects marine biota and ecosystems (Law et al, 2018; Orr et al, 2005).
- Sea levels are rising as the oceans heat up and expand, and glaciers, ice caps, and ice sheets melt (Levy et al, 2020).
- Sea-surface temperature is increasing with climate change and increasing atmospheric temperature (Salinger et al, 2020; Sutton & Bowen, 2019).
- Naturally occurring climate patterns such as the El Niño Southern Oscillation are changing, introducing further variability to our oceans, including in sea-surface temperature, storm events, and circulation (Godoi et al, 2017; Salinger et al, 2020; Sutton & Bowen, 2019).

Plastic litter entering our marine environment may have long-lasting impacts and remain in our marine environment for centuries.

- Different types of human-made coastal litter can be found along our coastlines. Plastic is the most common type of litter found on our beaches, with around 64 percent of measured items being plastic in 2019, 67 percent in 2020, and 70 percent in 2021 (Stats NZ, 2022).
- Plastic waste is a major problem: plastic takes centuries to break down, and large quantities continue to be produced. For example, in 2018, Aotearoa imported 575,000 tonnes of plastic material (PMCSA, 2019).
- Microplastics (less than 5mm in length) can be produced or broken down from larger plastics. There is an increasing amount of evidence showing that microplastics are widespread throughout the marine environment (Clere et al, 2022; De Bhowmick et al, 2021; PMCSA, 2019).

Human activities on land can place pressure on our marine species, habitats, and the mauri of the environment.

- Human settlement has brought large shifts in the nature of sediments in most coastal environments. These include changes in the rate of accumulation, increase in muddiness, and the type and amount of contaminants that are bound to sediments (Robertson & Stevens, 2015). See *Our marine environment 2019*.
- The main source of sediment varies regionally due to a range of factors such as, soil type, slope, climate, land cover, and human activities (Phillips et al, 2017).
- Nutrients, such as nitrogen and phosphorus, occur naturally in the marine environment; however, elevated levels due to human activities can drive eutrophication: an overload of nutrients that can cause algal blooms, depleted oxygen levels, and subsequent harmful effects on marine life (Snelder et al, 2020).
- In te ao Māori, mauri refers to the health and vitality of living systems. A healthy marine environment enhances the mauri of those who interact with it (Mead, 2003). Similarly, shifts in the mauri of any part of an ecosystem eventually affect the whole system (Harmsworth & Awatere, 2013).
- Excess nutrients from land-use activities place pressure on the mauri of Moana-nui-aa-kiwa (the Pacific Ocean). These pressures are increased by the rains of Taawhirimaa-tea. This is because the run-off and leaching from these activities is discharged into freshwater environments before eventually reaching Tangaroa and Moana-nui-aa-kiwa (Hopkins, 2018).
- Pathogens, such as faecal bacteria, can enter the water from animal excrement, stock effluent, wastewater discharge, and contaminated soil run-off (LAWA, 2021).

Human activities at sea place a range of pressures on our species and habitats.

- Commercial fishing includes, but is not limited to, trawling, dredging, long lining, and set netting, all of which can have long-term and wide-ranging effects on species and habitats (Clark et al, 2000; Clark & Rowden, 2009; Fisheries New Zealand, 2021a).
- The number of commercial trawl and dredge tows has decreased in the past two decades, and the area that is trawled is decreasing (Baird & Mules, 2021).
- The accidental capture (bycatch) of marine species including seabirds remains a significant pressure on some species (Clay et al, 2019; MfE & Stats NZ, 2019).
- In 2017, it was estimated that the non-target catches of invertebrates and fish in offshore fisheries was around 65,000 tonnes per year (Fisheries New Zealand, 2021a).
- The total catch from recreational fishing in 2017–18 was estimated to be 7 million finfish and 3.9 million other marine species (Wynne-Jones et al, 2019). The top three finfish species (snapper, kahawai, and blue cod) accounted for 72 percent of the total finfish catch, with snapper alone accounting for almost 50 percent of this (Wynne-Jones et al, 2019).
- Shellfish and finfish species used for aquaculture include green lipped mussels, Chinook salmon, and Pacific oysters. Different types of aquaculture can have differing ecological impacts on the seabed habitat, surrounding water column quality, and wider ecological effects on marine ecosystems. Some impacts are positive while others are adverse (Fisheries New Zealand, 2021a; MPI, 2013).

- The extraction of natural resources can place a range of pressures on the marine environment. Different types of mining, such as mineral mining and sand mining, can place differing pressures on the marine environment. Some of these can include disturbance to the seabed habitat, marine species, and wider marine ecosystems (Fisheries New Zealand, 2021a; MacDiarmid et al, 2012). Key oil and gas fields are concentrated off the North-West coast of the North Island in Taranaki; however, production from them has declined over the last decade (Yeoman et al, 2019).
- Over 99 percent of Aotearoa New Zealand's international trade by volume is supported by shipping (Deloitte New Zealand, 2022). Shipping contributes to pollution and construction of hard coastal infrastructure, impacting coastal wave dynamics and habitats (GESAMP, 2001).

Ongoing introductions of non-indigenous species to Aotearoa continue to be a risk to our national biodiversity.

- Non-indigenous species have the potential to quickly spread and compete with indigenous species, resulting in their decline and changes to habitat. There is also a risk of the introduction of pathogen species that may threaten indigenous species, aquaculture, or human health (Marine Biosecurity Porthole, nd; MfE & Stats NZ, 2019).
- Introductions of non-indigenous marine species, including parasites, to Aotearoa are an ongoing risk for our biodiversity (Lane et al, 2022).
- Between 2010 and 2017, 49 new-to-Aotearoa species were detected, and 21 of these showed established populations in our marine waters. Since 2015, three of nine key non-indigenous species have been found in ports where they have not previously been detected before (see indicator: Marine non-indigenous species).
- Shipping and recreational vessels are monitored as drivers of the introduction and spread of non-native species (Dodgshun et al, 2007; GESAMP, 2001; Lane et al, 2022).

The physical form of the marine environment influences its susceptibility to different pressures.

- As a long, narrow, and isolated nation, with a complex coastline and diverse undersea landscapes, our marine environment has a high level of local variation (Stevens et al, 2019). The physical form of the marine environment in an area influences its susceptibility to different pressures. For example, estuaries with limited exchange with the ocean are more susceptible to the adverse effects of nutrient inputs (including high eutrophication) than well-flushed estuaries (Plew et al, 2020).
- The coastal environment has been modified since human settlement, including parts of the seabed and coastline. For example, coastal development, seawalls, and dredging modify habitats and affect coastal processes. Modification of river catchments can reduce the proportion of river sediment that would be intercepted before reaching the ocean (NIWA, 2019b). See *Our freshwater 2020*. The pressure of seawalls on the marine environment is highly site dependent due to variations in coastal processes along our coastlines (Thompson et al, 2022).

State of our marine environment

Climate change continues to affect the state of the marine environment; oceans are continuing to acidify, sea levels are rising, and sea-surface temperatures continue to increase. Recent trends for nutrient-related coastal and estuarine water-quality measures have been improving at more sites than worsening. While there is limited information on the health of marine habitats and ecosystems, monitored biogenic habitats (those created by living organisms or biological processes) have typically reduced in extent and condition since human settlement, with the exception of mangroves, which have expanded. Many marine bird, invertebrate, and identified taonga (treasured) species assessed are threatened with extinction or at risk of becoming threatened with extinction.

As a consequence of climate change, our oceans are acidifying, our sea levels are rising, and sea-surface temperatures are increasing.

- Our oceans continue to become more acidic, with ocean acidity increasing 8.6 percent in our subantarctic surface water off the coast of Otago between 1998 and 2020 (see indicator: Ocean acidification).
- Annual average coastal sea levels have risen (relative to land) at all six monitoring sites around Aotearoa based on available data to 2020 (see indicator: Coastal sea-level rise). Sea-rise levels vary by location, and can be affected by different factors, including ocean and wind circulation, heat uptake, and vertical land movement from tectonic processes.
- Sea levels are continuing to rise. The annual mean coastal sea-level rise recorded between 1961 and 2020 was greater than between 1901 and 1960 at four long-term monitoring sites around Aotearoa (see indicator: Coastal sea-level rise).
- On average sea-surface temperature increased by 0.1 to 0.2 degrees Celsius per decade across the four oceanic regions (Chatham Rise, Tasman Sea, subtropical, and subantarctic waters) between 1981 and 2018. For coastal waters for the same period, there was an average increase of 0.2 degrees Celsius per decade (see *Our marine environment 2019* and indicator: Sea surface temperature).
- Short-term and regional-scale variability in sea-surface temperature (or warming and cooling) has resulted in increasingly warmer summers and ongoing marine heatwaves, which are becoming more frequent and severe (Chiswell & Sutton, 2020; Moana Project, nd; Pinkerton et al, 2019; Thomsen et al, 2019).
- In coastal regions 17 extreme wave events exceeded 8 metres in 2017, of which 15 were around the South Island. In the same year, 16 extreme wave events exceeded 8 metres in oceanic regions (see indicator: Oceanic and coastal extreme waves).
- Preliminary trends indicate that the frequency of extreme wave events is increasing to the east and south of Aotearoa, and decreasing on the North Island's west coast and to the north of the Bay of Plenty (see indicator: Oceanic and coastal extreme waves). Data is only available for a short period of time (2008–17), meaning it is not yet possible to conclusively determine whether this is a long-term trend or due to climate cycles such as the Interdecadal Pacific Oscillation.

Coastal and estuarine water quality and sediment show variable trends, reflecting changing human and natural pressures.

- A range of physical, chemical, and microbiological measures are used to monitor coastal and estuarine water quality at sites across Aotearoa (see indicator: Coastal and estuarine water quality). For regional councils/unitary authorities where trends could be determined, trends were analysed between 2006 and 2020, and classified as improving or worsening, (or increasing or decreasing), where the confidence in trend direction was 'likely' (above 66 percent) or 'very likely' (above 90 percent). However, where the confidence in trend direction was below 66 percent, we use the term 'indeterminate' which indicates that there was insufficient evidence to confidently determine a trend direction.
- Of measures influenced by suspended sediment, there were more sites with improving trends than worsening trends for suspended solids and turbidity (a measure of how cloudy the water is). However, more sites had worsening trends than improving for visual clarity.
- For all nutrients measured (forms of nitrogen and phosphorus), more sites had improving trends than worsening trends.
- Of other measures, more sites had improving trends than worsening for chlorophyll-a and faecal coliforms. However, for *Enterococci* and dissolved oxygen more sites showed worsening trends than improving trends.
- It is difficult to measure the ecological importance of state and trends in coastal and estuarine water quality without established thresholds for ecosystem health.
- Sediment accumulation in estuaries is increasing in many parts of Aotearoa, but the accumulation rates are highly variable (see *Our marine environment 2019*). In the Pāuatahanui and Onepoto arms of Te Awarua-o-Porirua Harbour, the average sedimentation rates were 9.1 millimetres per year and 5.7 millimetres per year respectively for the 35 years from 1974 to 2009 (Gibb & Cox, 2009). Sediment accumulation rates in some parts of Waikato estuaries are many times greater than historic sedimentation rates (Hunt, 2019). See *Our marine environment 2019*).
- Heavy metals can accumulate in estuarine and coastal sediments from rural and urban sources. Concentrations of lead, cadmium, copper, and zinc were below default guideline values (DGV) for toxicants in sediment at most monitored coastal and estuarine sites across Aotearoa between 2015 and 2018 (see indicator: Heavy metal load in coastal and estuarine sediment). Values below the DGV indicate a low level of risk of toxic effects on marine ecosystems (Australian Government Initiative, 2018).

The condition and extent of some marine habitats continue to change, which can adversely affect ecosystems and species.

- Our marine environment covers a very large area. It includes a diverse range of habitats, ecosystems, and unique species, of which many are considered taonga (Harmsworth & Awatere, 2013; MacDiarmid et al, 2013; Paul-Burke et al, 2020). Since human settlement, the condition of marine habitats has significantly declined, which in turn affects ecosystems and species (see *Our marine environment 2019*).
- Our limited knowledge and understanding of marine habitats and ecosystems makes it challenging to assess their extent and condition. These limitations are, in part, due to

the high monitoring costs, particularly those for remote and deep waters (MacDiarmid et al, 2013).

- The extent and condition of most biogenic habitats that are monitored has reduced dramatically, from intertidal areas to subtidal areas, including seamounts (Harmsworth & Awatere, 2013; Morrison et al, 2014). For example, salt marsh and seagrass extent has declined since human settlement, with land converted from native forest for agricultural and urban land use (Morrison et al, 2014). See *Our marine environment 2019*).
- In response to land-based sediment inputs, mangroves are increasing in extent on northern North Island coastlines, (Anderson et al, 2019; Horstman et al, 2018; Morrison et al, 2014).
- The state and condition of habitats affects marine species in a number of ways, including by affecting food supply, shelter, breeding, and migration (MfE & Stats NZ, 2019). High levels of biodiversity within an ecosystem help to support its resilience to different pressures (Thrush et al, 2011).
- Ocean primary productivity provides the energy that supports most marine food webs, and at broad scales is indicated by the abundance of phytoplankton (see *Our marine environment 2019*). Ocean primary productivity has decreased in some coastal and oceanic regions but increased in others (see *Our marine environment 2019* and indicator: Primary productivity).

Many marine bird and identified taonga species are threatened with extinction or at risk of becoming threatened.

- Ninety percent of indigenous seabirds and 82 percent of indigenous shorebirds were classified as threatened with extinction or at risk of becoming threatened with extinction in 2016 (see indicator: Extinction threat to indigenous marine species).
- Only 9 percent of sharks, rays, and chimaeras were classified threatened with extinction or at risk of becoming threatened with extinction in 2016, with over 50 percent considered not threatened. Thirty-nine percent were classified as data deficient (see indicator: Extinction threat to indigenous marine species). Since the introduction of the 2008 New Zealand threat classification system, the only marine fishes assessed have been sharks, rays, and chimaeras.
- Twenty-two percent of marine mammal species were threatened with extinction or at risk of becoming threatened with extinction in 2019. Sixty-seven percent were classified as data deficient (see indicator: Extinction threat to indigenous marine species).
- Eighty-one percent of assessed marine invertebrate species were threatened with extinction or at risk of becoming threatened with extinction in 2013. Of those assessed, 15 percent were classified data deficient. Over 95 percent of New Zealand marine invertebrates remain unassessed (see indicator: Extinction threat to indigenous marine species).
- Thirteen percent of assessed macroalgae were threatened with extinction or at risk of becoming threatened with extinction in 2019. Among this assessment are 609 species (68 percent of the total assessment) recorded as being data deficient (see indicator: Extinction threat to indigenous marine species).
- Twenty-nine of 112 identified marine taonga species were threatened with extinction, 57 were at risk of becoming threatened with extinction, and 26 were described as not

threatened in New Zealand Threat Classification System reports released in 2019 or earlier (Stats NZ, 2021) (see indicator: Extinction threat to indigenous marine species).

Impacts on people, culture, and wellbeing

The state of the marine environment has impacts on marine species, habitats, ecosystems, and people. Increases in sea-surface temperature, ocean acidification, and sea-level rise may impact marine species and ecosystems, coastal infrastructure and communities, sites of significance, and mātauranga Māori and tikanga. Excess sediment and nutrients, plastics, and non-indigenous introductions can pose risks to marine ecosystems. Changes to biodiversity and ecosystems have potential to influence connections to our marine environment.

Marine species and ecosystems may be impacted by climate change.

- Ocean acidification may directly and indirectly affect a large number of marine mammals, as some species that have a narrow habitat tolerance struggle to adapt as they get nearer their biological limits (Roberts & Hendriks, 2022).
- Increased acidity means shellfish may have to use more energy to grow their shells, which leaves less for tissue growth and reproduction (Law et al, 2018). Many molluscs affected by ocean acidification are taonga species such as pāua and green-lipped mussels (Cummings et al, 2021; Keegan et al, 2022; Paul-Burke et al, 2020).
- Organisms such as deep-water corals form important biogenic habitats but are particularly susceptible to ocean acidification, which has negative impacts for the associated ecosystems (Cummings et al, 2021).
- Ongoing sea-level rise and the potential for increased frequency and intensity of extreme wave and storm surges pose significant risks to the extent and health of coastal species and ecosystems, including the intertidal zone, estuaries, dunes, coastal lakes, and wetlands (Wong et al, 2014).
- There have been observations of sea-level rise and storm surges leading to a loss of nesting sites for some shorebirds (Keegan et al, 2022).
- Climate change impacts in areas with coastal development, such as sea walls, can lead to 'coastal squeeze', which is the loss of coastal habitat due to sea-level rise (Cummings et al, 2021; MfE & Stats NZ, 2022; Rouse et al, 2017).
- Increased erosion and wave exposure can impact seaweeds and animals, such as mussels, living on exposed rocky reefs (see *Our marine environment 2019*).
- Increasing sea-surface temperatures can affect the growth and reproduction of some marine species, including plankton and snapper, which can affect the wider food web. Marine heatwaves can also disrupt species – for example, bull kelp suffered losses in Kaikōura and Lyttleton during the 2017/18 marine heatwave in Aotearoa (Thomsen et al, 2019). See *Our marine environment 2019*.

Our coastal infrastructure, communities, and sites of significance may be at risk from climate change.

- Sea-level rise, extreme wave and storm events, coastal erosion, and coastal inundation threaten the infrastructure near our shores. Infrastructure at risk includes housing, public amenities, water, energy, transport, communications, waste, and coastal defences (MfE & Stats NZ, 2022; PCE, 2015). In 2019, 2,273 km of roads, 5,572 km of water pipes, 2,457 km^2 of land, and buildings with $26.18 billion replacement value (2016), were assessed as vulnerable if sea levels rise by 0.6 m (NIWA, 2019a).
- Many communities are affected by climate change, with over 72,000 people and 49,700 buildings currently at risk from coastal flooding (MfE & Stats NZ, 2022; Paulik et al, 2020). Such events disrupt communities and damage buildings, which can impact the financial, physical, and mental health of individuals and communities (MfE & Stats NZ, 2020; Stephenson et al, 2018).
- Wāhi tapu (sites of significance) (eg traditional coastal burial sites),and marae along the foreshore and seabed are prone to erosion and can be compromised (Awatere et al, 2021). This can require an adaption of tikanga practices, and in some cases, reburial/relocations (Awatere et al, 2021).
- Many sites of importance for ecological, archaeological, and recreational purposes are in low-lying coastal areas at risk from coastal inundation with rising sea level, including 420 archaeological sites on Public Conservation Land (Tait, 2019).

Traditional knowledge practices and tikanga can be impacted by climate change.

- At the core of tikanga Māori is a world view which emphasises the importance of relationships: between people and the natural world and among people (Bargh & Tapsell, 2021).
- Many forms of mātauranga Māori were directly or indirectly sourced from the environment, making special note of seasons, circumstances, and habitual cycles (Paul-Burke et al, 2020). Intergenerational knowledge, such as the use of whakataukī (proverb), is essential to established practices that govern the harvesting, use, and protection of natural resources (Whaanga et al, 2018).
- “There will be a shift and a movement in how we understand the taiao (environment) and how this affects taonga species in the environment. It is possible that our knowledge of the maramataka will adapt and how it is applied to current practices (eg fishing, mahinga kai (food gathering practices), planting, and harvesting) and how this will be applied to the stars and moon will adapt.” (Rereata Makiha pers. comm., 2022). Maramataka is the traditional Māori way by which time was marked by observing the phases of the moon.
- Climate change and the changes to habitats, ocean temperatures, weather events, and ocean acidification can impact tikanga and associated practices such as observing the maramataka. Mātauranga Māori, including maramataka, holds centuries of observations to understand causal effects (Hikuroa, 2017).
- Changes to marine ecosystems due to climate change, impacts the ability to practice manaakitanga (caring for visitors) and undertake other important kaitiakitanga (guardianship) practices (Awatere et al, 2021; Harmsworth & Awatere, 2013). These impacts could also mean the loss of knowledge to future generations and transmission of mātauranga Māori and have cultural consequences impacting the links between tāngata (people) and the marine environment (Ataria et al, 2018; Awatere et al, 2021).

Mahinga kai practices associated with gathering kai moana are at risk.

- Being able to gather kai moana and practice mahinga kai (customary food gathering) is an important indication of mauri both for iwi, hapū and whānau, the surrounding community and the ocean (MfE & Stats NZ, 2022; Phillips et al, 2016). Mauri is an important Māori measure that describes the health and vitality of living systems.
- Mauri is found in all things, through all things and around all things, including us as people (Hikuroa et al, 2011). The essential bond between the physical and spiritual is weakened when actions negatively impact the mauri of something. Broken bonds can lead to the separation of the physical and spiritual elements causing the loss of capacity to support life (Morgan, 2006).
- Sea-level rise and coastal erosion are impacting coastal habitats, biodiversity, and access to sites of customary gathering of taonga species (Awatere et al, 2021). Coastal habitats and places of customary gathering are prone to reduction which can compromise tikanga practices (MfE & Stats NZ, 2019, 2022).
- Ocean acidification and sea-surface temperature put taonga species at risk, which affects the sustainability of kai moana and ability to practice mahinga kai and transmission of knowledge (Awatere et al, 2021; MfE & Stats NZ, 2022; Paul-Burke, 2020; Phillips et al, 2016).
- Climate change pressures are likely to affect the ability to practice mahinga kai and rongoā (healing), and the associated mātauranga Māori (Awatere et al, 2021; MfE & Stats NZ, 2022).
- Excess nutrient levels in estuaries or the ocean can lead to algal blooms which reduce the availability of key cultural species and their habitats, leading to the loss of customary harvesting grounds (MfE & Stats NZ, 2022; PCE, 2020).

Marine ecosystems can be impacted by excess sediment and nutrient, plastic pollution, and the introduction of non-indigenous species.

- Excess suspended and deposited sediment in estuaries and coastal areas can harm marine species. Excess sediment can be harmful for the larval and juvenile life stages of some fish species by reducing available nursery grounds and changing fish gill structure. Fine suspended sediment can clog the gills of cockles, pipi, and scallops which feed by filtering food from the water (Booth, 2020; Lowe et al, 2015; Morrison et al, 2009; PMCSA, 2021).
- Deposited sediment can have a range of impacts on marine ecosystems such as smothering sensitive species, altering habitats on the seafloor, and reducing water quality in coastal zones (Booth, 2020; Lowe et al, 2015; Morrison et al, 2009; PMCSA, 2021).
- Excess nutrient loads can lead to increased algal blooms, reduced oxygen levels, and potentially eutrophication, which can impact marine ecosystems (Dudley et al, 2020; Plew et al, 2020; Snelder et al, 2020).
- Plastic pollution can affect marine species and seabirds with ingested microplastics and affiliated contaminants accumulating as they move up the food chain (PMCSA, 2019). Some reported global impacts include, reduced nutrient intake, decreased reproduction, poisoning, and entanglement (PMCSA, 2019).
- A recent study in southern New Zealand found microplastics in 75 percent of fish across 10 assessed commercially valuable species (Clere et al, 2022).

- The extent to which microplastics will affect ecosystems is still largely unknown. The impact of microplastics is a growing area of research (PMCSA, 2019). See *Our marine environment 2019*.
- Non-indigenous species that become established have the potential to compete with, and prey on, indigenous species, modify natural habitats, affect marine industries, and alter ecosystem processes. Their impact on native species and habitats means they pose a risk to our natural and cultural heritage and to commercial and recreational fishing, shellfish harvesting, and aquaculture (MfE & Stats NZ, 2016).
- Between 2015 and 2018 most monitored sites had heavy metal concentrations below the default guideline values (DGV) for toxicants in sediment (see indicator: Heavy metal load in coastal and estuarine sediment). However, heavy metal concentrations above guideline values can be harmful to marine species as they can accumulate in some organisms (MfE & Stats NZ, 2019).

Commercial activity in the marine environment can impact ecosystems and biodiversity.

- Some commercial fishing activities, such as trawling and dredging, have long-lasting impacts on the seabed and surrounding marine environment (Clark et al, 2019). These impacts can include, altering the structure of the seabed, damaging habitats, re-suspending sediment, removing species from food webs, and altering marine population structures (Clark et al, 2019; MfE & Stats NZ, 2019).
- Some commercial fishing methods can lead to the accidental capture (bycatch) of species like seabirds, marine mammals, sharks, and dolphins. Bycatch particularly impacts our protected species because they generally have long life spans, mature at a late age, and have low fertility (Carrier et al, 2010; Fisheries New Zealand, 2021a; Robertson & Chilvers, 2011; Schreiber & Burger, 2001). See *Our marine environment 2019*.
- In the 2019/20 fishing year, there were 4,120 estimated seabird deaths, mainly from longline fisheries (Protected species bycatch, nd). See *Our marine environment 2019*.
- During fishing, non-commercial fish and invertebrates may also end up as bycatch. Undersized species and those without commercial value are often discarded. The scampi fishery has the proportionately highest amount of bycatch, with 3.8 kilograms discarded for every kilogram of scampi caught (MfE & Stats NZ, 2019).
- Healthy fish stocks and ecosystems are important for the fisheries industry. As of December 2021, almost 85 percent of routinely assessed fish stocks in New Zealand were considered to be fished within safe limits and most of these also met their management goals (Fisheries New Zealand, 2021b). Of the 15 percent that are considered overfished, 8 stocks were collapsed, meaning that closure should be considered to rebuild the stock as quickly as possible (Fisheries New Zealand, 2021b).
- Shipping and recreational vessels can cause ship strike and introduce and spread non-native species throughout New Zealand's marine environment (Clarke Murray et al, 2011; Constantine et al, 2015; Darling et al, 2012; Dodgshun et al, 2007; Seebens et al, 2016). They can also be a source of noise and air pollution (Walker et al, 2019).

Faecal contamination in coastal and estuarine areas can have consequences for public health.

- In coastal and estuarine waters, the suitability of water for shellfish gathering and recreation are typically assessed using faecal indicator bacteria (LAWA, 2021). Their presence is used to identify the potential risk of illness from waterborne pathogens; the effects can include gastroenteritis, respiratory illness, and ear and skin infections (LAWA, 2021).
- From 2006 to 2020, where trends could be assessed, 50 percent of monitored sites were found to have improving trends of faecal coliforms, an indicator of the suitability for shellfish gathering. Thirty-eight percent of sites had worsening trends of Enterococci, an indicator of the suitability for recreation across New Zealand (Australian Government Initiative, 2018) (see indicator: Coastal and estuarine water quality).

Our connection to and ability to engage with the marine environment is a reflection of its state.

- The marine environment is of significant cultural importance and value to many Māori (Paul-Burke et al, 2020).
- Connection of tangata whenua to the soil and to the water is through whakapapa (genealogy). Māori are connected to ecosystems and all living beings as all beings whakapapa (genealogically connect) to Papatūānuku (Earth mother) and Ranginui (Sky father) (Harmsworth & Awatere, 2013; Rout et al, 2019).
- For many Māori, water is a taonga that implies kaitiakitanga responsibilities along with an intimate kinship connection to the taonga species of the waters (Rout et al, 2019). The tangata whenua ethos is a living arrangement and connection between tangata and whenua (land) across generations (Hakopa, 2019).
- If the mauri of the ocean is compromised, then the mauri of taonga species will also be compromised. This will impact on hapū and iwi connection to these taonga species. See *Environment Aotearoa 2022*.
- A degraded state of the marine environment and changes to the environment such as coastal sea-level rise and land loss affects connectivity to whenua for Māori, and the foundation of tūrangawaewae (the land base, a place of belonging, standing and identity) (Awatere et al, 2021; Harmsworth & Awatere, 2013). This poses a risk to the cultural functioning capacity of Māori and impacts the health and wellbeing of people.
- Many Māori have substantial concerns regarding the degradation of marine species and spaces (Paul-Burke et al, 2020).
- Many Māori see a need for improved provisions for tangata whenua to restore connections between iwi and hapū and their environments and enable Māori participation in decision-making at all levels (Ruru et al, 2017). This inherent right to participate as mana whenua is fundamental in te ao Māori.
- For some people, harbours, estuaries, coastal reefs, oceans, and beaches are places for recreation and play, enjoyment, and pleasure. For some Māori, these places are considered important for mahinga kai with kaitiakitanga responsibilities for sustaining life (Brake & Peart, 2013; Harmsworth & Awatere, 2013).

- The natural beauty of our estuaries, coastal and open ocean areas is central to our culture and national identity. Major population centres are also concentrated around the coast (MfE & Stats NZ, 2022).
- We get important cultural and wellbeing benefits from activities such as swimming, waka ama, surfing, kayaking, or gathering shellfish along the coast. If the water is too polluted to do these activities safely, its mauri is degraded, and so too is the mauri of the communities who engage with it. See *Environment Aotearoa 2022*.

Future reporting opportunities and information gaps

Our marine environment is highly interconnected. As a result, the challenges facing the marine domain are often complex and linked to pressures occurring far from our coasts and oceans. Understanding these pressures is necessary to ensure the decisions we make now give us the best possible chance of enjoying a thriving marine environment in the future.

New Zealand's environmental monitoring and reporting system plays a key role in protecting te taiao (the environment), but our ability to report on the state of the environment depends on how well we collect and analyse data about it, and that needs improving. *Our marine environment 2022* illustrates these challenges, in particular the passive harvesting of data raised by the Parliamentary Commissioner for the Environment in 2019. While work is underway to amend the Environmental Reporting Act, the need for a fit-for-purpose environmental monitoring and reporting system that is adaptable to future challenges is increasingly important.

While this report has highlighted new evidence and research into the state of our marine environments since *Our marine environment 2019*, there are opportunities to further advance our understanding by investing in and prioritising environmental research. This includes:

- advancing our knowledge of the interconnected and cumulative pressures on the state of the marine environment and its subsequent impacts
- investing in the development and use of emergent technologies that can improve the scale and coverage of environmental data and evidence
- improving access to rohe-based and place-based knowledge and evidence to enhance our understanding of localised pressures and impacts
- further research into the impacts of microplastics and liquid chemical pollutants on marine ecosystems, species, and people
- improving our understanding of the state of marine habitats and ecosystems, including their extent, condition, and ecological integrity
- enhancing the availability of data to monitor and assess the risks faced by key marine species
- increasing the resourcing, access, and integration of mātauranga Māori within our environmental monitoring and reporting system to reflect te ao Māori perspectives and aspirations
- conducting more research and improving national data around coastal and estuarine water quality, erosion and sediment, and their effects on ecosystem health.

Environmental indicators

The data used in *Our marine environment 2022* is drawn from *Our marine environment 2019* and *Environment Aotearoa 2022* and the Stats NZ indicators that have featured in them. Data from four indicators updated since *Our marine environment 2019* have also been incorporated. Listed below are the indicators that have been incorporated in this report including the four updated indicators (in bold):

- **Coastal and estuarine water quality**
- **Ocean acidification**
- **Coastal sea-level rise**
- **Extinction threat to indigenous marine species**
- Heavy metal load in coastal and estuarine sediment
- Marine non-indigenous species
- Primary productivity
- Oceanic and coastal extreme waves
- Sea surface temperature
- Temperature

Acknowledgements

Data providers

We would like to thank the following for providing data and advice in the development of indicators used in this report:

Auckland Council; Bay of Plenty Regional Council; Climate Research Unit at the University of East Anglia; Department of Conservation; Environment Canterbury; Environment Southland; Environment Waikato; Greater Wellington Regional Council; Hawke's Bay Regional Council; Horizons Regional Council; John Hannah (Vision NZ Ltd); Land Information New Zealand (New Zealand Hydrographic Authority); Marlborough District Council; Ministry for Primary Industries; National Aeronautics and Space Administration; National Oceanic and Atmospheric Administration; Nelson City Council; New Zealand Ocean Acidification Observing Network and sampling partners; NIWA; Northland Regional Council; Otago Regional Council; Rob Bell (Bell Adapt Ltd); Tasman District Council, Waikato Regional Council.

Mātauranga providers

This report includes several passages of mātauranga from te ao Māori contributed by individuals, groups, whānau, hapū, and iwi. In particular, we acknowledge:

Rereata Makiha

Dr Hauiti Hakopa

Senior science and mātauranga advisors

Dr Hauiti Hākopa, Mātauranga Māori Researcher and Advisor

Pete Wilson, 4Sight Consulting – Part of SLR

External peer reviewers

Carolyn Lundquist, NIWA

Hilke Giles, Pisces Consulting

Oliver Wade, Marlborough Regional Council

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