

A photograph of two children in a stream. In the foreground, a girl with blonde hair, wearing a red and white striped shirt, blue shorts, and a colorful patterned hat, is crouching in the water. She is holding a yellow, fan-like object (possibly a net or a piece of coral) and is about to drop it into the water. In the background, a boy wearing a blue t-shirt with a whale graphic, blue shorts, and a tan bucket hat is standing in the water, holding a long wooden stick. The water is calm with some ripples. The background shows green foliage and trees.

Environment Aotearoa 2019 Summary

New Zealand's Environmental Reporting Series



Ministry for the
Environment
Manatū Mō Te Taiao

Stats NZ
Tatauranga Aotearoa

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► Aotearoa New Zealand

Our land and sea are unique and very special, having evolved so distinctly and separately from the rest of the world. From the time our ancestors first stepped onto its shores, the land of the long white cloud has provided nourishment, protection, and resources to its inhabitants. People have become part of the environment and shaped it, modifying the land to grow food, building houses, and establishing settlements, roads, and infrastructure.

The relationship and connection New Zealanders have with the environment goes well beyond the goods and services we receive from it, like food, fuel, and clean water. Our environment is where we stand, our *tūrangawaewae* – where we live, learn, work and earn a living, play, and socialise. It is our home and our identity, and the foundation of our national culture and tradition.

For Māori as *tangata whenua* – people of the land – that connection is indivisible from the health of Papatūānuku, the Earth Mother.

Te ao Māori (the Māori world view) has an important place in environmental reporting in New Zealand. It ensures the unique connection of *tangata whenua* is respected and brings a way of thinking that helps us all see ourselves as a part of, not apart from, the environment.

The changes we have made (and continue to make) to this rich landscape are having profound effects on our environment. Some parts of our environment are in good shape, others less so. How we go forward from here is up to us all.

► About this summary report

This summary is an overview of *Environment Aotearoa 2019*, which is part of the Ministry for the Environment and Stats NZ's legislated environmental reporting programme. Every six months we produce a report focused on a different 'domain' – air, freshwater, marine, atmosphere and climate, and land. Every three years we produce a 'synthesis' report – bringing together the data and findings from across the domain reports to help us step inside and view our environment as a whole, in all its complexity.

Environment Aotearoa 2019 uses five themes to look into nine priority issues – those that matter most to the current state of our environment.

An 'issue' is a change in the state of the environment that is (partly) caused by human activities (pressures) and has consequences (impacts).

Parliamentary Commissioner for the Environment

While not suggesting any responses (which are out of scope under the report's governing legislation), *Environment Aotearoa 2019* provides evidence to enable an open and honest conversation about what we have, what we are at risk of losing, and where we can make changes.

For the full picture on the health of our environment and more detail on each issue, see [Environment Aotearoa 2019](#).

Throughout this summary report, you'll see references and links to various environmental indicators. These are metrics that help us assess the state of the environment. Each indicator that appears in *Environment Aotearoa 2019* has an accompanying web page and a dataset that is free to access.

► A focus on what matters

Environment Aotearoa 2019 presents the most important issues that affect the health of our environment today.

Four criteria were established to help describe the sense of significance and urgency of the issue:



Spatial extent and scale – how much of New Zealand is affected by the issue?



Magnitude of change – is the issue increasing in scale and/or distribution, or accelerating?



Irreversibility and lasting effects of change – how hard is it to fix?



Scale of effect on culture, recreation, health, and economy – how much does it affect the things we value?

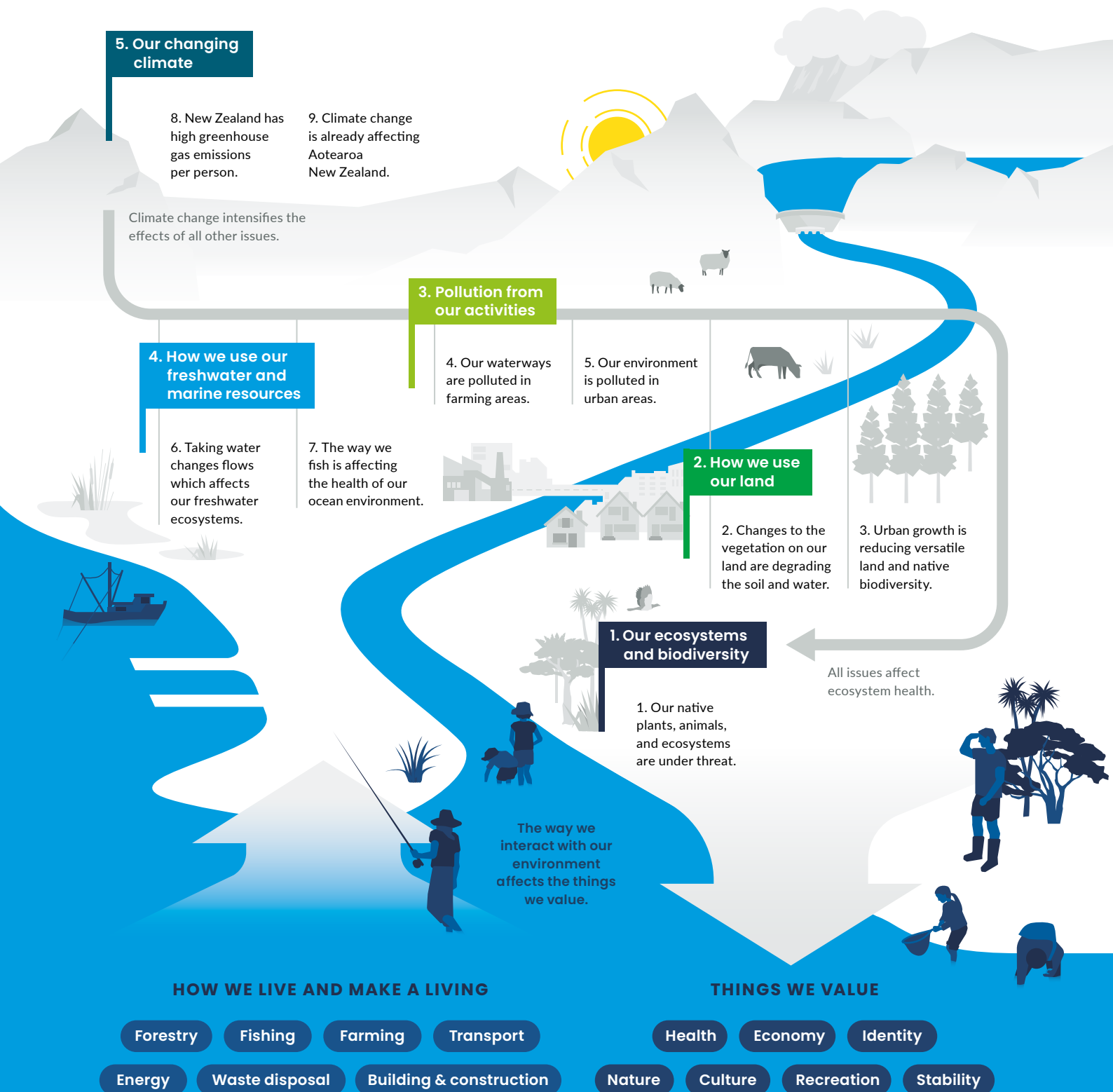
An independent panel of scientists verified the selection process to ensure the criteria were appropriately applied to the issues. The relevance of the nine issues to *mātauranga Māori*, *kaitiakitanga*, and other cultural values was also considered by Māori researchers and practitioners.

The priority issues presented here are not an exhaustive list of all the pressures our environment faces. Some have an impact on the environment but are not featured here as they do not rank as highly against the criteria as other issues. Mining for example, is not included because of its localised nature.

As an issue is defined as a change in the state of the environment, some environmental problems are not included such as plastic waste which is considered as a pressure.

► *Environment Aotearoa 2019* themes and issues

The themes and issues in this report show how the way we live and make a living affects our environment and the things we value.



**THEME 1**

Our ecosystems and biodiversity

Photo credit: iStock

The biodiversity of Aotearoa New Zealand is essential to our culture, identity, and well-being. The whole variety of native plants, animals, microorganisms, and the ecosystems they create, is unique to New Zealand and irreplaceable.

Our native plants and animals are under pressure from all the issues identified in *Environment Aotearoa 2019*, including climate change, sedimentation, and urban development. When combined with the significant pressure from introduced species, this forms a set of 'compounding pressures' that can intensify the effects of individual pressures on animal and plant communities.

In this theme, we report on the state of our biodiversity, considering the loss and risk to species and ecosystems across land, freshwater, and marine environments.

ISSUE 1

Our native plants, animals, and ecosystems are under threat

Our unique native biodiversity is under significant pressure from introduced species, pollution, physical changes to our landscapes and coast, harvesting of wild species, and other factors. Almost 4,000 of our native species are currently threatened with or at risk of extinction.

► What is happening?

The biodiversity of Aotearoa New Zealand is unique and vulnerable to changes we make to the environment. Many of the species found here are found nowhere else in the world.

Our biodiversity has declined significantly. At least 75 animal and plant species have become extinct since humans arrived in New Zealand. Marine, freshwater, and land ecosystems all have species at risk: 90 percent of seabirds, 76 percent of freshwater fish, 84 percent of reptiles, and 46 percent of vascular plants are currently threatened with or at risk of extinction.

The extinction risk has worsened for 86 species in the past 15 years. The conservation status has improved for 26 species in the past 10 years, but more than half require active management to stay that way. Kākāpō is one example.

For a small country, we have a very diverse range of unique ecosystems. Some are naturally rare (there were only a few even before people arrived, like volcanic dunes) and others are also uncommon internationally (like braided rivers). Many of our native ecosystems have been cleared or extensively altered, and this trend continues today.

► Why is it like this?

People have changed the landscape and introduced new species. Farming and urban expansion have caused forests to be cleared and wetlands to be drained. In the process, habitats and species have been lost. Farming and urban expansion also create pollution, such as excess nutrients (like nitrogen) and sediment, which can degrade ecosystems and harm organisms. Taking water degrades our freshwater ecosystems (see Issue 6), while commercial fishing alters marine ecosystems and can accidentally kill threatened species (see Issue 7).

Introduced species threaten our native species through competition, predation, and diseases. Non-native plant species now outnumber natives here, and stoats, possums, and rats were present on more than 94 percent of New Zealand land in 2014.

New diseases also pose threats: myrtle rust, a disease that kills native plants like mānuka, pōhutukawa, and rātā, made it to our shores in 2017.

Climate change is already impacting some species by changing where they are found or creating conditions where invasive pests like wasps can live (see Issue 9).

► What are the consequences?

Healthy ecosystems provide important functions that benefit us and our society. Native forests, for example, regulate the climate (by storing carbon), prevent erosion, and create nectar for honey production. Natural wetlands also provide important ecosystem services (benefits we receive from nature) such as purifying water by filtering out nutrients and sediments, regulating water flow during storms, and storing carbon as peat. Degraded habitats and a loss of species can make ecosystems less resilient to other changes and lead to further declines in biodiversity.

Degradation of our ecosystems and a loss of biodiversity can also impact our ability to connect with and use the environment. Native biodiversity provides mahinga kai (food provisioning) and materials for other purposes like raranga (weaving) and rongoā (medicinal uses). It also provides important indicators (like the timing and intensity of flowering) for kaitiaki, as well as being essential for maintaining and passing knowledge from one generation to another.

Losing biodiversity affects our sense of belonging and connection. We call ourselves 'Kiwis' and proudly use the silver fern (ponga) as a national symbol, so our identity suffers when we experience damaged or lost native species and ecosystems. Recreation opportunities and the connections we have to nature are also affected.

New and updated environmental indicators used in *Environment Aotearoa 2019*:

- **Conservation status of indigenous freshwater species**
- **Conservation status of indigenous land species**
- **Conservation status of indigenous marine species**
- **Lake water quality**
- **River water quality: macroinvertebrate community index**

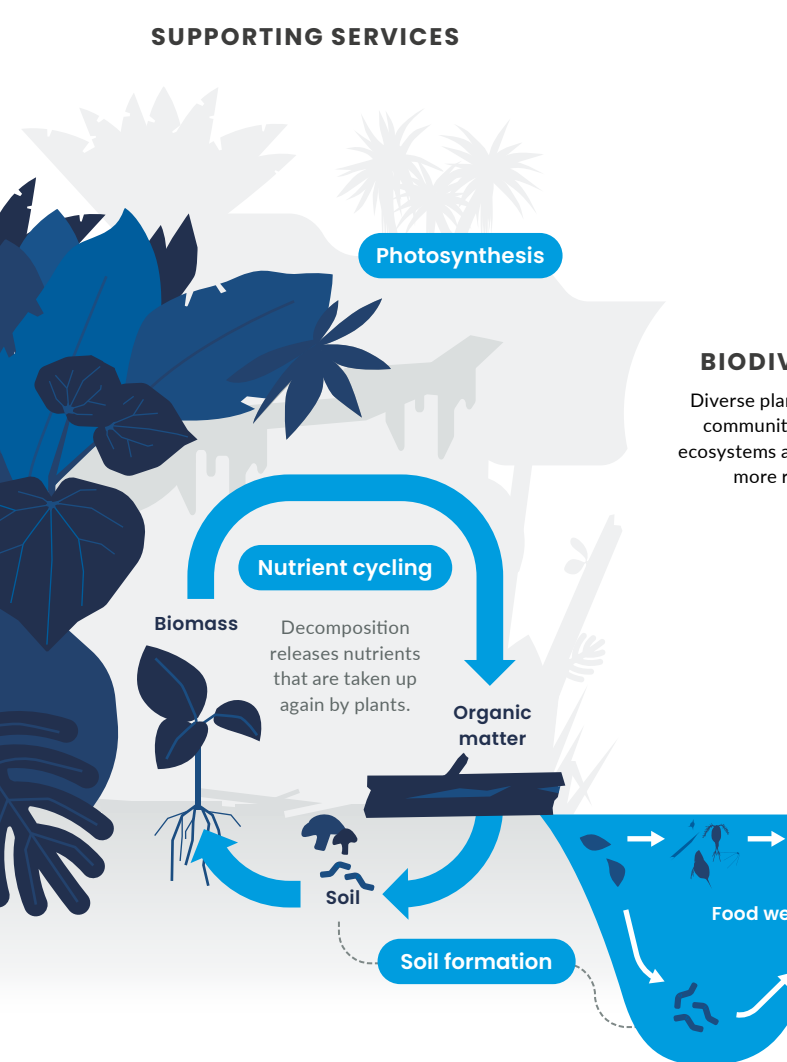
Existing environmental indicators used in *Environment Aotearoa 2019*:

- **Active sand dune extent**
- **Cultural health index for freshwater bodies**
- **Freshwater pests**
- **Lake submerged plant index**
- **Land cover**
- **Land pests**
- **Marine non-indigenous species**
- **Predicted pre-human vegetation**
- **Rare ecosystems**
- **Wetland extent**

► Ecosystems

A healthy ecosystem provides many benefits (services) that are essential for native plants and animals as well as our own well-being.

SUPPORTING SERVICES



REGULATING SERVICES

Air purification

Plant pollination

Disease control

Climate stabilisation

Flood mitigation

Erosion control

Water purification

Riparian zone

The transitional habitats between land and water have many important functions.

BIODIVERSITY

Diverse plant and animal communities stabilise ecosystems and make them more resilient.

CULTURAL SERVICES



CULTURAL VALUE

A healthy ecosystem enables tangata whenua to connect with the environment and each other. It provides sustenance and materials for cultural practices and expressions like waiata, karakia, and wairua.

PROVISIONING SERVICES



Food



Water



Medicines



Wood and fibre

ECOSYSTEM HEALTH

Measuring the overall condition of our ecosystems is more than counting the number of different species. Ecosystems are complex and made of many interacting biological and physical components that can all be affected by environmental changes.



THEME 2

How we use our land

Photo credit: Photonewzland

The changes we have made to our land have significantly altered the wider environment. This theme highlights two specific types of physical changes we humans have made to the world around us:

1. **What we have removed:** Cutting down native forests, draining wetlands, and clearing land for farming and development have accelerated our naturally high rates of soil loss. This has also degraded a range of ecosystem services provided by native vegetation.
2. **What we have built:** Human-made structures and hard surfaces affect the natural systems we rely on. There is a particular focus in this issue on the spread of urban areas over versatile land (which can be used for many purposes, including farming) and scarce high-class soils.

ISSUE 2

Changes to the vegetation on our land are degrading the soil and water

Logging native forests, draining wetlands, and clearing land have degraded a range of benefits provided by native vegetation, accelerated our naturally high rates of soil loss, and affected our waterways.

► What is happening?

Since human arrival in New Zealand we've shaped our physical surroundings. Native vegetation has been extensively cleared so that the native forests that once covered about 80 percent of the country, now only cover a little over one quarter of New Zealand. Ten percent of New Zealand was once covered by wetlands – 90 percent of these original wetlands have now been drained.

In 2012, just over half of our land had a modified land cover like urban areas and non-native (exotic) vegetation. Exotic grassland (pasture) is now the largest single type of land cover and accounts for about 40 percent of our total land area. Exotic (plantation) forest covers about 8 percent of the country, concentrated in the central North Island.

The loss of native vegetation has continued in recent years, with more than 70,000 hectares lost between 1996 and 2012 through conversion to pasture, plantation forestry, and urban areas. Wetland areas have also continued to shrink, with at least 1,247 hectares lost between 2001 and 2016.

► Why is it like this?

The conversion of native vegetation to pasture and plantation forestry has supported the way we live and provided our livelihoods. In 2016, agriculture contributed 4.2 percent of our gross domestic product (GDP) and employed more than 122,000 people, while forestry contributed over \$1.7 billion to our economy and employed over 6,000 people. Our growing population also drives urban expansion.

► What are the consequences?

When native forests, shrublands, and wetlands are lost, we lose the wide range of benefits (ecosystem services) they provide. These benefits include regulating the flow of water in rivers and streams, recreation, storing carbon, purifying water, and providing habitats for native species. The benefits we get from simply being in nature, though not measured or quantified, could also be lost.

Loss of native vegetation has accelerated New Zealand's naturally high rates of erosion and soil loss. A model of soil erosion shows that 44 percent of the soil that enters our rivers each year is likely to come from land covered in pasture. Once they are established, plantation forests retain soil in the same way as native forests, but harvesting by clear-felling exposes and disturbs the soil, which can then be vulnerable to erosion for up to six years after harvest.

The economic losses associated with soil erosion and landslides are estimated to be at least \$250–300 million a year. Increased erosion and soil loss can also increase sediment in our rivers, lakes, and coastal environments. Too much sediment can smother freshwater and marine habitats, inhibit the growth of aquatic plants and animals, and increase the risk of flooding in towns and cities.

When ecosystems and biodiversity have been degraded, there is a corresponding effect on the extent, quality, and access to customary resources, like kaimoana.

Updated environmental indicator used in *Environment Aotearoa 2019*:

- [Highly erodible land](#)

Existing environmental indicators used in *Environment Aotearoa 2019*:

- [Estimated long-term soil erosion](#)
- [Land cover](#)
- [Wetland extent](#)

► The changing way we use our land

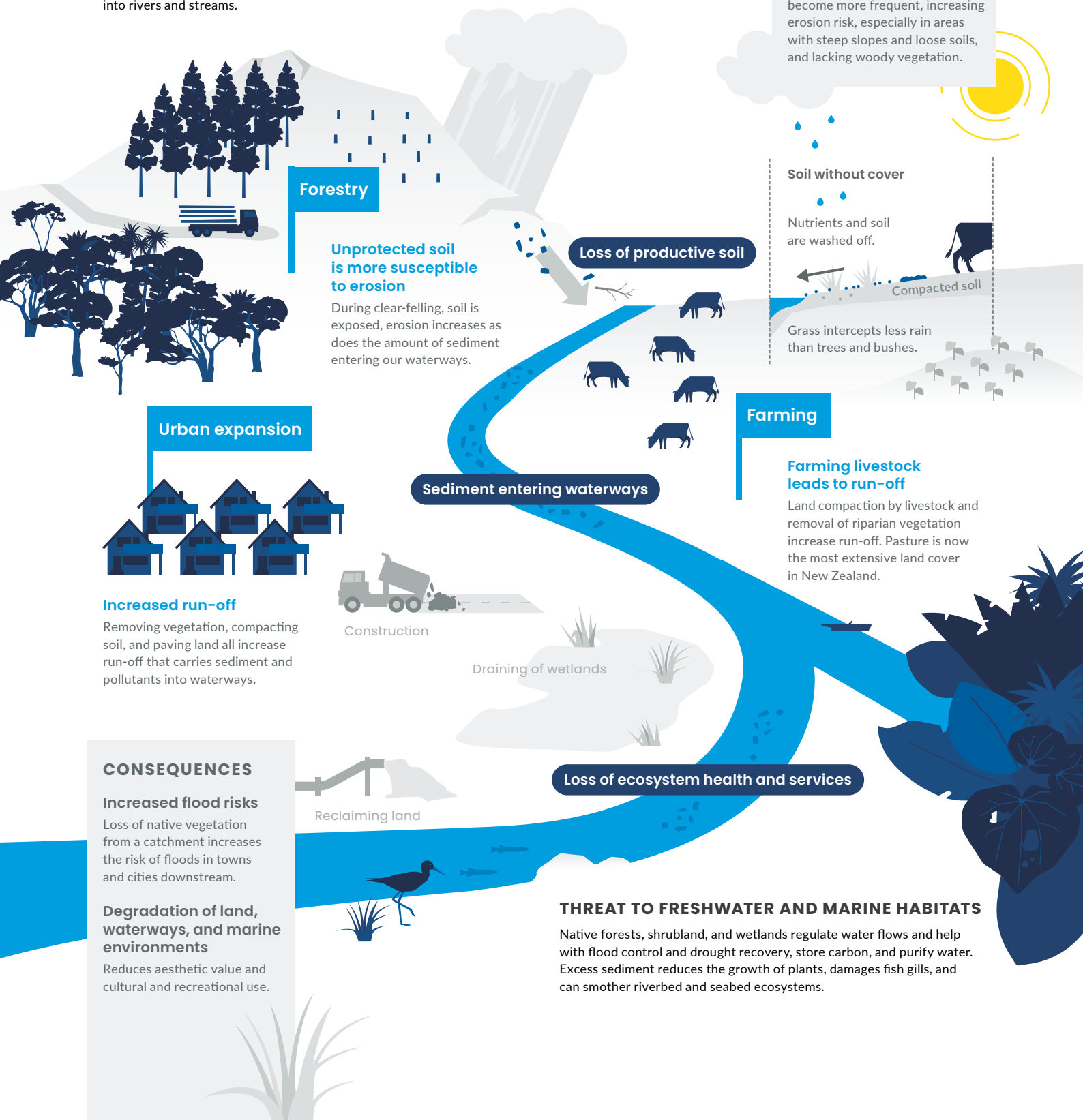
Replacing native vegetation with exotic forest, grasslands, or urban areas can increase erosion and degrade land, freshwater, and marine environments.

THE PROCESS OF EROSION

Water, wind, or ice can move sediment into rivers and streams.

CLIMATE CHANGE

Extreme rainfall is likely to become more frequent, increasing erosion risk, especially in areas with steep slopes and loose soils, and lacking woody vegetation.



ISSUE 3

Urban growth is reducing versatile land and native biodiversity

Growth of urban centres has led to land fragmentation and threatens the limited supply of versatile land near Auckland and other regional centres.

► What is happening?

Most New Zealanders live in cities. According to 2018 population estimates, 86 percent of us live in urban areas. Urban areas make up a small proportion of our total land area, only about 0.85 percent (approximately 228,000 hectares) in 2012. Most urban centres have developed on our best land – often fertile floodplains near the coast – with native forests being cut down and wetlands drained (see Issue 2).

Our urban areas are spreading – the area of urban land increased by 10 percent between 1996 and 2012, especially around Auckland, Waikato, and Canterbury. Between 1990 and 2008, 29 percent of new urban areas were on 'versatile' land. This type of land often has the best, or 'high-class', soils and has many agricultural uses (like growing food), but represents just over 5 percent of New Zealand's land.

The fringes of our urban areas are increasingly being fragmented – broken into smaller land parcels – and sold as lifestyle blocks. The number of lifestyle blocks has increased sharply in recent decades, with an average of 5,800 new blocks a year since 1998. A 2013 study found that 35 percent of Auckland's versatile land was used as lifestyle blocks.

► Why is it like this?

Urban expansion is mostly driven by population growth. Between 2008 and 2018 our population increased by 14.7 percent. Growth is expected to continue, with the highest rates in Tauranga, Auckland, and Hamilton, and lower rates in Wellington and Dunedin.

► What are the consequences?

Our versatile land and high-class soils are gradually being lost to urban growth, making them unavailable for growing food.

The loss of versatile land is happening at the same time as our food production system is under pressure to increase production without increasing its effect on the environment. This loss can force growers onto more marginal land that is naturally less productive and requires more inputs, like fertiliser.

Urban growth changes the land cover dramatically – and often reduces native habitats and biodiversity. In New Zealand, native land cover accounts for less than 2 percent of land in urban centres and only 10 percent on the urban-rural boundary.

Also, many of the plants and animals people bring with them to cities can be harmful to native biodiversity. For example, cats can hunt native animals, and non-native plants in gardens and urban plantings can become problematic weeds if they spread to native areas.

Existing environmental indicator used in *Environment Aotearoa 2019*:

- [Land cover](#)



THEME 3

Pollution from our activities

Photo credit: Ministry for the Environment

Our environment is polluted when substances or kinds of energy (noise, light, heat) enter it and cause harm.

Some pollutants directly affect our health. Pathogens (disease-causing microorganisms like the bacteria *Campylobacter*) in drinking water can cause illness, and very fine particles in the air can cause lung and heart problems. Other pollutants pose threats to the health of plants, animals, and ecosystems, like plastic waste in the ocean or excess nutrients in our waterways.

Pollution also affects our connections to nature. Artificial light from towns and cities reduces our view of the night sky, and murky streams spoil our enjoyment of these environments.

Most pollution comes from human activities, such as industry, agriculture, power generation, home heating, and transport, but some comes from natural events like volcanic eruptions. Often pollution has a mix of sources. Waterways, for example, can contain disease-causing bacteria from human or animal faeces, nutrients from farm run-off and urban areas, and heavy metals from vehicle wear (copper from brake pads and zinc from tyres).

This theme focuses on two kinds of pollution – pollution of waterways from farming and pollution in urban areas.

ISSUE 4

Our waterways are polluted in farming areas

Waterways in farming areas are polluted by excess nutrients, pathogens, and sediment. This threatens our freshwater ecosystems and cultural values, and may make our water unsafe for drinking and recreation.

► What is happening?

In farming areas, water pollution affects almost all rivers and many aquifers. Some lakes and estuaries may also be affected. Compared to catchments dominated by native vegetation, waterways in areas of pastoral farming have markedly higher levels of pollution by excess nutrients (like nitrogen), sediment, and pathogens.

Recent measurements show that water quality has been improving at some places, but worsening at others. It can be difficult to understand exactly what is causing the changes in water quality because water catchments can contain a mix of different types of farms and land uses, and the effects of natural variations in climate and the connections between rivers and groundwater are also poorly understood.

► Why is it like this?

In less than 1,000 years New Zealand has changed from an unpopulated group of islands covered with dense forest, to an intensely farmed country. Setting up our farms involved clearing native vegetation and draining wetlands, which have dramatically affected how our soils and water function.

More recently there has been a significant shift from sheep and beef farming into dairy farming, most notably in Canterbury, Otago, and Southland. The national dairy herd increased by 70 percent between 1994 and 2017, while numbers of sheep and beef cattle declined. This shift is important because cattle excrete more nitrogen per animal than sheep (cows produce more urine and the urine has a higher nitrogen concentration).

We are also using our farmland more intensively now than a few decades ago. The number of cattle per hectare has increased in some parts of the country, a change that can make it more likely that pollutants will leach into waterways. The amount of nitrogen applied in fertiliser has also increased more than six-fold across the country since 1990.

► What are the consequences?

Our ecosystems can be seriously impacted by water pollution. For 2013–17, 71 percent of river length in pastoral farming areas had modelled nitrogen levels that could affect the growth of sensitive aquatic species. Higher nutrient levels may also cause excess algal growth (or blooms), which degrades the ecosystems and can make waterways and coastal environments unfit for recreational and cultural uses.

Water pollution by pathogens from livestock dung also has risks to human health, including gastrointestinal illness. Computer models estimate that 82 percent of the river length in pastoral farming areas was not suitable for activities such as swimming, based on the predicted average *Campylobacter* infection risk during the period 2013–17.

Water pollution degrades cultural values such as mauri and wairua of waterways, and impacts the customary practices associated with mahinga kai and kaitiakitanga (guardianship). When waterways are polluted it can also affect the mana (prestige) associated with an iwi or hapū.

New and updated environmental indicators used in *Environment Aotearoa 2019*:

- Coastal and estuarine water quality
- Groundwater quality
- Lake water quality
- Livestock numbers
- Nitrate leaching from livestock
- Nitrogen and phosphorus in fertilisers
- River water quality: clarity and turbidity
- River water quality: *Escherichia coli*
- River water quality: macroinvertebrate community index
- River water quality: nitrogen
- River water quality: phosphorus

Existing environmental indicators used in *Environment Aotearoa 2019*:

- Agricultural and horticultural land use
- Cultural health index for freshwater bodies

► Intensified farming

Recent intensification of farming has increased the risks of water pollution.

CHANGES TO OUR USE OF LAND IN THE PAST THREE DECADES

Less sheep, more cows

Cattle numbers have increased, especially dairy cattle. Cows produce more urine with a higher nitrogen concentration than sheep.

More animals per hectare

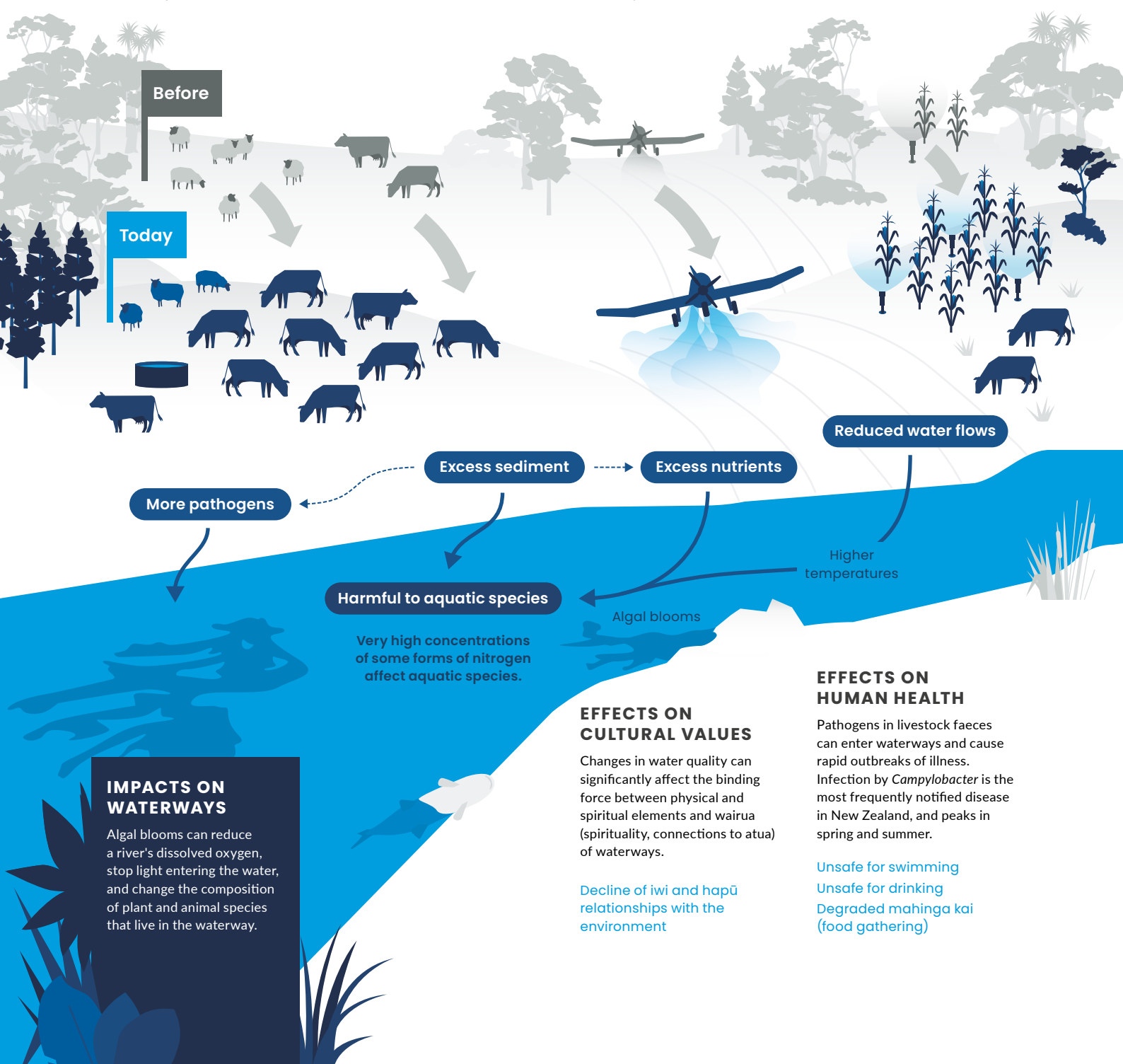
High stocking rates and vehicles driven on the land cause soil compaction, increasing the likelihood of polluting run-off into streams.

More fertiliser

The amount of nitrogen applied in fertiliser has increased. Fertilisers like nitrogen and phosphorus can pollute waterways.

More irrigated land

The amount of irrigated land has increased. Taking more water for irrigation reduces river flows and affects species and habitats.



ISSUE 5

Our environment is polluted in urban areas

Some of our cities and towns have polluted air, land, and water. This comes from home heating, vehicle use, industry, and disposal of waste, wastewater, and stormwater. Pollution affects ecosystems, health, and use of nature.

► What is happening?

Many different pollutants are produced in urban centres where most (86 percent) New Zealanders live (see Issue 3). The pollutants vary in type and amount, from place to place, and over time.

Our air quality is good in most places and at most times of the year. However, levels of tiny particles in the air that are bad for our health can exceed air quality standards, especially in cooler months because of emissions from home heating.

Urban waterways contain many of the same pollutants found in farming areas – excess nutrients (such as nitrogen), sediment, and pathogens – but their levels are typically even higher in our cities and towns. Urban waterways can also contain other pollutants, like heavy metals.

Recent measurements show that urban pollution has lessened in many places. Air particulate matter (PM₁₀) levels decreased in 17 of 39 monitored areas in winter between 2007 and 2016. Where changes in water quality could be detected between 2008 and 2017, the majority of urban river water monitoring sites had improving trends for nutrients and sediment. The trends for *E. coli* were mixed, with some sites getting better and some getting worse.

Less information is available about other types of urban pollution. Monitoring networks do not yet cover all our cities and towns. Data is not available to assess trends in light pollution, noise pollution, odours, or pollution in urban soil, land, or coastal waters.

► Why is it like this?

In urban areas, burning wood and coal for home heating in winter are the main sources of particulate matter in the air. Emissions from vehicles and industry also contribute to air pollution in some places. This includes particulate matter and carbon dioxide from cars, and nitrogen oxides and other gases from industries.

Pollutants enter urban waterways through the stormwater and wastewater networks. Stormwater is rainwater plus any pollutants it picks up on the land surface, like nutrients, pathogens, sediment, or heavy metals from the wear of road surfaces, tyres, and brake pads. Wastewater is the water that has been used in houses and businesses, which can contain nutrients, pathogens, and many chemicals used in industrial and domestic activities.

► Urban pollution

Urban areas are sources of pollutants that affect ecosystems and our health. The type and amount can vary from place to place and over time.

SOURCES OF URBAN POLLUTION

Home heating

Burning wood and coal for home heating during cooler months is the main source of particulate matter in the air in our cities and towns. Burning treated timber is the primary source of arsenic in urban air.

Air particulate matter



Transport

Vehicle emissions contribute to poor air quality. Abrasion of road surfaces, tyres, and brake pads release small particles, including heavy metals into the environment. Petroleum spills and leaks contaminate land, soil, and water.

Air particulate matter
Gaseous pollutants
Heavy metals



Industry and manufacturing

Pollutants from industry vary depending on the type of industry. Burning fuels for processes or electricity pollutes the air while storage or disposal of waste can contaminate soil and waterways.

Air particulate matter
Gaseous pollutants
Heavy metals



Wastewater and stormwater

Wastewater and stormwater enter urban streams through leaky pipes, illegal connections, and consented overflows during storms. Rainwater carries pollutants through the stormwater system into the waterways.

Nutrients
Pathogens
Sediment
Heavy metals



Soil pollution

Water pollution

Pesticides, pharmaceuticals, personal care products, and other substances are not all removed by treatment plants.

EFFECTS ON CULTURAL VALUES

Degraded mahinga kai and kaimoana limit traditional food for daily consumption and significant events, reducing the mana of individuals, whānau, and hapū, and their capacity to express hospitality.

EFFECTS ON HUMAN HEALTH

Asthma	Strokes
Coughing	Diabetes
Shortness of breath	Gastro-intestinal illness
	Premature death

EFFECTS ON AQUATIC ECOSYSTEMS

High concentrations of nitrate-nitrogen or ammonia can be toxic to aquatic species. Heavy metals can accumulate in food sources like fish and shellfish, making them unsafe to eat.

Contaminated drinking water

Degraded food

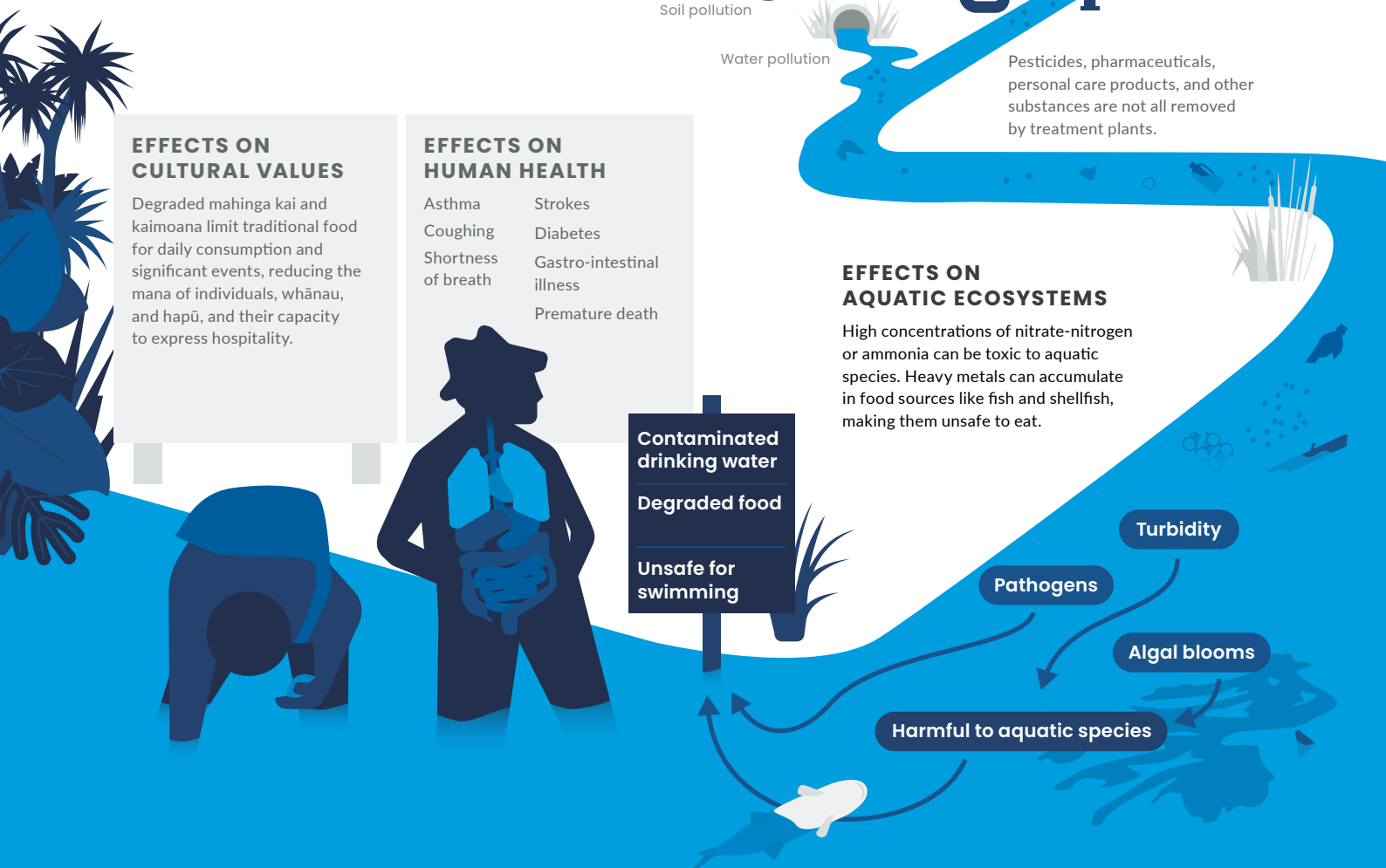
Unsafe for swimming

Turbidity

Pathogens

Algal blooms

Harmful to aquatic species



► What are the consequences?

Air pollution can have health impacts including shortness of breath, asthma, heart attack, stroke, and even premature death.

Water pollution can affect both human and ecosystem health. Computer models estimate that 94 percent of the river length in urban areas is not suitable for activities such as swimming, based on the predicted average *Campylobacter* infection risk between 2013 and 2017.

The models also show that 94 percent of river length in urban areas has nitrogen levels that may affect the growth of sensitive aquatic species. The elevated levels of nutrients in urban streams also increase the likelihood of excessive algal growth.

Pollution in urban areas impacts the mauri of ecosystems and affects values like the condition of mahinga kai and kaimoana (traditional foods), recreation (swimming, waka ama), and ora (health and well-being) of Māori.

Limited knowledge of the full range of pollutants, their extent, and their cumulative effects, makes it challenging to fully understand the impacts of urban pollution.

New and updated environmental indicators used *Environment Aotearoa 2019*:

- Coastal and estuarine water quality
- Heavy metal load in coastal and estuarine sediment
- River water quality: clarity and turbidity
- River water quality: *Escherichia coli*
- River water quality: nitrogen
- River water quality: phosphorus

Existing environmental indicators used in *Environment Aotearoa 2019*:

- Air pollutant emissions
- Artificial night sky brightness
- Carbon monoxide concentrations
- Ground-level ozone concentrations
- Health impacts of PM₁₀
- Land cover
- Nitrogen dioxide concentrations
- PM_{2.5} concentrations
- PM₁₀ concentrations
- Sulphur dioxide concentrations
- Urban stream water quality



THEME 4

How we use our freshwater and marine resources

Photo credit: Nature's Pic Images

Natural resources are essential for our modern way of life and we use them in an astounding number of ways. Some resources regenerate naturally but others, like fossil fuels, are not easily replaced. If we take too much from the environment, the use of a resource becomes unsustainable. This can affect natural systems and deny future generations the same opportunities and benefits from nature that we enjoy today.

This theme examines two activities where our use of a natural resource is affecting how the environment functions, and changing our relationship with it:

1. **Taking water from rivers, lakes, and aquifers:** Using water for agriculture, hydroelectric generation, and domestic purposes can have significant effects on our waterways. Here, we look at how taking water is affecting our waterways and our relationships with them.
2. **Fishing:** We fish for commercial gain, for food, recreation, and as part of our culture in te ao Māori. Fishing and gathering seafood are widespread in coastal areas and in our exclusive economic zone, and can have long-lasting effects.

ISSUE 6

Taking water changes flows which affects our freshwater ecosystems

Using freshwater for hydroelectric generation, irrigation, domestic, and other purposes changes the water flows in rivers and aquifers. This affects freshwater ecosystems and the ways we relate to and use our waterways.

► What is happening?

The use of freshwater supports our economy and way of life. We rely on surface water and groundwater (taken from aquifers) for drinking, domestic, and industrial uses, and irrigation from these sources is vital for farming. Although New Zealand has plenty of fresh water, we are also heavy users. In 2014, New Zealand had the second highest volume of water take per person of OECD countries.

Consents (permits) to take water are managed by regional authorities, which allocate water for particular uses. Individual consents to take water have specified conditions, such as how much water can be taken, from where, at what rate, and at what times.

Nationally, aside from hydroelectricity (which generally doesn't consume water but does alter river flows), most of the consented water allocation was for irrigation (51 percent in the 2013/14 year). Household consumption made up 14 percent, and industrial use made up 13 percent. Taking water for irrigation happens nationwide but on a large scale mainly in Canterbury and Otago. About 100 hydropower sites nationwide provided 55–60 percent of our electricity in 2017, lessening our dependence on fossil fuels.

► Why is it like this?

The demand for fresh water for irrigation has increased markedly. This has been driven by a near doubling of New Zealand's irrigated agricultural land area between 2002 and 2017, most notably in Canterbury. This reflects a nationwide shift from sheep and beef farming to dairy farming, and an increase in the number of animals per hectare in some parts of the country (see Issue 4).

► What are the consequences?

The consequences of taking water are mainly related to changes in river flows. Low river flows reduce the habitat for freshwater fish and other species that provide food for other species and for people. Native fish such as the taonga whitebait species inanga and tuna (eels) are vulnerable because they need to move between the sea and fresh water during their lifecycle and dams and culverts can block these migration. Taking water can also reduce the flows and number of channels in braided rivers, which affects some threatened birds like wrybill and kakī.

With reduced or less variable flows, the temperature and the concentration of nutrients and pathogens in a waterway can also increase and make them more susceptible to algal blooms. These changes can degrade freshwater ecosystems and make waterways unfit for recreational and cultural uses.

Updated environmental indicator used in *Environment Aotearoa 2019*:

- [Irrigated land](#)

Existing environmental indicators used in *Environment Aotearoa 2019*:

- [Consented freshwater takes](#)
- [Cultural health index for freshwater bodies](#)
- [Groundwater physical stocks](#)
- [Selected barriers to freshwater fish in Hawke's Bay](#)

► Effects of taking water

Taking water for irrigation, drinking, and hydroelectricity generation reduces the flow of water and its variability.

EFFECTS OF LOW FLOWS

Most hydro-generation does not use up water, but dams change the river flow and ecology downstream.

Barriers to migration
Loss of sediment transport

Reduced flows

Increased temperature
Creates algal bloom
Reduced oxygen

Degraded ecosystem

CLIMATE CHANGE

is projected to reduce flows in some rivers but increase flows in others. This will affect the frequency of droughts and floods in different parts of the country.

Less variability in flows

Changing the natural cycles of flooding and sediment supply affects habitats, migration, spawning, and food supply of some aquatic species.

Reduced biodiversity

Many of our native freshwater fish and birds are threatened with or at risk of extinction.

CONSENTED WATER TAKE

Regional authorities allocate water for hydroelectric generation, irrigation, drinking water, industrial, and other uses.

Irrigation is a major consented use of ground and surface water.

Shrinking habitat

Rivers become less dynamic and have fewer channels.

Reduced water availability

Wetlands dry out and less water is available.

CULTURAL VALUE

Decreased water flows reduce the mauri of the environment and the ability of tangata whenua to exercise kaitiakitanga of wetlands, rivers, and lakes.

Water table decline

Some rivers are recharged by aquifers and some aquifers are recharged by rivers. Taking water from aquifers can reduce the water flow in rivers and vice versa.

Salt water intrusion

Extracting groundwater can cause salt water to move into aquifers that are near the coast. This makes groundwater unfit for irrigation and drinking.



ISSUE 7

The way we fish is affecting the health of our ocean environment

Harvesting marine species affects the health of the marine environment and its social, cultural, and economic value to us. Fishing could change the relationship that future generations have with the sea and how they use its resources.

► What is happening?

As befitting an island country, many New Zealanders have a strong connection to the sea. For many, that connection is through fishing – for employment, enjoyment, or cultural connections.

Commercial fishing and the pressures associated with it have reduced in the last decade, and most (97 percent) commercially caught fish come from stocks that are considered to be managed sustainably. In 2017 16 percent of routinely assessed stocks were overfished and 10 stocks are considered collapsed.

Animals that are caught unintentionally are called bycatch. Bycatch of protected species like Hector's and Māui dolphins, fur seals, sea lions, and seabirds has reduced, but still has a serious effect because many of these species are already threatened.

Trawling the sea floor with large nets or dredges to catch fish and species like scallops and oysters are the most destructive fishing methods and cause damage to the seabed. The area trawled and the number of tows have decreased over the past 15 to 20 years, but still cover a large area, and some areas have been trawled every year for the past 27 years. Between 1990 and 2016 trawling occurred over approximately 28 percent of the seabed where the water depth was less than 200 meters, and 40 percent where depth was 200–400 meters.

► Why is it like this?

Fishing vessels are now larger and more powerful, and use wider trawls and longer lines than when trawling first started more than 100 years ago. A small number of boats today can have the same impact as a larger fleet would have had in previous decades.

Past activities, like hunting seals, are still having an effect on marine mammals, seabirds, and other species. Some species, particularly those with long lifespans or low fertility, recover slowly from disturbance.

Other environmental pressures interact with fishing to increase our impact on the marine environment. Excess sediment and nutrients from rivers, urban pollution including heavy metals, plastic pollution, introduced predators, loss of habitats, and a warming and acidifying ocean all combine to put pressure on the marine environment. When combined and acting simultaneously, these pressures may have more serious impacts that are complex and hard to predict.

► What are the consequences?

Fishing affects the whole marine ecosystem. Fish stocks are managed individually and do not account for interactions between different stocks or the broader marine environment. Because we don't know the cumulative effects of fishing on the marine environment, it is unclear if the current levels of fishing are sustainable or where the tipping points are.

Removing fish also changes food chains, affecting species that depend on fish for food (like seabirds and marine mammals), or that are eaten by them.

Seabed trawling changes the physical structure of the seabed and we don't know how long it takes to fully recover.

Any accidental capture of a protected species is an issue. For example, the number of Māui dolphins caught has declined in recent years, but this is a critically endangered animal and in 2015/16 there are only an estimated 63 animals left.

Overfishing can lead to loss of livelihoods. For commercial fishers, depleted fish stocks could mean catching less or having to go out further to catch fish.

Overfishing removes opportunities to harvest kaimoana. The loss of biodiversity erodes the mauri of the marine environment and impacts key values such as ahikāroa, mana, manaakitanga (acts of giving and caring for), and whanaungatanga (community relationships and networks).

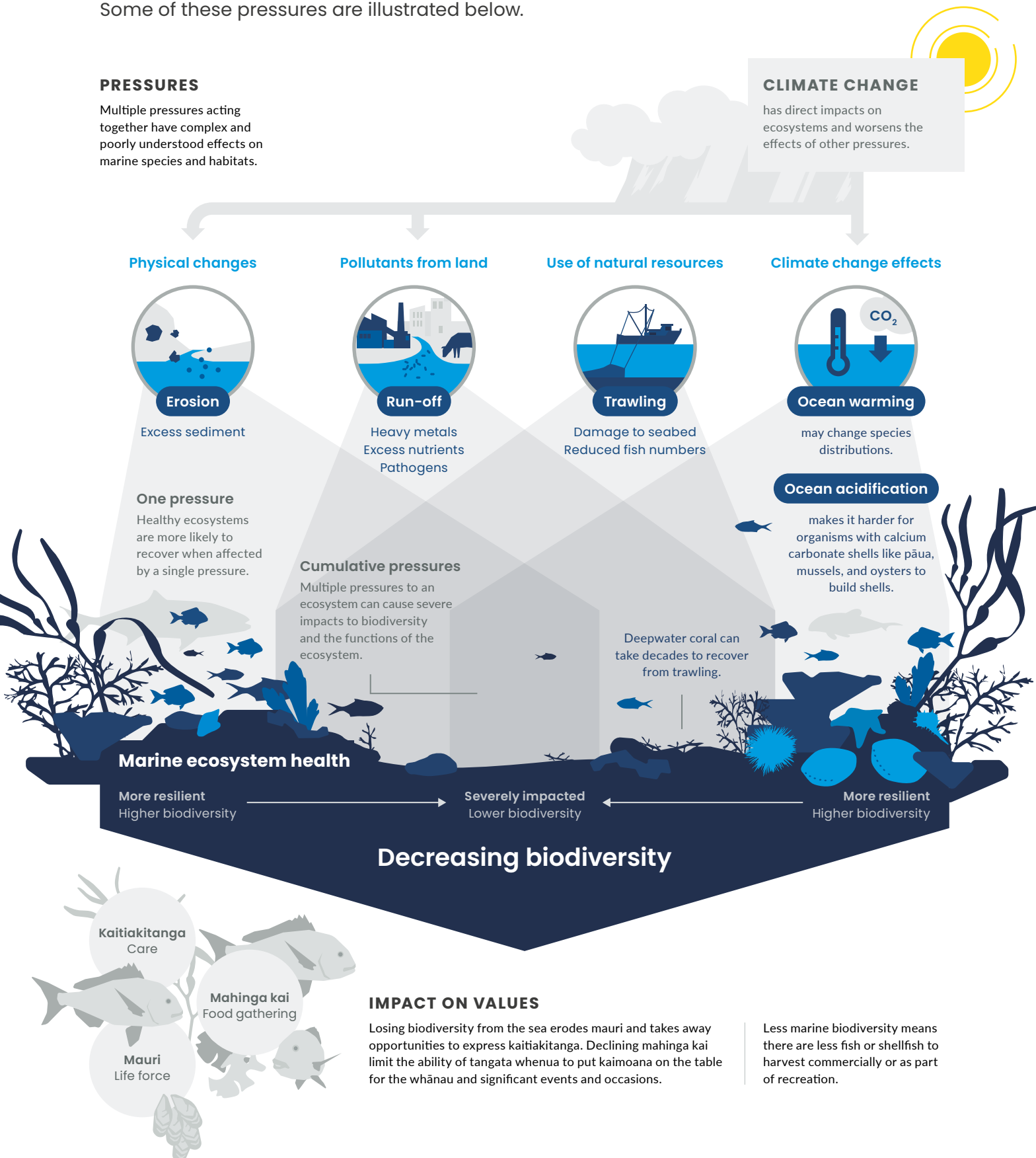
New Zealand's marine environment faces increasing pressures from activities besides fishing. This includes the effects of excess sediment and nutrients from rivers, plastic pollution, loss of habitats, and climate change. These multiple and simultaneous pressures may have far-reaching and hard-to-predict effects on marine species and habitats.

Existing environmental indicators used in *Environment Aotearoa 2019*:

- [Bycatch of fish and invertebrates](#)
- [Bycatch of protected species: Hector's and Māui dolphins](#)
- [Bycatch of protected species: seabirds](#)
- [Bycatch of protected species: sea lion and fur seal](#)
- [State of fish stocks](#)

► Cumulative pressures on the marine environment

Life in the ocean is degraded when there are multiple pressures on the environment. Some of these pressures are illustrated below.



**THEME 5**

Our changing climate

Photo credit: Alan Blacklock, NIWA

Greenhouse gas emissions are causing significant changes to Earth's oceans, atmosphere, and climate. We expect these changes to be very long-lasting – some will be irreversible.

We are already seeing changes in our climate and marine environment, and these are expected to become more severe. These changes reach across the length and breadth of Aotearoa New Zealand, with some regional differences. As an island nation with a large marine zone, long coastline, and an economy based mainly on primary production and international tourism, we are vulnerable to the impacts of climate change.

This theme looks at two climate change issues:

1. How our activities in New Zealand are contributing to global increases in greenhouse gases.
2. How changes in the climate are already affecting our environment, and how they will affect our lives now and into the future.

ISSUE 8

New Zealand has high greenhouse gas emissions per person

Our per-person rate of greenhouse gas emissions is one of the highest for an industrialised country. Most of our emissions in 2016 came from livestock and road transport.

► What is happening?

Global greenhouse gas emissions have increased dramatically and are at a record high. As a consequence, global temperatures have already increased by about 1 degree Celsius above pre-industrial levels. Such rates of change far exceed any past natural rates of change.

New Zealand makes a small contribution to global emissions, but we have high emissions per person when compared internationally. In 2015, New Zealand emitted 17.5 tonnes of carbon dioxide equivalent greenhouse gases per person, which was higher than all but five of the 43 Annex I (industrialised) countries. Agriculture is responsible for nearly half of our gross greenhouse gas emissions, which reflects agriculture's economic importance, followed by road transport, which enables movement of goods and services on our roads.

Although our global contribution is small (0.17 percent of gross global greenhouse gas emissions in 2013), the contribution of small nations like New Zealand is important. Our gross greenhouse gas emissions have increased by 20 percent since 1990, but have been relatively steady in the past decade, despite increases in population and GDP. This means our emissions per person are lower now than 10 years ago. Similarly, our emissions per unit of gross domestic product since 1990 are 43 percent lower, but still high internationally – the fourth highest in the OECD in 2016.

Our larger cities tend to have high levels of black carbon (also known as soot), one of the most important contributors to global warming.

According to the International Panel on Climate Change, our emissions are reversible if we make that choice as a society. Even small reductions in greenhouse gas concentrations will reduce the changes that our grandchildren and their descendants will experience.

► Why is it like this?

Our high emissions per person are partly due to the large proportion of methane and nitrous oxide from agriculture. These gases warm our atmosphere more strongly than carbon dioxide (CO₂), and increase our per-person CO₂-equivalent greenhouse gas emissions.

Road vehicles are our main source of CO₂ emissions. We have the highest rate of car ownership in the OECD which, combined with relatively high CO₂ emissions per kilometre of newly registered vehicles, means that New Zealand is among the highest OECD countries for emissions of CO₂ per capita from on-road transport. This raises per-person emissions because older cars tend to use more fuel for each kilometre travelled and emit more black carbon.

► What are the consequences?

The rate of warming is unprecedented, and may be faster than some organisms and ecosystems can adapt to. The impacts of these changes are already being felt globally, for example ice sheets and Arctic sea ice are shrinking. Climate change is already affecting Aotearoa New Zealand (see Issue 9).

The issues described in the report are made worse in some way by climate change. Climate change will add another layer of stress on our ecosystems, making it harder for them to recover from other impacts like pollution or seabed trawling. In turn, this will decrease the benefits we get from nature and undermine our connection to the natural environment.

Our high rate of per-person emissions compared with other industrialised countries also carries a reputational risk because international trade and tourism are strongly linked to our environmental credentials.

Updated environmental indicator used in *Environment Aotearoa 2019*:

- [New Zealand's greenhouse gas emissions](#)

Existing environmental indicators used in *Environment Aotearoa 2019*:

- [Black carbon concentrations](#)
- [Global greenhouse gas emissions](#)

ISSUE 9

Climate change is already affecting Aotearoa New Zealand

Changes to our climate are already being felt in our land, freshwater, and marine environments. We can expect further wide-ranging consequences for our culture, economy, infrastructure, coasts, and native species.

► What is happening?

New Zealand is already being affected by climate change and many significant changes in our climate are being seen across the country.

These include higher land and sea temperatures, sea-level rise (14–22 centimetres in the last century), ocean acidification, more sunshine, and melting glaciers (our glaciers have lost 25 percent of their ice in the past 40 years). Some locations are experiencing drier soils, altered precipitation patterns, fewer frost days, and more warm days. Extreme wind has decreased at some locations. Most places have seen no change in extreme rainfall since 1960, but studies indicate that because of climate change, some flood and drought events were worse than they would have been or had a higher likelihood of happening.

Many of the impacts of climate change are irreversible on a human timescale, and some impacts, like erosion from extreme rainfall or species extinction, cannot be reversed at all. Stopping further emissions will not return us to a normal climate because carbon dioxide remains in the atmosphere for centuries to millennia. As long as greenhouse gas concentrations remain elevated, the risk from extreme events like heat waves, droughts, and storms will be elevated.

Existing environmental indicators used in *Environment Aotearoa 2019*:

- [Annual glacier ice volumes](#)
- [Coastal sea-level rise](#)
- [Extreme wind](#)
- [Frost and warm days](#)
- [National temperature time series](#)
- [Oceanic sea-surface temperature](#)
- [Ocean acidification](#)
- [Rainfall intensity](#)
- [Soil moisture and drought](#)
- [Sunshine hours](#)

► Why is it like this?

Carbon dioxide and other greenhouse gases are building up in the atmosphere and causing changes to the global climate.

New Zealand makes a small contribution to global emissions, but we have high emissions per person because of methane and nitrous oxide emissions from agriculture, our high rate of car ownership, and our aging vehicle fleet (see Issue 8).

► What are the consequences?

The effects that are already being felt in New Zealand are expected to intensify in the coming decades. Although good information on the cumulative and cascading effects that climate change will have on our economic, social, and cultural well-being is still lacking, we can be sure that nearly all aspects of life in New Zealand will be affected.

Climate change will affect the things we value. Many culturally important sites such as early Māori and European archaeological sites, as well as marae and urupā (burial sites), are located in areas that are vulnerable to flooding or erosion. As sites are lost, so is the intergenerational connection to these places, along with the knowledge and understanding of those connections. Also, changing environmental conditions may cause some species to move to other areas, while others may be lost.

Climate change will affect where we live. Sea-level rise will put property at risk, and some places may become uninsurable. Flooding and heat waves could impact our infrastructure, including the transportation, communication, and power networks that our modern life relies on.

Climate change will affect how we live. It will affect what we grow and where, through warmer temperatures, changed precipitation patterns, more intense and frequent droughts, and intense rainfall, but also more growing days. A warming and acidifying ocean will affect the fish we catch and harvest, while more extreme fire conditions and pests could change the landscape and how we use it.

► Impacts of climate change

Relatively small changes in our climate can have big effects on our ecosystems.

CHANGES ARE ALREADY AFFECTING NEW ZEALAND

Warming land

+ 1°C

Average temperature increase, 1909–2016



Warming sea

+ 0.7°C

Average sea-surface temperature increase around New Zealand, 1909–2009



Rising sea levels

+ 14–22 cm

Varying sea-level rise around New Zealand, 1916–2016



Increasing ocean acidity

+ 7%

Increase in acidity off Otago coast, 1998–2016



Climate change affects our environment directly and intensifies the effects of other pressures.



Changing distribution

Warmer temperatures played a role in shifting the range of two wētā species in Taranaki.



Drought

The 2012–13 drought was one of the most extreme in recent history and affected the entire North Island and the west coast of the South Island. Climate change made it more likely to happen.



Shifting seasons

Hapū and whānau-based fishers observe changes in the seasons, which affect harvest times.



Flood

Sea-level rise caused more flooding during storm, 2011.

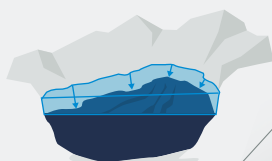


Flood

Flooding from the highest high tide, 2016.

Melting glaciers

Glaciers in Southern Alps decreased 25% in ice volume, 1977–2016.

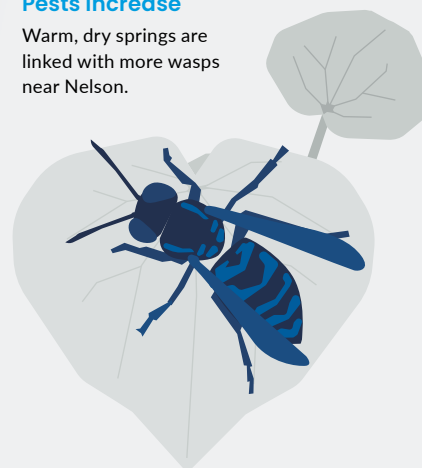


Warming seas

Increasing sea-surface temperatures were a factor in the reduced survival of yellow-eyed penguin.

Pests increase

Warm, dry springs are linked with more wasps near Nelson.



Note: Data for this illustration is from Mattern et al (2017) and this report.



Photo credit: photonewzealand

► Understanding our environment

Our environment is complex and multi-dimensional, and changes in the environment can have multiple causes and happen at different rates. The time it takes for the effects of a change to show can also be significant, which makes establishing a cause harder.

Each place is also distinct because of the environmental conditions and the people who live there – what they do, how they make a living, what they value, and what they want to achieve. All of these are important and have effects on the health of their local environment.

Good progress has been made on understanding particular aspects of our environment but many significant gaps in our knowledge remain. These are highlighted throughout *Environment Aotearoa 2019* and include how the environment functions as a whole system, the cumulative impacts of multiple pressures, regional variations, and where tipping points (when change becomes irreversible) may exist. More work is needed to address these challenges.

Environmental data and knowledge currently come from many sources, including scientific data, computer models, monitoring data, cultural monitoring systems, and citizen science. Finding good ways to draw on all of these sources will provide the richest picture of our environment.

Collecting and analysing data, and exploring scientific knowledge, take time and money. Taking opportunities to align our efforts across the knowledge and reporting system would enable New Zealand to be better equipped to understand the effect our actions are having on the environment, as well as deciding what our response to that understanding should be.

