Toitū Te Whenua
Land Information
New Zealand

Department of
Conservation
Te Papa Atawhai

Long-term Insights Briefing

October 2021

Kakapo (Photo credit: Pania Dalley, DOC)

How can innovation in the way we use information and emerging technology help biodiversity thrive?

This consultation will help the Department of Conservation Te Papa Atawhai (DOC) and Toitū Te Whenua Land Information New Zealand (Toitū Te Whenua) shape the future of Aotearoa New Zealand's biodiversity work.[1]

Your feedback will help prepare a Long-term Insights Briefing that explores how innovation in technology and information can support us to achieve thriving biodiversity in Aotearoa New Zealand.

DOC and Toitū Te Whenua want to hear from anyone who has an interest in biodiversity.

What is a Long-term Insights Briefing?

A Long-term Insights Briefing explores the medium and long-term trends, risks and opportunities facing Aotearoa New Zealand and potential options for responding to them. It aims to stimulate debate and, by looking to the long-term, we can make sure we are ready to make decisions that achieve our vision for biodiversity.

This is a great opportunity for you to share your thoughts on what challenges and opportunities might lie ahead, and how we could respond.

To find out more about Long-term Insights Briefings under the Public Services Act 2020 and see what other agencies have released:

Long-term Insights Briefings

List of released Long-term Insights Briefings

At the end of this document, you can find out how to make a submission and get involved in each stage of consultation.

The proposed Long-term Insights Briefing

DOC and Toitū Te Whenua are excited to be developing a joint Long-term Insights Briefing. Both agencies work together and across government to support national biodiversity and related biosecurity priorities, policies, and strategies. Both organisations have roles in and responsibilities for the long-term protection of Aotearoa New Zealand's biodiversity.

Biodiversity and the natural environment are important to Aotearoa New Zealand. We face many challenges and will only experience more in the future, such as the effects of climate change, introduced and invasive pest species and unsustainable use of natural resources.

In 2020, the government released *Te Mana o te Taiao* – Aotearoa New Zealand Biodiversity Strategy. This new strategy sets out the vision we want to achieve for nature by 2050: te mauri hikahika o te taiao – the life force of nature is vibrant and vigorous. *Te Mana o te Taiao* provides guidance for all of those with a role in biodiversity to help achieve this vision.

The vision of *Te Mana o te Taiao* is ambitious, and we will need to be innovative to achieve it. We have some tools to help control introduced and invasive pest species, such as toxins and traps. However, these methods are relatively costly and are challenging to apply to pest populations on very large scales or in very remote areas. Advances in information and technology have created new and exciting opportunities for us to help look after our biodiversity in different and complementary ways. For example, we can now use satellite imagery to map biodiversity across landscapes, and artificial intelligence to help detect any last remaining pests following predator control activities.

Government, industry, and communities at an international, national and local scale are already using innovative tools and methods to locate and measure threats to biodiversity and analyse and report on changes, but new information and emerging technology innovation in information could make our efforts cheaper and more effective. For example, the use of drones has made it possible to gather information on areas that previously were difficult to monitor. As DOC and Toitū Te Whenua develop the Long-term Insights Briefing, we will keep in mind other ongoing initiatives and international approaches that are part of the conversation on the future of biodiversity.[2]

[1] "Biodiversity" and other similar terms are defined in the glossary at the end of this document.

[2] Development of a National Policy Statement for Indigenous Biodiversity, review of the Biosecurity Act 1993, reform of the Resource Management Act 1991and reforms, and reform of the Crown Pastoral Land Act 1998.

Innovative use of information and emerging technology

It is becoming increasingly important that we leverage information and emerging technologies to work together in new ways. The topic of the proposed Long-term Insights Briefing is: *How can innovation in the way we use information and emerging technology help biodiversity thrive?*

A focus on two areas that have the potential to be particularly transformative will help DOC and Toitū Te Whenua to explore the topic question. The areas of focus are:

- new and improved information
- the use of biotechnology.

With numerous examples of emerging information and technologies being developed and used internationally, this Long-term Insights Briefing is a great opportunity to have a conversation around how such developments could look in the context of Aotearoa New Zealand. We will also consider the ways in which social innovation, such as citizen science, can play a role and help us make the most of the opportunities in information and emerging technologies.

New and improved information

Information improves our ability to identify and respond to the challenges that biodiversity is facing. As the uses of information evolve, there will be more tools we can use to produce data that is better quality, more accessible and integrated (linked with other data).

We have the opportunity now to think about what types of new data we want, how we want to use new and existing data, and what types of tools might help us to get it. For example, citizen-science is an emerging source of data built by using the public to help gather and analyse environmental information, this has the potential to provide a larger data set gathered from more places and more frequently than that available through conventional data gathering methods.

Further information on new and improved information can be found in Appendix 1.

The use of biotechnology to support biodiversity

Biotechnology includes a wide range of techniques and technologies using biological systems. These include looking for genetic markers of desirable traits in plant and animal species for breeding programmes (including to help build disease resistance), genome sequencing, and developing approaches such as surveillance and monitoring using environmental DNA, and gene editing. Biotechnology has the potential to help us detect and measure biodiversity, manage invasive species, build resistance to climate extremes, and reduce chemical use. Using biotechnology can realise environmental benefits faster, with reduced financial costs and human effort required. Further information on biotechnology can be found in Appendix 1.

Everyone has a role to play in helping biodiversity thrive

Te Mana o te Taiao acknowledges that everyone who lives in, or visits Aotearoa New Zealand has a part to play in helping to restore the mauri (life force) of nature for our future generations. Tangata whenua have a special and critical role in nurturing and enhancing biodiversity. Other groups, including central government, local government, industry, NGOs and scientists through to landowners, the broader community, recreational groups such as those for hunting and fishing, and individuals can all contribute to this future in diverse ways.

Your feedback

Your feedback will help shape the Long-term insights briefing. DOC and Toitū Te Whenua propose the topic: How can innovation in the way we use information and emerging technology help biodiversity thrive?

Please answer the following questions:

1. Do you agree that the Long-term Insights Briefing should focus on new and improved information and biotechnology to find ways to care for Aotearoa New Zealand's biodiversity in the future? Why or why not?
2. Are there any parts of information or biotechnology that you think need to be covered in the Long-term Insights Briefing? This can include applications in other sectors and disciplines, international approaches, social innovation, and any unintended consequences.
3. How can we make sure we include other forms of expertise when making decisions about the use of information and biotechnology? Examples include mātauranga Māori social science and citizen science?
4. What else should DOC and Toitū Te Whenua consider?
5. Are there any topics you would like the Department of Conservation or Toitū Te Whenua to consider for future briefings?

How to send us your thoughts

Submissions must be lodged by 5pm on

Sunday 14 November 2021 and can be:

- completed online at www.doc.govt.nz/LTIB
- emailed to LTIB@linz.govt.nz
- posted to LTIB Consultation, PO Box 10420, Wellington 6140.

Privacy

Any submission you make will become public information, and anyone can ask for a copy of all submissions under the Official Information Act 1982 (OIA). The OIA states that the information must be made available unless there is a good reason for withholding it (see section 6 and section 9 of the OIA).

If you think there are grounds for withholding specific information in your submission, please let us know. Possible reasons include the information being commercially sensitive or personal. Any decision made to withhold information can be reviewed by the Ombudsman, who may require the information to be released.

Next steps

Combined feedback will be published on both the DOC and Toitū Te Whenua websites. This reflects DOC and Toitū Te Whenua's commitment to maintaining transparency and accountability throughout the Long-term Insights Briefing process.

DOC and Toitū Te Whenua will use your feedback from this consultation to draft the Long-term Insights Briefing. Consultation will open again before the Long-term Insights Briefing is finalised in early 2022, to make sure that your feedback has been included correctly where appropriate. Once finalised the document will be presented to Parliament.

Waimakariri River, South Island, New Zealand

Appendix 1: Focus areas within the Long-term Insights Briefing

DOC and Toitū Te Whenua are proposing to focus on two key areas to explore how innovation in the way we use information and emerging technology can help biodiversity thrive:

- new and improved information
- the use of biotechnology.

The Long-term Insights Briefing will also consider the ways in which social innovation, such as citizen science, can play a role and help us make the most of the opportunities that we may find.

This appendix provides a limited selection of examples of recent advances in technology and discusses how we could make the most of their potential. These examples are intended to stimulate your thinking and are not a complete list of all information and technologies that are being developed internationally. DOC and Toitū Te Whenua welcome your feedback on other examples or issues you feel should be explored for inclusion within the Long-term Insights Briefing.

New and improved information

Current developments in information

Information and data inform decisions in all areas of biodiversity work. Tangata whenua, local government, central government, the research sector, private and community sectors are increasingly partnering to collate and combine data sets, providing a more comprehensive view of our landscape and biodiversity. Advances in information collection and quality to date have helped us find new ways to tackle existing threats to biodiversity and predict and prevent new ones. We have been able to improve our ability to detect and track invasive species, monitor biodiversity recovery, and collect increasingly large amounts of data. There has also been an increase in public, or community driven initiatives to rid Aotearoa New Zealand of our most destructive predators. These initiatives are increasingly looking for new tools and approaches for planning, surveillance and detection, monitoring and other purposes.

Making the most of information now and in the future

We want to know ideas for how we can innovate in what information is collected and how we can improve the ways in which environmental data are gathered, stored, connected, analysed and made accessible. Realising such opportunities could transform how new and existing data are used to inform biodiversity initiatives, environmental research and future key government strategies.[3]

Māori have a critical role to play in decisions affecting indigenous biodiversity. Future initiatives must be developed in partnership with Māori to adequately consider Māori rights and interests, and how best to incorporate and learn from mātauranga Māori. This knowledge can then inform decisions about managing biodiversity and biosecurity threats and protecting Aotearoa New Zealand's natural environment.

Such innovation could ensure our information assets and investments also promote public participation and collaboration. The examples below show how new and emerging information could help us to identify potential challenges and opportunities through data quality improvement, which supports decision-making.

Recent innovations

[3] See the Parliamentary Commissioner for the Environment's 2019 report Focusing Aotearoa New Zealand's environmental reporting system.

Identifying habitats and habitat change

Imagery collected via aircraft and satellites is now being regularly used to identify, map and monitor biodiversity, and pressures on biodiversity such as pests and diseases). Advances in technology have meant higher resolution imagery, and a wider range of measurements is now collected, improving our understanding of these environments and supporting more effective management. Some of this information is new as we are now able to access and map areas we could not reach before.

Such advances enable individual weeds, threatened species and pest habitats to be identified. The information is already used to pinpoint areas of interest. For example, to identify areas where invasive weeds are threatening the nesting sites of the wrybill (a vulnerable species of riverbed nesting bird).

In the future, artificial intelligence could increasingly be used to process the information instead of people to detect invasive species and pinpoint exact locations for targeted interventions.

Field tools for data collection

Toitū Te Whenua has developed various field tools for data collection. This allows phones and tablets to be used for a range of activities. For example, to assist with the control of animal pests such as wallabies and feral cats or biodiversity projects such as seed collection.

These tools enable more efficient collection and transfer of data, such as mapping the locations of rare and endangered plants and recording the location of installed bat boxes to support and monitor bat populations. Further innovation and development of these tools, plus their wider use will have significant positive impacts for managing biodiversity in the future.

Realising the potential of existing data collection

Elevation data collected using the remote sensing technique of light detection and ranging (LiDAR) can produce highly accurate 3D maps. LiDAR provides accurate measurements that can determine landscape characteristics such as canopy height, the slope of terrain and depth and coverage of foliage. With this information we can monitor vegetation change after damage or recovery from pests and environmental change.

Toitū Te Whenua has currently mapped 20 percent of Aotearoa New Zealand using LiDAR and, in partnership with councils, aims to increase this to 80 percent by 2024. As the coverage increases and the quality of LiDAR data increases, this information can be used by agencies to identify target areas for managing invasive species and for multiple other purposes.

The impact of kauri dieback (Photo credit: Laura Honey, DOC)

The use of biotechnology

Current advances in biotechnology

Biotechnology refers to techniques and technologies that utilise biological systems, living organisms or parts of this to develop or create different products. Currently, a limited number of biotechnologies are used to manage biodiversity in Aotearoa New Zealand. These current technologies do not involve altering the genes of an organism. One example is using plant tissue culture to preserve genetic material to safeguard the diversity of a species. This type of technology is being explored to build resilience against the impacts of kauri dieback or myrtle rust.

Anything involving genetic modification (including gene editing) is strictly regulated by the Hazardous Substances and New Organisms (HSNO) Act 1996. Scientists in Aotearoa New Zealand have been researching genetic modification in contained experiments to understand how genes work, improve the traits of plants and animals used in agriculture, seek treatments for diseases, and find new ways of controlling pests. This type of biotechnology is currently only used in laboratories, and offshore in agricultural systems, and is not yet used for biodiversity protection or restoration purposes.

Biotechnologies are advancing rapidly, which will present both opportunities and risks for Aotearoa New Zealand. We know that other countries, including Australia, the United States and the United Kingdom, are beginning to think about the real-life application of these technologies. This means we are going to be faced with choices about what technologies we as a society are comfortable with. We need to be thinking ahead to make sure we are well positioned to manage both the risks and the opportunities and can make good decisions on these issues.

Making the most of biotechnology

The use of innovative biotechnology could accelerate our ability to reduce pressures on biodiversity. With the help of tissue culture technology, we could breed plants and trees that are better at capturing carbon and are more resilient to the effects of climate change. Biotechnologies could help us manage a range of invasive species, from protecting commercial kiwifruit vines from harmful bacteria to reducing the populations of animal predators.[1] These technologies could reduce the effects of our use of chemicals, such as fungicides, herbicides, and poisons, on the wider ecosystem. Additionally, as these technologies could produce environmental benefits faster, the costs and human effort to manage pest control could be reduced.

However, alongside the potential benefits, we understand that the use of some of these technologies raises some important cultural and ethical issues, particularly from a Māori perspective. This must be taken into account in consideration of whether or not to use these technologies for conservation purposes. Below are some examples of international programmes exploring the use of biotechnology to support biodiversity.

Herekino-forest-river (DOC)

Ribonucleic acid interference (RNAi)

RNAi is used to switch off or 'silence' genes by targeting ribonucleic acid (RNA), which is present in all living cells. RNAs that target specific pathogens can be sprayed directly onto plants, providing protection from disease without changing their genetic make-up.

Australia is currently investigating the potential use of RNAi vaccines to control the myrtle rust fungus on critically endangered Australian plants. The fungus is also found in Aotearoa New Zealand, where it threatens a number of taonga species: pōhutukawa, rātā, mānuka, and ramarama. RNAi is a promising alternative to fungicides.

Gene editing

Gene editing technology allows the genetic material of an organism to be changed more quickly and precisely. One such technology (CRISPR-Cas9) has been developed using a system found in bacteria that can 'cut up' DNA, enabling gene sequences to be altered. This technology could be used to make plants disease resistant. International research has investigated the application of this type of technology in pest eradication for plant species that invade and take over our native landscapes, such as conifers.

Gene drives

Gene drives are a type of technology designed to modify a gene of a particular individual from a specific species, and make sure that gene will be passed on to its offspring, as opposed to the usual 50% chance. This could be applied to cause sterility in pest species. Gene drives have been developed internationally for the fruit fly and two mosquito species. Target Malaria is an international alliance that has developed genetic technology to modify mosquitoes and reduce malaria transmission. It is proposing to use Burkina Faso as a case study.

The Genetic Biocontrol of Invasive Rodents programme is an international partnership of universities, governments and non-governmental organisations, including New Zealand's Biological Heritage National Science Challenge. The program is working to advance gene drive research as a potential tool to manage mice and prevent the extinction of island species. If successful, this technology could be extended to other invasive predator species such as possums and stoats.

[1] This sentence has been amended to reflect technical feedback.

Glossary of te reo Māori terms

He Awa Whiria	Braided rivers. In this document and Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy 2020, He Awa Whiria is used as a metaphor for considering the relationship between Māori and non-Māori streams of knowledge. In braided rivers the water flows through a number of channels separated by alluvial depositions. These channels intersect and shift over time as they respond to the changing water and soil conditions, but they all lead to the same destination. (Ministry of Education, Te kete Ipurangi on-line).
Kaitiaki	Guardian, trustee, minder.
Mauri	The life force or vital essence of a both an individual or a community which may be made up of people who are existing together, or a forest system made up of multiple species. The mauri is the collective spirit of a community or forest.
Mātauranga Māori	Māori knowledge; the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity, and cultural practices.
Tangata whenua	People of the land.
Taonga	A treasure or something that is prized. The term can be applied to anything that is of value, including socially or culturally valuable objects, resources, phenomena, ideas and techniques.
Te mana o te taiao	The prestige, authority, control or personal charisma of the living environment.
Te taiao	Natural world, environment, nature.
Whenua	Land.

Glossary of technical terms

Biodiversity	Biological diversity, means the variability among living organisms from all sources, including land, marine and freshwater ecosystems and the ecological complexes of which they are a part; this includes diversity within species (including genetic diversity) between species and of ecosystems (based on the definition of the Convention on Biological Diversity).
Biosecurity	The exclusion, eradication or management of pests and diseases that pose a risk to the economy, environment, or cultural or social values, including human health.
Biotechnology	Technologies that use biological systems, living organisms or parts of them to develop or create different products.
Genetic modification	The use of technology to alter the genetic sequence (DNA) of an organism.
Citizen Science	Scientific research conducted through public participation and collaboration, usually by collecting and sharing data. An example of citizen science is the Great Kererū Count, where New Zealanders report sightings of kererū, contributing to data on their abundance and distribution.
Climate change	Changes in global or regional climate patterns that are evident over an extended period (typically decades or longer). May be due to natural factors or human activities.
Conservation	'The preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations' (Conservation Act 1987).
Data	Factual information (such as measurements or statistics) used as a basis for reasoning, discussion, or calculation.

Drone	Aircraft of any size that operate without a pilot, crew or passengers on board. They can be remotely piloted or fly autonomously. Also known as an unmanned aerial vehicle.
Ecosystem	A community of plants, animals and microorganisms in a particular place or area interacting with the non-living components of their environment (e.g., air, water and mineral soil).
Emerging technology	Generally used to describe a new technology where its development or practical application are not fully realised. It may also refer to the continuing development of an existing technology.
Endemic species	A species that that is found naturally only within a specified region or locality and are unique to that area. Aotearoa New Zealand's endemic species include birds that breed only in this country but may disperse to other countries in the non-breeding season or as sub-adults.
Gene editing	The manipulation of the genetic material of a living organism by insertion, deletion or replacement of genetic material called DNA.
Habitat	A place where either an organism or population naturally occur.
Indigenous species	Species that have evolved and continue to live within a specific place naturally.
Information	Knowledge obtained from investigation, analysis or study. This term is sometimes used interchangeable with "data".
Innovation	A new method, idea, device or product.
Introduced species	Plant or animal species that have been brought to Aotearoa New Zealand by humans, either by accident or design. A synonym is 'exotic species'.
Invasive species	Non-indigenous species whose introduction or spread threatens biodiversity, food security, and/or human health and wellbeing.
LiDAR	Acronym for Light Detection and Ranging. LiDAR is a method for measuring distances using light in the form of a pulsed laser.
Nature	A holistic term that encompasses the living environment (te taiao) – i.e., all living organisms and the ecological processes that sustain them. By this definition, people are a key part of nature. This strategy uses the term 'biodiversity' to refer to biological diversity and 'nature' when considering the wider processes, functions and connections of the natural environment, of which biodiversity is a part.
Pathogen	A bacterium, virus or other microorganism that causes disease to its host.
Predator	An organism that feeds on another living organism (its prey).
Protection	Looking after biodiversity in the long term. This involves managing all threats to secure species from extinction and ensuring that their populations are buffered from the impacts of the loss of genetic diversity and longer-term environmental events such as climate change. This includes, but is not restricted to, legal protection.
Resilience	The ability of a species, or variety or breed of species, to respond and adapt to external environmental stresses.
Restore	The active intervention and management of modified or degraded habitats, ecosystems, landforms and landscapes in order to reinstate indigenous natural character, ecological and physical processes, and cultural and visual qualities.
Species	A group of living organisms consisting of similar individuals capable of freely exchanging genes or interbreeding. In this strategy, the term 'species' also includes subspecies and varieties.
Sustainable	The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations' (Convention on Biological Diversity).

Threatened species	Species assessed according to the New Zealand Threat Classification System as facing imminent extinction (or a reduction to just a few small, safe refuges, which makes them highly susceptible to unpredictable events such as flooding) because of their small total population size and/or rapid rate of population decline. This includes three sub-categories: 'Nationally Critical', 'Nationally Endangered' and 'Nationally Vulnerable'.
Weed	A plant that is considered to be unwanted or a nuisance. The term is often used to describe native or non-native plants that grow and reproduce aggressively.

Brushtail Possum (Photo credit: Alan Cressler)

Te Kāwanatanga o Aotearoa
New Zealand Government