Department of Conservation
Te Papa Atawhai

Toitū Te Whenua
Land Information New Zealand

Long-term Insights Briefing Appendix

How we developed this draft Long-term Insights Briefing

This supplementary note outlines the process used to develop the Long-term Insights Briefing (LTIB), including consultation, engagement and key research inputs.

Presented to the House of Representatives pursuant to schedule 6, section 8 of the Public Service Act 2020.

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Process

Our initial thinking included desktop research and discussions with a range of experts, both inside and outside of government, to understand the drivers and trends in biodiversity. Technological advancement was an important driver and mega-trend, and one that could be game-changing for achieving thriving biodiversity.

In October 2021 we consulted on the proposed topic: How can innovation in the way we use information and emerging technology help biodiversity thrive? Most submissions supported the proposed topic. Submitters noted the importance of understanding the risks associated with biotechnology, and the need for good governance and decision-making to support its use.

Based on consultation feedback, the proposed topic was refined to: *How can we help biodiversity thrive through the innovative use of information and emerging technologies?*

In March 2022, we held a futures-thinking workshop using a scenario-sketching tool developed by the Global Business Network. This produced options for potential futures, and a log of risks and opportunities associated with them. The most common insight was that the systems that support the use of technology and information have a huge impact on its success or failure.

A draft LTIB was then prepared, taking into account insights from consultation and the futures-thinking workshop. It was also informed by desktop research, including background analysis completed to support Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy.

To demonstrate the opportunities for biodiversity to be found through innovation, information, and emerging technology, the draft explored data-driven technologies (such as AI), satellite and remote sensing, and genetic technologies.

The draft was published for public consultation in December 2022, and received 32 submissions. Toitū Te Whenua and DOC used feedback from the submissions, and chief executives to finalize the draft and table it at Parliament.

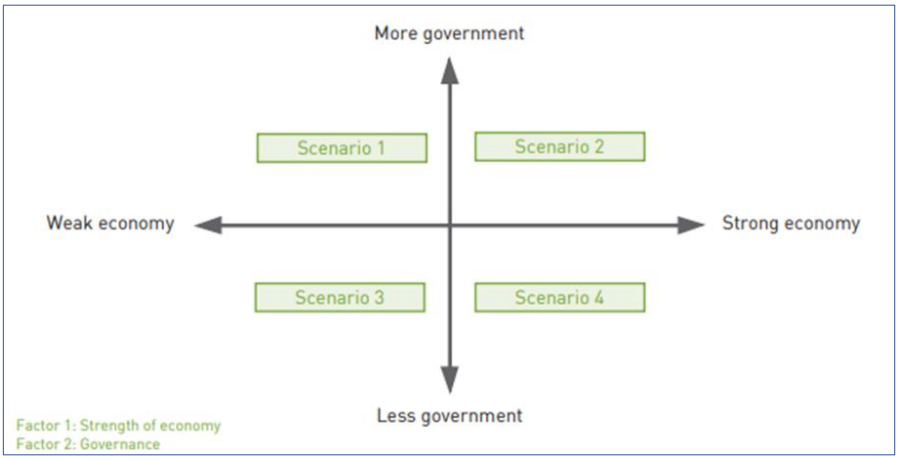
The LTIB was tabled at Parliament in March 2023.

To keep the focus of the document on Aotearoa New Zealand and its biodiversity, and declutter the final LTIB, the process followed to research and draft the document and an 'international context' section were created and published separately.

The draft LTIB has been reviewed by subject matter experts across DOC and Toitū Te Whenua. It has also been reviewed by relevant public service agencies and by groups with expertise in biodiversity.

Futures thinking workshop

The early twenty-first century is a period of huge change and technological advancement. We cannot predict what Aotearoa New Zealand will look like in 2050 but we can identify possible megatrends (events that are happening at a global level and scale) and drivers that may influence the future and the state of our biodiversity.



An example of what the scenario sketching method looks like. Using two drivers of change to create four scenarios or 'worlds'.

In March 2022, we held a futures-thinking workshop as part of our consultation on the LTIB. Most attendees were first round submitters. To help visualise these potential futures, the participants looked at the following megatrends to see what impact they might have on biodiversity. We chose to focus on megatrends that have a significant impact or where there is uncertainty about direction or rate of change.

- **Indigenous knowledge and leadership:** Growing worldwide recognition of the mutual benefits of collaborative partnerships between indigenous peoples, governments and conservation practitioners acknowledges the deep spiritual and cultural ties of indigenous peoples to the land, and the value of indigenous knowledge for ecology and conservation.

- **Globalisation:** The world has become increasingly interconnected through globalisation. However, the future of globalisation is uncertain due to the rise in populism, which often opposes globalisation.

- **Governance:** In Aotearoa New Zealand, decision-making power is highly concentrated at a central government level. However, to effectively address the complex and multi-dimensional problems that we face today, local decision-making may need to play a larger role in the future, especially in the management of our biodiversity.

- **The future of work:** Globally, the way we work is changing. There is a blurring of work, leisure and learning time. As a result, the century-old norm of the eight-hour workday and the five-day work week is shifting. Changes in the way we work will have knock-on effects for all sectors of society, including environmental impacts.

- **Population:** The global population is growing and aging, putting increasing stress on limited resources. Our growing, and diversifying population is likely to impact on biodiversity. For example, as populations grow there is increasing demand for land and resources, and more waste production.

- **Health:** The health of humanity and the health of the environment are interconnected. Improvements and innovations within our healthcare systems may improve health and wellbeing.

- **Introduced invasive species:** Pest plants, animals and pathogens can have devastating effects on our native species and ecosystems. The prevalence of pest species in Aotearoa New Zealand is expected to increase with climate change. Many native species will continue to decline towards extinction if drastic action is not taken.

- **Climate change:** Climate change is, and will, significantly affect our biodiversity by disrupting the distribution of our native species, their seasonal behaviour and survival rates. If no action is taken to reduce greenhouse gas emissions the world could warm by up to 4°C above preindustrial levels by the end of the century. In this scenario, Aotearoa New Zealand will become one of the few land masses habitable by humans and globally up to one-third of species will have become extinct.

- **Land and sea use change:** We are rapidly intensifying the way we use our land and seas, which significantly disrupts biodiversity. Land use intensification decreases habitat, and increases levels of sedimentation and pollution in marine and freshwater environments, negatively impacting aquatic biodiversity. Sea use changes such as increased coastal development, aquaculture and bottom trawling can significantly disrupt marine ecosystems.

- **Direct exploitation:** Rising demand for resources is increasing extraction and exploitation of natural resources, which can have detrimental impacts on biodiversity.

- **Pollution:** Pollution can have severe impacts on terrestrial, freshwater and marine ecosystems. For example, high rates of plastic ingestion by seabirds have been recorded in Aotearoa New Zealand

Participants workshopped and produced a set of scenarios. An example of this can be seen below, based on the megatrends and drivers of change they were working with. The most common insight was that the systems that support the use of technology and information have a huge impact on its success or failure. We have used these insights as we have shaped up the topic and content LTIB.

Scenario 1: Mad Max

Drivers

- Natural resources are in short supply and huge demand
- The line between work, life and leisure is blurred
- The traditional 9 to 5, five day working schedule is no longer apparent as well as the idea of an 'office'
- How we work is incredibly flexible and diverse

What the world looks like / How the scenario was shaped

- Natural resources are harvested manually from new locations within the natural environment. There is a struggle to manage waste products coming from harvested materials, and sustainability is considered less. Harvesting has been 'out-sourced' to offshore companies and environmental degradation is occurring.
- Community structures are fragmented, there is less travel between regions and more people are living regionally. Flexible work makes more jobs available regionally but also reduces engagement opportunities as more people work remotely.
- Individualism is the dominant force in this world as people try to access limited resources.
- It is harder to connect to the environment and more likely these connections will be in controlled settings (such as zoos and reserves).
- National institutions are weaker due to individualism.
- People working in the environment step into advocacy roles and their beliefs (cultural and scientific) become more aligned as the environment comes under more pressure.
- The economy is less resilient to shifts in the global market.

Key risks

→ Because of diminishing natural resources, New Zealand becomes less attractive as a tourism destination.
→ Mana whenua become disconnected from the natural environment, resulting in grief and loss of identity.
→ The economy is less resilient to shifts in the global market.
→ A weaker economy is a threat to social cohesion as there is less money to help solve big problems.

Key opportunities

→ Possibility for integrated landscapes – using one area of land for multiple purposes.
→ Strong leadership could emerge to protect remaining resources.
→ In response to community fragmentation, people might be more purposeful in creating coherent communities.
→ Flexibility as to how we work sees greater self-sufficiency with food grown and sourced locally. Pest species are also a food source.

International examples

While the LTIB primarily focuses on Aotearoa New Zealand, it is important that we do not lose sight of what is happening globally.

International examples and context play an important role in futures thinking, research and policy work. As an example, they can provide valuable insight into the potential effects of a specific policy or show how solutions work in other cultures and contexts. They can also help identify opportunities for international cooperation as well as potential sources of funding.

We highlight below some interesting international examples of new technologies and approaches to biodiversity protection which were provided by submitters. We are aware that there are many other examples on good practice in these countries that we could learn from and we can see many opportunities for potential future collaboration and sharing of ideas.

Australia

Australia has undergone a large decline in biodiversity in the last 200 years. In collaboration with the states and territories, the Australian government has set a national framework for biodiversity conservation.

In Victoria, the Arthur Rylah Institute for Environmental Research, funded through both the Victorian and Australian governments, is using artificial intelligence (AI) technology to analyse identify frog calls.[1]

An audio recording device deployed in the field. Copyright State of Victoria. Creative Commons Attribution 4.0

https://www.ari.vic.gov.au/research/field-techniques-and-monitoring/artificial-intelligence-identifies-frogs-by-their-calls

Researchers deploy small recording devices in the field which gather thousands of hours of audio. AI technology can analyse up to an hour of audio every 10 seconds, and distinguish

[1] Artificial intelligence identifies frogs – by their calls (ari.vic.gov.au)

the calls from different species of frog. Researchers are directed to points in the recording so that they can check the software has correctly identified the species.

The software has resulted in significant cost savings by reducing the amount of time spent on sample analysis, and it can survey larger areas for longer periods.

In New South Wales, the Department of Planning, Industry, and the Environment is using a satellite-based early change monitoring system to capture and analyse images and identify unlawful clearing of native vegetation.[2]

Using this technology, the department can identify vegetation change almost as soon as it occurs. The data is then cross-checked with other agencies to see if the clearing is lawful and, if there is any doubt, the department can contact the landowner.

The Pacific

The Pacific area has one of the richest and most complex ecosystems globally, surrounded by oceans full of marine and land diversity.

In the last few years, much of the Pacific has been covered under a community-based system of marine resource management known as locally managed marine areas (LMMAs).[3]

The LMMA Network is a global initiative founded in 2000. The network consists of communities, dedicated practitioners and government officials all focused on community-based marine resource management projects, providing capacity building, awareness, and monitoring support. Its focus is on the sharing of ideas and experiences to improve the performance of LMMAs, while empowering more communities to manage their marine resources in a sustainable way.[4]

LMMAs are protected areas that are largely or wholly managed by coastal communities or land-owning groups, with the support of government and partner representatives. The communities impose restrictions on areas such as 'no-take zones' and on certain equipment, practices, species or sizes of catches. These zones or restrictions allow resource and habitat recovery in over-exploited areas, enabling a return to more sustainable harvest of marine resources for the community.

In Fiji, for example, the results of implementing LMMAs since 1997 have included a 20-fold increase in clam density in areas where fishing is banned, an average 200 to 300 percent increase in harvests in adjacent areas, a tripling of fish catches, and a 35 to 45 percent rise in household incomes. Such initiatives have the potential to be widely replicated.

[2] Improved satellite technology is better for farmers and native vegetation | NSW Environment and Heritage

[3] https://lmanetwork.fun/

[4] https://sdgs.un.org/partnerships

A submitter also pointed us towards a collaboration project in New Caledonia, where drones with thermal sensors are being used to detect and monitor deer at night.[5] The Conservatory of Natural Spaces of New Caledonia has partnered with Ecotone Company to monitor deer abundance in the tropical rainforests. The aim is to gather accurate data to help devise programmes and solutions for deer management.

Another AI initiative in the Pacific is the tracking of humpback whales and putting in place marine protected areas to protect them. The National Oceanic and Atmospheric Association is using acoustic recorders to monitor marine animals in remote and hard to reach islands. They have partnered with Google AI for Social Good to create a machine learning model that can recognise whale song. From this, they have been able to see patterns in where whales are across the Hawaiian and Mariana Islands.[6]

Community efforts in the Pacific. Copyright State of Victoria. Creative Commons Attribution 4.0

[5] https://protege.spc.int/en/news/invasive-species/study-automatic-detection-and-counting-deer-drone-night-thermal-sensor

[6] https://www.fisheries.noaa.gov/science-blog/ok-google-find-humpback-whales

Canada

Canada's federal, provincial and territorial governments and indigenous organisations released the Biodiversity Goals and Targets for Canada in 2020. As part of these, they have been looking at how to improve information about ecosystems.

BioSpace is a joint project of the Canadian Forest Service and the Canadian Space Agency to monitor biodiversity using Earth observation data.[7] Remote sensing technology is used to observe the landscape, gather data, and monitor changes in landscape features that can signal shifts in biodiversity.

BioSpace allows data to be gathered in areas that are difficult or impossible to access, and it makes data gathering more affordable by allowing scientists to study many species at once without travelling to different locations. The data gathered by BioSpace will, over time, show where the biggest threats to biodiversity are and where to target interventions.

One submitter mentioned the Great Bear Rainforest Agreement in British Columbia[8] as an example that 'formalises an ecosystem-based management approach to conservation that incorporates Indigenous and traditional, local knowledge and is co-led by First Nations peoples.' The agreement restricted logging from 85 percent of the forest and recognises First Nations as co-decision makers in the area as well as providing economic opportunities for communities.

Investment in Indigenous communities is also being supported by the federal government. In 2021 it was announced the government of Canada will be investing $340 million in new funding over five years to support Indigenous leadership in nature conservation, as part of Canada's historic Budget 2021 investment of $2.3 billion over five years in nature conservation[9].

Dallas Smith, President of the Nanwakolas Council, speaks at the GBR agreements. Photo courtesy of the Province of BC.

https://coastfunds.ca/news/final-agreement-reached-to-protect-b-c-s-great-bear-rainforest/

[7] Monitoring biodiversity with remote sensing (nrcan.gc.ca)

[8] https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/great-bear-rainforest

[9] https://www.canada.ca/en/environment-climate-change/news/2021/08/government-of-canada-announces-340-million-to-support-indigenous-led-conservation.html

United Kingdom

The United Kingdom (UK) has committed to protecting 30 percent of its land by 2030 for biodiversity. It has a number of programmes and initiatives underway. Submitters mentioned a couple of useful local initiatives to us.

One is Slowing the Flow[10] at Pickering, Yorkshire, which is exploring a new approach to flood management. The project is about working with nature to try and store more water in the landscape and slow its passage downstream. It is expected to reduce the frequency of floods in nearby towns, as well as improve riparian biodiversity and reduce the need for stopbanks and channels.

A second was Environmental Stewardship[11], an agri-environment scheme that provides funding to farmers and other land managers in England who deliver effective environmental management on their land. It builds on other successful land stewardship schemes, encouraging landowners to conserve biodiversity and wildlife and protect the land's historic and conservation values.

The UK contributes to MAMBO[12], an EU project that develops, tests and implements enabling tools to monitor wildlife and conservation status in areas where there are gaps. Its objectives include using AI solutions, remote sensing and deep learning to gather data and evaluate their costs and benefits. MAMBO aims to build a global community of practice for use of these tools.

Slowing the Flow at Pickering uses natural measures to control floodwaters – such as large woody debris (LWD) dams.

Slowing the Flow at Pickering | Institution of Civil Engineers (ICE)

[10] https://www.canada.ca/en/environment-climate-change/news/2021/08/government-of-canada-announces-340-million-to-support-indigenous-led-conservation.html

[11] https://www.canada.ca/en/environment-climate-change/news/2021/08/government-of-canada-announces-340-million-to-support-indigenous-led-conservation.html

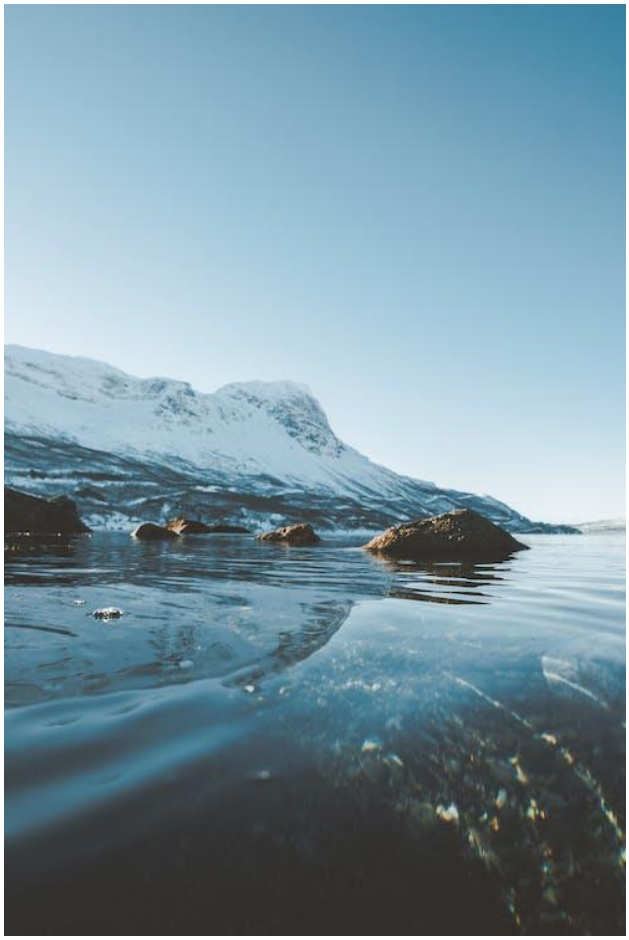
[12] https://www.canada.ca/en/environment-climate-change/news/2021/08/government-of-canada-announces-340-million-to-support-indigenous-led-conservation.html

Finland

Finland is committed to biodiversity recovery and sees information and data as a useful tool to help in this aim.

Biodiversity.fi is an online national indicator collection reflecting the state and change of biodiversity in Finland. It includes more than 110 indicators reflecting the state and development of biological diversity as well as factors driving changes in the natural environment. Biodiversity.fi is financed by the Ministry of Environment and has been developed in close cooperation by environmental research organisations and non-governmental organisations.

The Finnish Biodiversity Information Facility (FinBIF) is an open access data repository for researchers, government and the public. FinBIF consolidates many collections and datasets into a single source. The online portal allows people to browse, search and download information about all forms of life, and to record and share their own observations.



Body of water across from White Mountain.

https://www.pexels.com/photo/body-of-water-across-white-mountain-2004388/

United States

The United States (US) has one of the most advanced technology and science sectors in the world.

The US uses remote sensing technologies such as drones, satellites and aerial photography for surveying and monitoring endangered species, habitats and ecosystems. It uses data analysis and machine learning tools to better understand the effects of climate change on biodiversity. Additionally, the US is investing in digital tools to help researchers, conservationists and policy makers better track, manage and protect biodiversity.

It is also looking into recognising and including Indigenous knowledge. At the White House Tribal Nations Summit, the administration released new government-wide guidance and an accompanying implementation memorandum for federal agencies on recognizing and including Indigenous knowledge in federal research, policy and decision making, including protections for the knowledge holders[13].

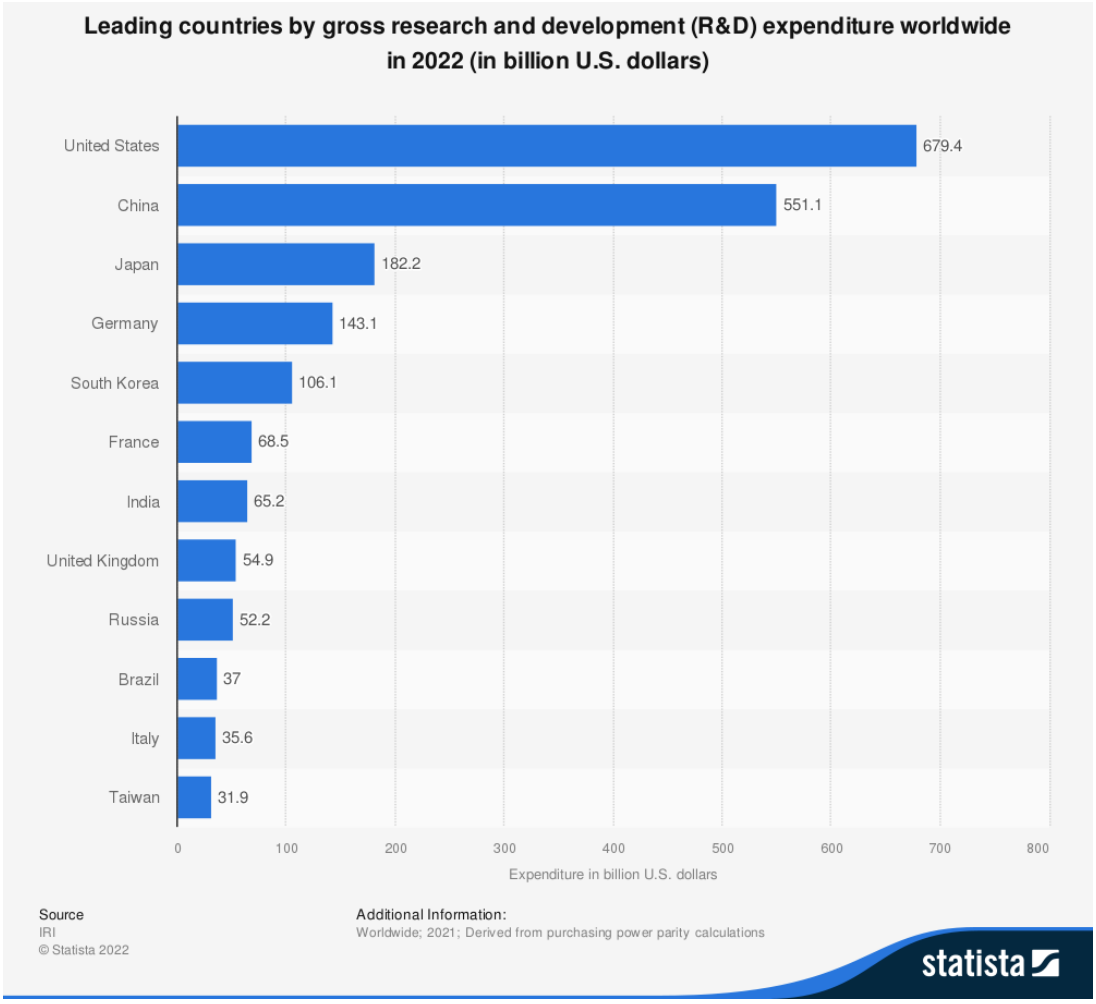
[13] https://www.state.gov/highlighting-u-s-efforts-to-combat-the-biodiversity-crisis/#:~:text=In%202021%2C%20USAID%20invested%20%24319.5,food%2C%20jobs%2C%20and%20security.

Google Earth Engine is a platform that combines a catalogue of satellite imagery and geospatial datasets with planetary-scale analysis capabilities. This platform can be used to detect and quantify changes and map trends on the Earth's surface.

Microsoft has created AI for Earth, a platform that uses cloud technology and artificial intelligence to facilitate the collection and processing of massive amounts of data and predict future biodiversity trends. This platform helps researchers and policymakers gain access to information relevant to protect nature.

Universities are also active in the biodiversity space. Harvard University's Wyss Institute for Biologically Inspired Engineering is working on a project called Circe, which aims to develop engineered microbes to produces polymers. These microbes would use and harvest greenhouse gases created by industrial processes, which could help reverse or limit global warming and CO_2 emissions[14] and relieve pressure on biodiversity.

Finally, the US collects data on vegetation, soil, water and land use. The National Land Cover Database (NLCD) where this is stored is a national resource, used to monitor and protect biodiversity by providing a visual representation of the land cover and vegetation in a given area.



[14] https://wyss.harvard.edu/technology/circe-transforming-greenhouse-gases-into-biodegradable-products/

Botswana

Botswana has done a lot of work in building and maintaining community engagement in conservation. More than 25 percent of the land in Botswana is set aside for parks and reserves to protect and conserve flora and fauna. The government has put in place strong measures to protect wildlife against criminal threats such as poaching and trafficking.

Cheetah Conservation Botswana aims to preserve the cheetah population through a mix of scientific research, outreach to farmers, education and community development. It works alongside the Botswana government to help facilitate and manage relationships with rural communities and the cheetahs. It focusses on effective and practical programmes that build trust with communities and help humans live peacefully alongside these animals.

Cheetah in a field. https://commons.wikimedia.org/wiki/File:Cheetah_Botswana.jpg
Attribution-ShareAlike 3.0 Unported

Informing the draft Long-term Insights Briefing

To inform the thinking in the LTIB, we reflected on the past and present states of biodiversity, explored global mega trends likely to shape the future, and thought about emerging technologies that have the potential to be game changing for biodiversity.

Some of the resources used to inform our thinking are outlined below.

Biodiversity states and trends

The 2019 global assessment report on biodiversity and ecosystem services is the most recent and comprehensive assessment of the state of the world's natural environment. Prepared by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), it assesses changes to biodiversity over the last 50 years.

- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019. The global assessment report on biodiversity and ecosystem services: Summary for policymakers. Bonn: IPBES Secretariat. https://doi.org/10.5281/zenodo.3553458

Biodiversity in Aotearoa – An Overview of State, Trends and Pressures, presents data and information that describes the extent of the biodiversity crisis in Aotearoa New Zealand. It explores the five key direct pressures responsible for the decline of Aotearoa New Zealand's species and ecosystems (introduced invasive species, changes in land and sea use, direct exploitation and harvesting, pollution and the increasing threat of climate change).

- Department of Conservation. (2020). *Biodiversity in Aotearoa: An overview of state, trends and pressures.* https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-2020-biodiversity-report.pdf

Global mega trends

To inform the thinking and consultation behind the LTIB, we looked broadly at global mega trends likely to shape the future. Mega trends are the transformative global movements, patterns, or forces likely to impact the future. They are identified in the futures thinking workshop section above.

The resources below have been created to inform decision makers, businesses, and communities about the forces that will likely impact their work in the future.

- World Economic Forum. (2022). *Strategic Intelligence*. https://www.weforum.org/strategic-intelligence
- United Nations. (2020). *Report of the UN Economist Network for the UN 75th Anniversary Shaping the Trends of Our Time*. https://www.un.org/development/desa/publications/wp-content/uploads/sites/10/2020/09/20-124-UNEN-75Report-2-1.pdf
- EY. (2020). *Megatrends 2020 and beyond*. https://www.ey.com/en_nz/megatrends
- Oxfam. (2020). *Global mega trends: Mapping the forces that affect us all*. https://oxfamilibrary.openrepository.com/bitstream/handle/10546/620942/dp-global-megatrends-mapping-forces-affect-us-all-310120-en.pdf?sequence=1&isAllowed=y
- United Kingdom Government. (2021). *Trend Deck Spring 2021*. https://www.gov.uk/government/collections/trend-deck-spring-2021

Emerging technologies

Significant research has been published on the role emerging technologies, such as biotechnologies and data-driven technologies, might play in the future. Of this work, the LTIB has been particularly informed by the resources below.

- Chui, M., Roberts, R., Lareina Yee. McKinsey Technology Trends Outlook 2022. https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/the%20top%20trends%20in%20tech%202022/mckinsey-tech-trends-outlook-2022-full-report.pdf?shouldIndex=false
- AI Forum New Zealand. (2022). Artificial Intelligence for the Environment in Aotearoa New Zealand. https://aiforum.org.nz/wp-content/uploads/2022/05/AI-for-the-Environment-Report-2022-1.pdf
- European Policy Centre. (2020). Improving biodiversity: How can digitalisation help? https://www.epc.eu/content/PDF/2020/Digitalisation_v3.pdf
- Royal Society Te Apārangi. (2022). Gene editing in Aotearoa. https://www.royalsociety.org.nz/major-issues-and-projects/gene-editing-in-aotearoa/
- Segelbacher, G., Bosse, M., Burger, P. et al. (2022). New developments in the field of genomic technologies and their relevance to conservation management. Conserv Genet 23, 217–242. https://doi.org/10.1007/s10592-021-01415-5
- Hudson, M., et al. (2019). Indigenous Perspectives and Gene Editing in Aotearoa New Zealand. Frontiers in bioengineering and biotechnology, 7, 70. https://doi.org/10.3389/fbioe.2019.00070
- OECD AI Policy Observatory. (n.d). Policies, data and analysis for trustworthy artificial intelligence. https://oecd.ai/en/
- Global partnership on Artificial Intelligence (GPAI). https://gpai.ai/