

# Biological Heritage Submission to Te Ara Paerangi Future Pathways Green Paper

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## Purpose

This document provides the New Zealand Biological Heritage National Science Challenge, *Ngā Kōiora Tuku Iho* (BioHeritage Challenge), collective Challenge response to the Te Ara Paerangi Future Pathways Green Paper (Green Paper).

The response below is expected to be supplemented with further specific discussion with the BioHeritage Challenge to ensure full understanding of our developments and advances in research and science.

## Preamble

The BioHeritage National Science Challenge, *Ngā Kōiora Tuku Iho*, aims to protect and manage Aotearoa New Zealand's biodiversity, improve our biosecurity, and enhance our resilience to harmful organisms. **Our ultimate goal is to reverse the decline of our biological heritage.** We're doing this through national partnerships across Aotearoa's land-based and freshwater ecosystems. We aim to achieve three aspirational goals or impacts (*whakamana, tiaki, whakahou*; empower, protect, restore) via a collective impact approach that includes our 18 Challenge Parties and many others (<https://bioheritage.nz/about-us/strategic-partnerships/>). In short, The BioHeritage Challenge can provide insights into developing major, national collaborative approaches to science in Aotearoa intended to accelerate progress toward solving major societal issues.

## Structure of this submission

**This submission focusses on two headline issues: 1) Mission-led science, and 2) Te Tiriti o Waitangi-led partnerships, developed through broad consultation. The Challenge has developed new approaches and provided leadership across the science system on these issues, some of which is detailed below in our response.**

We strongly support many of the points raised in Te Ara Paerangi, but do not provide detailed responses to each of the questions posed within the green paper; rather, we encourage ongoing engagement beyond the immediate deadline for written submissions. To that end, **we strongly recommend directly following up with the BioHeritage Challenge to ensure our discoveries and advances in doing mission-led science are implemented in the next stages of Te Ara Paerangi. Likewise for collective discussion with National Science Challenges (NSC) and evaluation of NSCs outcomes.**

To support navigation and analysis of the responses, this submission document is structured under the Te Ara Paerangi Green Paper main chapter headings, with the specific questions from the Green Paper that the response answers referenced in each of the sections below.

## Response to the Te Ara Paerangi Paper and Questions

### Our Headlines

#### 1. Research Priorities - A focus on mission-led science

Questions addressed:

##### 1. (1.2.2) Priorities design

- What principles could be used to determine the scope and focus of national research Priorities?
- **Key points:**
  - Overall the 'designing research priorities' principles are well considered and should stimulate greater integration of talent across the research system. Priorities forming a single 'home' or hub of research activities has merit, with the caveat that this potentially adds another layer of governance or administration to the system (see overall comments below).

National Science Challenges (NSC) have developed and championed 'mission-led' research (e.g., Duncan et al. 2020). Rapid changes in how we tackle major societal problems collectively have emerged that provide important discoveries and lessons across all of the questions raised in Te Ara Paerangi.

Some background is warranted. The BioHeritage Challenge was formed through deliberate inclusion of both biodiversity and biosecurity research efforts, and is built on decades of previous work and knowledge. Despite these efforts there has been an ongoing decline in our biological heritage. Thus, the overall mission of the Biological Heritage NSC *Ngā Kōiora Tuku Iho* is to reverse the decline of our biological heritage. This is done through a Tiriti-led national partnership to deliver a step-change in research innovation, globally leading technologies and community and sector action. Our primary role has been to convene, prioritise and connect a wide range of partners and existing capability or investments to accelerate progress toward our mission.

Within the Challenge, a wide range of partners are now working together, many for the first time, taking a collective, inter-disciplinary approach to achieve national-scale impact. The development and implementation of a 'mission-led' approach to science provides insights and concrete examples of how research priorities and more inclusive approaches to science are developed that differ from most *status quo* approaches (Duncan 2020), and that strongly support the approaches suggested within *Te Ara Paerangi*. Some examples:

- **A deliberate shift from topic-driven research programmes over the first 5 years to a focus on Impacts** (Whakamana, Tiaki, Whakahou). These impacts are larger programmes considered essential toward achieving our mission, and were developed through wide consultation and engagement across the science system, our challenge parties, and all major strategies related to biodiversity and biosecurity.

- **Empowering people (Whakamana) emerged as a major theme through both conceptual and practical needs.** For example, although the role of people as both a driver of biodiversity declines and potential solutions to reversing the decline is widely appreciated, new approaches linking social and ecological systems demonstrate the strong interdependencies between both biodiversity or ecosystem condition and people's wellbeing. These processes are also critical for restoring or renewing local and Indigenous peoples connections to the environment and kaitiakitanga (Lyver et al. 2019; [https://bioheritage.nz/wp-content/uploads/2019/04/McFarlane-et-al.-summary\\_final.pdf](https://bioheritage.nz/wp-content/uploads/2019/04/McFarlane-et-al.-summary_final.pdf)).
- Our Tranche 2 strategy and implementation was a major shift from contestable pass-fail funding of projects, to **explicit design of “strategic outcomes (SOs)” and impacts** (<https://bioheritage.nz/about-us/our-strategy/>). Design and scoping of SOs involved substantive engagement across the science system, often for up to a year, to identify the shared goals and meaningful contributions at the ‘meso-scale’, i.e., above the scale of individual institutions or lab groups, local communities, or organisations (detailed in Duncan 2020). Co-incident with this approach was:
  - A shift from ‘best teams’ to ‘right teams’ to widen the range of talents or skills included in research. ‘Best’ teams are formed based on high individual performance whereas ‘right’ teams include explicit consideration of collective skills and values;
  - Development of a values-based approach to research (<https://bioheritage.nz/about-us/our-values/>) needed to support a collective approach that is reflected throughout development of individual projects, leadership and governance;
  - Greater inclusion and support of Māori and te ao Māori-led goals and research throughout all stages of research design and programme implementation;
  - Identification and prioritisation by consensus of shared goals;
  - Co-design and co-leadership throughout the scoping process and implementation of science programmes (see also [https://bioheritage.nz/wp-content/uploads/2019/04/LC3849\\_Codesigning-for-research-impact-FINAL-REPORT.pdf](https://bioheritage.nz/wp-content/uploads/2019/04/LC3849_Codesigning-for-research-impact-FINAL-REPORT.pdf)).

## 2. (1.3.2) Priority-setting process

- What principles should guide a national research Priority-setting process?

## 3. (1.4.2) Operationalising Priorities

- How should the strategy for each national research Priority be set and how do we operationalise them?
- **Key Points:**
  - Consultation is insufficient in many cases; for priorities to be shared and meaningfully implemented (1.4.2 below), co-design, Tiriti-led development of priorities is required.
  - Developing national science strategies needs a comprehensive process to ensure relevance. The process that led to the National Science Challenges was more political than driven by national needs. In contrast, other strategies such as Biosecurity 2025 was a more comprehensive process with many well-considered

work streams resulting in draft strategies and research priorities and serves as an important example to consider for wider adoption/use.

**The design process developed and implemented by the Challenge provides insights into supporting highly collaborative programmes.** This more bottom-up approach to identify priorities could be more widely adopted. For example, the Challenge was heavily involved in development of the new Biodiversity Strategy, *Te Mana o te Taiao* (<https://www.doc.govt.nz/nature/biodiversity/aotearoa-new-zealand-biodiversity-strategy/>), demonstrating how prioritisation can be co-developed and included a greater focus on the role of people in conservation compared to previous strategies. Our Challenge Parties state that these processes are an “Efficient approach for engaging multiple stakeholders with limited time” (cf. individual research organisations competing for their time).

- **We developed and implemented an ‘innovation system’ approach to support mission-led and impacts-focussed science based on implementation pathway, or intervention logic.** The concept of an innovation system takes a collective-impact approach to research investment (<https://bioheritage.nz/about-us/our-strategy/>). The approach interweaves all types of knowledge, including mātauranga Māori, from new discoveries and innovations to novel ways to use this knowledge – for greater impact and benefit for Aotearoa (see Figure 1.). The innovation system allows for a diversity of contributions from a wide range of individuals and institutions: a national partnership.



**Figure 1. A visual representation of New Zealand’s innovation system.**

- Both lags and legacies necessitate a longer-term view of science, its use, and long-term impacts. Five year plans are a minimum for mission-led research, but the longer-term objectives or shared goals of those involved guide shorter-term work and ensure its lasting value or legacy (e.g., a 100 year vision co-developed with communities; see <https://bioheritage.nz/goals/strategic-objective/bioheritage-ecoindex/>).
- Detailed documentation of our approach is openly available and has been taken up or replicated elsewhere. This spans critical guidance on cultural safety in science; collaborative agreements; supporting treaty partnerships (see below); and ensuring equity, access, diversity and inclusion in science (<https://bioheritage.nz/resources/operational-and-guidance-documents/>).

- We strongly emphasise that continual learning and improvement drawing both on past and current science efforts and innovations should continue. We are currently at a critical juncture in the science system where **improvements to support, and include, Māori throughout the science system are required (see below).**

In short, these and other approaches developed, implemented and championed by the BioHeritage Challenge align strongly with the ideas in Te Ara Paerangi of directing science investments towards solving major societal issues, and provide new methods and insights for how this could be achieved.

## **2. Te Tiriti, mātauranga Māori and Māori aspirations - A commitment to a Te Tiriti o Waitangi-Led Science System**

Questions addressed:

### **4. (2.2) Engagement**

– How would you like to be engaged?

– **Key points:**

- We support statements in the submission by Rauika Māngai.
- Overall structural changes are needed to governance and support of Tiriti-based approaches to science, and are essential as outlined in our response below.

**Tiriti partnerships are essential to achieving our mission.** Māori have strong connections to Aotearoa New Zealand's environment, with valuable inter-generational views and belief systems that can underpin decision-making, governance and stewardship. The BioHeritage Challenge has developed and championed greater inclusion of Māori throughout all stages of our science from practitioners on the ground through to leadership and governance.

Below we highlight some of the many improvements we have made within the Challenge, but emphasise that the scale, nature and importance of improving Tiriti partnerships throughout the science system requires meaningful and wide engagement, and fundamental changes to governance. As a consequence, **we strongly support and endorse the submission by Māori science leaders through Rauika Māngai** (Māori leaders across the 11 National Science Challenges and Ngā Pae o te Māramatanga). Key points from this submission, that we support include:

- The overarching goal that Māori are equal and effective partners in the research, science and innovation sector.
- The current science sector does not work well for Māori across levels, because of structural inequalities and biases throughout, spanning value of knowledge systems through to prioritisation of outcomes for Māori. Many improvements and exemplar Tiriti partnerships have been achieved, albeit in different ways, across the NSCs.
- Establishment of an autonomous national Māori Science Authority would benefit Māori and tangata Tiriti alike, phased over 10 years, and monitored through key metrics.

- Ultimately, this approach provides multiple benefits spanning support and value of mātauranga; eliminating structural racism from the science sector; and lifting both capability and capacity of Māori across the science sector; and shifts the working culture toward stronger partnership among both Māori and tauwi.

### 5. (2.3) Mātauranga Māori

- What are your thoughts on how to enable and protect mātauranga Māori in the research system?
- **Key point:**
  - We support statements in the submission by Rauika Māngai.

### 6. (2.4) Regionally based Māori knowledge hubs

- What are your thoughts on regionally based Māori knowledge hubs?
- **Key points:**
  - We support statements in the submission by Rauika Māngai.
  - Hubs are only one of many potential mechanisms for meaningfully including local/regional Māori in science and ensuring deeper place-based knowledge.
  - A wider suite of support is appropriate depending on the science and local/regional needs.

Greater detail is provided in the Rauika Mangai submission and others that aren't repeated here. **We have embraced Te Ao Māori throughout the Challenge because this is essential for achieving our mission, but also leaves a lasting legacy in our science system.** Some illustrative changes and improvements championed by the BioHeritage Challenge include:

- Explicitly funding research programmes higher on the Vision Mātauranga scale (Tranche 1 projects). From the earliest investments made by the Challenge, we purposely expected and supported greater respectful collaborations with Māori, and strongly supported te ao Māori-led programmes of work.
- Supporting open debate, training and documentation for critical Treaty issues in the science system. For example, recognising the importance of supporting WAI262 across research projects and infrastructure, including data and collections; this is crucial for all biodiversity and biosecurity activities (e.g., <https://bioheritage.nz/wp-content/uploads/2019/04/Copy-of-Wai-262-Briefing-on-natural-resource-governance-and-policy-recommendations-1.pdf>).
- Developing a co-design approach to science investments that includes communities and Māori (Tranche 2 scoping above). We deliberately include and support Māori co-leads in all major programmes of work, and across decision making from individual science programmes, supporting activities (Pou), leadership, and governance. Our Challenge parties suggest we have shown how mātauranga practitioners can have a safe space to drive the priorities and solutions to investigate. Moreover, deliberate co-leadership has yielded much better participation of kairangahau Māori and has enabled a supportive training pathway (e.g., in project leadership) for many co-leads.
- This more inclusive and supportive approach of Māori in the science system, and biodiversity and biosecurity specifically, has stimulated additional collective approaches to environmental issues. For example, development and implementation of Ngā Rākau



Taketake (<https://bioheritage.nz/research/saving-our-iconic-trees/>), that necessitated fundamental shifts in inclusion and co-design of major research programmes with Māori researchers and communities. Several researchers in the Challenge founded Te Tira Whakamātaki (the watchful ones), a sorely-needed Māori biosecurity network that is now a thriving not-for-profit award-winning organisation (<https://ttw.nz/>).

- In addition, some specific mechanisms to support mātauranga Māori in the Challenge that could be more widely adopted include:
- Explicit commitments to invest and support Te Tiriti-led approaches to science. Illustrative examples such as Tranche 1 project Mātauranga Māori characterisation of NZ's biodiversity: Whakamanahia ngā mātauranga o nehe hai oranga tangata, oranga taiao, the Oranga theme of NRT (<https://bioheritage.nz/research/oranga/>) demonstrate that **supporting Māori methods and mātauranga (knowledge) first is a key part of restoring Aotearoa New Zealand's land and freshwater ecosystems.**
- Capability has been increased through multiple mechanisms including inclusion of Māori knowledge brokers, mentoring of students and internships, administrative support for over-stretched Māori researchers, and mentorship for research programme funding and implementation for many new researchers not familiar with requirements of our science system (e.g., developing contracts).
- Direct support and inclusion of BioHeritage mātauranga practitioners, for example, in community-led Kauri dieback management (*Tiaki mō kauri*: citizens combating kauri dieback (<https://bioheritage.nz/research/kauri-rescue/>), and in the renewal and empowerment of local communities to manage resources such as mahinga kai (*Kia mau tonu ki ngā tāonga tapu o ngā Mātua Tūpuna* - Hold fast to the sacred treasures of our ancestors (<https://bioheritage.nz/research/customary-approaches-to-ecosystem-resilience/>)). **These projects and others in the Challenge and NRT highlight the importance of place-based approaches required for successfully working with communities for mission-led science.**
- Guidance, training and education of non-Māori researchers – in a kind and safe way. This lifts the awareness, capability and respect for tangata Tiriti as partners and champions of mātauranga Māori and te ao Māori approaches to research throughout the science system. Multiple benefits such as overcoming negative perceptions or bias against mātauranga Māori, and greater understanding of how mātauranga can help to deliver enduring solutions to complex environmental problems, are anticipated from these efforts.
- Incorporating a collective mana whenua coordinated approach empowering mana whenua to be involved, co-design, share and undertake research with required tools to empower and protect mātauranga Māori and mana whenua. This includes appropriate engagement, resourcing and co-design with Cultural Authority Agreements that outline activities that researchers propose to undertake, full disclosure of existing and emergent science to mana whenua, and opportunities for discussion between scientists, researchers, and mātauranga Māori authorities. The approach heralds a progressive and transparent means of elevating and recognising mātauranga Māori and its authorities equitably in the science system while recognising the mana of tangata whenua (see Te Whakahononga: Māori-centred research to fight kauri dieback and myrtle rust).



- Recognising that both policy and governance structures require proactive changes to support the more meaningful inclusion of Māori across the science system, but also in how different knowledge systems and evidence are used for making decisions at all levels (see <https://bioheritage.nz/wp-content/uploads/2019/04/For-a-Tika-Transition.pdf>).
- Developing and adopting a values-based approach to science that reflects a stronger Tiriti-partnership approach (<https://bioheritage.nz/about-us/our-values/>). More recently, we have also made explicit commitment to Te Tiriti throughout our processes, values and investments (<https://bioheritage.nz/wp-content/uploads/2019/04/BioH-Te-Tiriti-Commitment-statement-bilingual-FINAL.pdf>).
- We strongly support the view that there are major pressures on capability of Māori researchers generally across the science system. Both training and support of tangata Tiriti, as well as longer-term support for Māori are needed to increase capability across the science system over the longer-term (5 years and beyond).

Overall, the BioHeritage Challenge has done a major body of work to encourage and support stronger Te Tiriti partnerships in research and inclusion of mātauranga Māori and both tangata Tiriti and Māori/Indigenous knowledge systems. Initially this was in response to Māori as a minority in the science system despite the crucial importance of Māori communities, researchers and decision makers to our mission. **We consider these improvements represent first steps toward the far greater systems-level changes required, as outlined by Rauika Māngai.**

**We strongly support the submission by Māori leaders through Rauika Māngai (the cross NSC Māori leadership group; link) who provide well-considered, constructive, detailed responses to the Green Paper questions 4, 5 & 6 that are listed above.**

## ***Additional Points***

### ***3. Funding***

Questions addressed:

#### **7. (3.2.1) Core functions**

- How should we decide what constitutes a core function and how do we fund them?

#### **8. (3.3.2) Establishing a base grant and base grant design**

- Do you think a base grant funding model will improve stability and resilience for research organisations, and how should we go about designing and implementing such a funding model?

#### ***Base funding and allocations***

Regardless of core functions or base grants, we emphasise the importance of open and shared information about research activities and capabilities. This information is critical for developing integrated collaborative research programmes, aligning research efforts, and implementation of new knowledge or innovations (i.e., developing implementation pathways for major research programmes).

Currently, major efforts are spent collating this information to support research investment, including core functions nationally (e.g., SSIF investments within CRIs; and databases and collections). For example, as demonstrated through the major consultation, synthesis and engagement needed to develop the Ngā Rakāu Taketake SSIF platform investments (<https://bioheritage.nz/research/saving-our-iconic-trees/>), charged, in part, with accelerating work already being done by Government agencies, councils, research providers, Māori and interest groups.

- Open, explicit knowledge of funding and activities should be used to guide any decisions on base/future funding and collaborative activities, but should follow improvements in treaty partnerships and prioritisation (see Headline issues above).
- A major benefit of base grants or core funding voiced widely by our Challenge Parties, researchers, communities and decision makers is improved security of capability within research organisations. Appropriate funding streams (both magnitude and levels of resourcing) are essential to support research providers and ensure the impacts and benefits of our work is achieved. Base funding could also be used to ensure supporting or pou activities are maintained; in the Challenge this includes critical support staff, but also integrated work across programmes and topics such as data sovereignty; increased awareness and capability of Māori researchers; conceptual syntheses; and an early career network.
- Although some competitive bidding or competition of ideas is valuable, the resources expended in bidding and reporting on competitive processes are viewed by many as excessive or 'hidden' costs within the system currently (e.g., see Gross & Bergstrom 2019 for an international example). Similarly, rationalising reporting systems and overhead costs among organisations would streamline programmes of work, and reduce the contracting and overhead burdens associated with complex collaborations amongst organisations. **Multi-disciplinary teams are essential for mission-led research, so adopting processes for overcoming or minimising barriers to inclusion of people and organisation are essential.**
- Although Challenges do not directly fund the support or maintenance of collections and databases, these are essential underpinning infrastructure for many of our science programmes. Base funding to support this research infrastructure is critical, but could be better or more explicitly aligned to 'platforms' or mission-led programmes of work.
- **We strongly endorse a mixed model funding system that includes negotiated or co-designed programmes together with some competitive projects.** Such a portfolio approach ensures greater inclusion of different research, inclusion of new and emerging ideas, but also supports longer-term science implementation and impacts.

## 4. Institutions

Questions addressed:

### 13. (4.6) Knowledge exchange

- How do we better support knowledge exchange and impact generation?
- What should be the role of research institutions in transferring knowledge into operational environments and technologies?

#### ***Better Impact Delivery – knowledge exchange and research impact***

Wider use of full pathways like intervention logic, or the implementation pathway developed for Challenge investments, can be used to improve knowledge needs, exchange and use. Wider adoption of these methods makes the contribution of different organisations explicit; can be used to prioritise investments to overcome knowledge gaps or barriers to exchange or use; and ultimately can be used to increase the overall impact of science (Duncan et al. 2020). Some additional issues such as uncertainty in knowledge; matching evidence needed to critical decisions in operations, policy or management; lags in uptake or use; and shifting goals or desired impacts can be considered taking this approach (e.g., as has been developed internationally by applying adaptation pathways approaches to future climate: Craddock-Henry et al. 2020; Werners et al. 2021).

All research organisations and future 'platforms' should be responsible for increasing their activities and skills in knowledge transfer both across the science system, and with 'users' of new knowledge, information and innovations. We have strongly benefited from the wide inclusion of 'knowledge brokers' (i.e., skilled experts who translate knowledge amongst diverse groups across the science system) as one mechanism to facilitate knowledge exchange amongst diverse communities of researchers, decision makers and practitioners. Increased training or capability in skills related to knowledge exchange and transfer are also a practical means of working across the innovation or implementation pathway (see above).

Aside from capability in knowledge transfer, there are major funding gaps for implementation and adoption of new knowledge and innovations. For example, Envirolink ([www.envirolink.govt.nz](http://www.envirolink.govt.nz)) was developed in 2005 because MRST at the time was concerned that \$100M/year of investment in environmental research was not being utilised by regional councils. Government (Vote Science) invest \$1.6M/year (ex GST) in Envirolink to transfer scientific knowledge from University and CRI scientists for a variety of purposes such as analysing council data sets; provide advice on small mammal or weed management; designing community-based monitoring systems.

### 9. (4.4.1) Institution design

- How do we design collaborative, adaptive and agile research institutions that will serve current and future needs?

#### *International linkages*

The overall importance of international linkages, and the role of international science community is not clear in Te Ara Paerangi. Overall, science is informed by international discoveries and there are numerous schemes and support for strengthening links to the international science community. However, several interlinked issues deserve greater consideration:

- recognising the unique contributions that science within Aotearoa New Zealand could make to international knowledge, or widening the impact of our work/investments;
- ensuring that prioritisation activities (Section 1) and 'platform' development draws explicitly on international science efforts and knowledge;
- recognising the critical role of international linkages to training, capability, and our scientific workforce.

In addition, some major societal issues that NSCs were charged with making new progress to resolve, and other crucial challenges (e.g., climate change in the Pacific; international biosecurity risks; see also Fernández-Llamazares et al. 2021) necessitate greater support for linkages and international collaborative efforts.

Refer to section 5 below regarding question 10 (4.4.2) Role of institutions in workforce development.

## **5. Research workforce**

Questions addressed:

### 10. (4.4.2) Role of institutions in workforce development

- How can institutions be designed to better support capability, skills and workforce development?

### 14. (5.2) Workforce and research Priorities

- How should we include workforce considerations in the design of national research Priorities?

**Taking a 'Mission-led' design approach to science (see Headline 1. Research Priorities above) necessitates including a wider range of skills and capabilities into the design and implementation of research programmes.** This provides benefits both for the impact of the work, and also highlights where improvements in workforce capability or capacity are needed. Thus both increasing capability through training or mentorship, and explicitly designing funding that provides for inclusion and development of these skills is warranted. For example, there are major capacity limitations for Māori scientists particularly that need to be addressed (e.g., Haar & Martin 2021; see also Kukutai et al. 2021). The BioHeritage Challenge has intentionally offered different types of leadership opportunities for Māori from co-leadership of projects through to strategic leadership and governance that could be more widely

adopted to overcome both current capability and capacity limitations. Training and mentorship of non-Māori (tangata Tiriti) for practical skills for engagement and collaboration with both Māori researchers and communities is also needed to achieve many of the goals suggested in Te Ara Paerangi.

An emerging issue that requires additional thought and leadership is how performance and science excellence are assessed. Rapid changes are underway for the evaluation of Māori researcher performance (e.g., in the University PBRF assessments), and individual career pathways within some CRI's. Training of 'highly qualified personnel' is a major consideration for most science funding organisations internationally, and should be more explicitly evaluated as a part of research priority development and investment decisions. Moreover, this is a major area for integration of efforts among Tertiary Education providers and others across the science system.

## Next steps

Mission-led design of research and science programmes is ultimately derived from wider public and societal expectations of what science can do to help resolve major environmental and societal issues. As such, public discourse and inclusion to develop future 'Missions' and prioritisation of efforts across the RS&I system is essential, particularly because long-term solutions to nearly all of these issues require sustained support, implementation and use of science far beyond the RS&I system itself. However, for this to occur a commitment to upholding Te Tiriti of Waitangi as our foundation for power sharing is required. Thus equitable outcomes, agreed priorities, focus and ultimately greater innovation, solutions, and outcomes for Aotearoa NZ overall. Tiriti-led science policy and partnerships, must be at the heart of the RS&I system. To do so requires empowering of mātauranga Māori and te ao Māori through a suitable resourced national mātauranga Māori commission and commitment to long term resourcing and changes in both the science/learning curriculum and valuing of mātauranga Māori, te ao Māori along with other knowledge systems.

We hope MBIE will undertake a coordinated collective evaluation of the performance and outcomes of NSCs to inform the future pathways for RS&I. We look forward to hearing your thoughts on our points above, and to contributing to the next steps of Te Ara Paerangi.

## Contact

Biological Heritage National Science Challenge  
c/o Landcare Research Manaaki Whenua  
PO Box 69040, Lincoln, 7640

P: +64 3 321 9794 | E: [support@bioheritage.nz](mailto:support@bioheritage.nz)  
W: [www.bioheritage.nz](http://www.bioheritage.nz)

## References

- Cradock-Henry, N.A., Blackett, P., Hall, M., Johnstone, P., Teixeira, E. and Wreford, A., 2020. Climate adaptation pathways for agriculture: insights from a participatory process. *Environmental Science & Policy*, 107, pp.66-79.
- Duncan R (2020). Co-designing for research impact: lessons learned from practice in Aotearoa New Zealand. Manaaki Whenua Contract LC3849 Prepared for New Zealand's Biological Heritage National Science Challenge.
- Duncan R, Robson-Williams M & Fam D (2020). Assessing research impact potential: using the transdisciplinary Outcome Spaces Framework with New Zealand's National Science Challenges, *Kōtuitui: New Zealand Journal of Social Sciences Online*, 15:1, 217-235, <https://doi.org/10.1080/1177083X.2020.1713825>
- Fernández-Llamazares, Á., Lepofsky, D., Lertzman, K., Armstrong, C.G., Brondizio, E.S., Gavin, M.C., Lyver, P.O.B., Nicholas, G.P., Reo, N.J., Reyes-García, V. and Turner, N.J., 2021. Scientists' Warning to Humanity on Threats to Indigenous and Local Knowledge Systems. *Journal of Ethnobiology* 41:144-169.
- Haar, J. and Martin, W.J., 2021. He aronga takirua: Cultural double-shift of Māori scientists. *Human Relations*, p.00187267211003955.
- Kukutai, T., McIntosh, T., Boulton, A., Durie, M., Foster, M., Hutchings, J., Mark-Shadbolt, M., Moewaka Barnes, H., Moko-Mead, T., Paine, S-J., Pitama, S. & Ruru, J. (2021). Te Pūtahitanga: A Tiriti-led science- policy approach for Aotearoa New Zealand. Auckland: Ngā Pae o te Māramatanga. ISBN 978-0-473-57159-7 (pdf)
- Lyver, P.B., Timoti, P., Davis, T. and Tylianakis, J.M., 2019. Biocultural hysteresis inhibits adaptation to environmental change. *Trends in Ecology & Evolution* 34:771-780.
- Lyver, P.O.B., Ruru, J., Scott, N., Tylianakis, J.M., Arnold, J., Malinen, S.K., Bataille, C.Y., Herse, M.R., Jones, C.J., Gormley, A.M. and Peltzer, D.A., 2019. Building biocultural approaches into Aotearoa–New Zealand's conservation future. *Journal of the Royal Society of New Zealand* 49: 394-411.
- Werners, S.E., Wise, R.M., Butler, J.R., Totin, E. and Vincent, K., 2021. Adaptation pathways: A review of approaches and a learning framework. *Environmental Science & Policy*, 116, pp.266-275.
- Gross, K. and Bergstrom, C.T., 2019. Contest models highlight inherent inefficiencies of scientific funding competitions. *PLoS biology*, 17(1), p.e3000065.



## Appendix

### *NZBH Values*

- Mahi whaipāinga
- Ngākaunui / Uekaha / Ngakau Whakapuke
- Whanaungatanga
- Manaakitanga
- Mana Motuhake / Tino Rangatiratanga
- Whakapapa
- Kaitiakitanga
- Mātauranga
- Tohungatanga / Ngā tiketitanga o te pai
- Mahi rangapū

### *How we apply our values*

- We care about making a difference for Aotearoa
- We are passionate and enthusiastic about our work
- We work as a family
- We have fun together
- We build trust and create a place that others want to be a part of
- We build mana in others around us to enhance the mana of the whole
- We recognise and empower sovereignty and autonomy
- We recognise interconnections
- We have an intergenerational vision
- We enable stewardship of our biological and cultural heritage
- We recognise the value of blending traditional and modern knowledge
- We apply excellence to everything we do
- We work respectfully in partnership