Australia's National
Science Agency

Recommendations for partnering with Aboriginal and Torres Strait Islander peoples in synthetic biology in Australia

11 March 2025

Cultural sensitivity warning

Aboriginal and Torres Strait Islander people should be aware that this report contains the name of a deceased person who was a valued co-author of the report.

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Contents

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The authors also want to thank the people in the Torres Strait, who, in their various roles, responsibilities and capacities, have generously shared their time, knowledge, thoughts and perspectives on synthetic biology collectively in meeting discussions and/or as individuals interviewed in this research. We acknowledge that knowledge, thoughts and perspectives shared by Traditional Owners and community residents as mentioned in this article remain the Indigenous Cultural and Intellectual Property (ICIP) of each individual and we recognise these rights as outlined within the CSIRO ICIP Principles (Indigenous Cultural and Intellectual Property Principles). We would like to thank Gur A Baradharaw Kod Sea and Land Council Torres Strait Islander Corporation and key directors, Traditional Owners and staff for kindly enabling us to communicate information about synthetic biology gene drive research in various meetings and for introducing us to Prescribed Body Corporate (PBC) directors and some members across the Torres Strait. In particularly, we thank Magani Lagaugal, Wakeyama as well as Warraberalgal PBCs for allowing some of the authors to present and discuss this research project during PBC meetings.

CSIRO acknowledges the Traditional Owners of the land, sea, waters and skies of the areas that we live and work on across Australia. We acknowledge their continuing connection to their culture, and we pay our respects to their Elders past and present.

Abbreviations

Abbreviation	Full term
ABS	Access and Benefit Sharing
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AIMS	Australian Institute of Marine Science
CSIRO	Commonwealth Scientific and Industrial Research Organisation
FPIC	Free, Prior and Informed Consent
FPOC	First Point of Contact
ICIP	Indigenous Cultural and Intellectual Property
NESP	National Environmental Science Program
NHMRC	National Health and Medical Research Council
OKOW	Our Knowledge, Our Way (Guidelines)
PBC	Prescribed Body Corporate
RAP	Reconciliation Action Plan

Executive summary

As the National Science Agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is committed to "working with Indigenous communities and organisations to create Indigenous-driven science solutions that support sustainable futures for Indigenous peoples, cultures and Country" (Indigenous science - CSIRO). CSIRO's Future Science and Technology Plan (2020) identifies "breakthrough science" to include "Indigenous knowledge and science" as one of nine key capability areas that cross science disciplines and to deliver impact through innovation for all Australians. The Advanced Engineering Biology Future Science Platform (AEB FSP), which hosts much of the CSIRO's current synthetic biology (synbio) research, also values the contributions of Indigenous Australians and identifies Indigenous science as a key principle.

The CSIRO Futures *A national synthetic biology roadmap: Identifying commercial and economic opportunities for Australia* (CSIRO Roadmap) defines synbio, sometimes also called engineering biology, as the "the rapid development of functional DNA-encoded biological components and systems through the application of engineering principles and genetic technologies" (pp. iii, 3). By applying engineering principles to biology, it is "possible for biological systems (or components thereof) to be built to design" (Gray et al., 2018, p. 10). As a research community noted for being "open to collaboration with people from outside the field" (Calvert & Martin, 2009, p. 204), synbio scientists have an opportunity to expand and interact with certain knowledge systems, including those developed by Indigenous and local communities which, at times, have been neglected in various scientific sectors (Carter & Mankad, 2021; Mazzocchi, 2006).

The *Recommendations for partnering with Aboriginal and Torres Strait Islander peoples in Synthetic Biology in Australia* presented here provide one mechanism for synbio scientists and their partners to consider future avenues for 'best practice' research partnership development with Aboriginal and Torres Strait Islander peoples (who are, at times, also referred to as Indigenous Australians). As the characteristics of a partnership will differ depending on each Aboriginal or Torres Strait Islander community/entity, the project scale, the context of synbio application and other considerations, these recommendations are not a one size fits all approach. Rather, they are intended as a starting provocation and invitation to plan and undertake earlier, more inclusive and respectful partnerships with Aboriginal and Torres Strait Islander peoples in synbio related projects.

Informed by desktop review of various frameworks, policies and recommendations within the Australian context that consider research partnerships with Aboriginal and Torres Strait Islander peoples, empirical data shared and documented during discussions in the Torres Strait, and practical experiences of some of the reports' (Indigenous and non-Indigenous) authors, we recommend a set of core principles for synbio scientists to consider before they begin any partnership discussions. The core principles are ordered around three priority areas identified in CSIRO'S recent Stretch Reconciliation Action Plan (Stretch RAP) October 2024 – June 2027 (CSIRO's Reconciliation Action Plan - CSIRO) as well as CSIRO's previous Reconciliation Action Plan (RAP) December 2021 – December 2023: relationships, respect, and opportunities.

Below we provide a summary of these core principles in table format, with hyperlinks to relevant resources. We then elaborate on each principle, drawing on desktop and empirical information as relevant.

Table 1 Core principles for synthetic biology scientists to consider when partnering with Aboriginal and Torres Strait Islander peoples in Australia

CSIRO Stretch RAP (2024-2027) Priority Area	Core Principles	Related Resources
Relationships	Identify appropriate Aboriginal and(/or) Torres Strait Islander partners, participants and wider communities	See Section 3 of the Australian Institute of Marine Science (AIMS) Indigenous Partnerships Plan See Section 'Scoping and building a partnership' of the National Environmental Science Program (NESP) Indigenous Partnership Principles See Section 'Cultural Competency' of the National Health and Medical Research Council (NHMRC) Ethical Conduct in Research with Aboriginal and Torres Strait Islander Peoples and Communities: Guidelines for Researchers and Stakeholders See Section 'Stage 2' of the Collaborative Science on Kimberley Saltwater Country: A Guide for Researchers (henceforth the Collaborative Science on Kimberley Saltwater Country Guide)
	Face-to-face interactions matter	See Section 1.6 and Section 2.4 of the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) Guide to Applying the Code of Ethics for Aboriginal and Torres Strait Islander Research (henceforth termed the AIATSIS Guide) See Section 5 of the AIMS Indigenous Partnerships Plan See Appendix 4 of A Procedural Framework for Researchers in the Torres Strait
	Build in flexibility and adaptability	See Section 5.2.3 of the Our Knowledge Our Way in caring for Country: Indigenous-led approaches to strengthening and sharing our knowledge for land and sea management. Best practice guidelines from Australian experiences (henceforth the OKOW Guidelines)
	Determine partnership details	See Section 4 of the AIMS Indigenous Partnerships Plan
	Consider oversight and governance structures	See Section 'Indigenous Protected Areas' of the Collaborative Science on Kimberley Saltwater Country: A Guide for Researchers See Section 5.1.2 of the OKOW Guidelines
	Determine roles and responsibilities (which may change over the project)	See Section 'Rights about participating in research' and Section 'Research Agreements' of the NHMRC 'Keeping Research on Track II' Companion Document to Ethical Conduct in Research with Aboriginal and Torres Strait Islander Peoples and Communities: Guidelines for Researchers and Stakeholders (henceforth the NHMRC 'Keeping Research on Track II' Companion Document) See Section 'Critical Agreement Terms' of the Collaborative Science on Kimberley Saltwater Country Guide See Section 5.2.3 of the OKOW Guidelines
Respect	Create two-way knowledge sharing and learning	See Section 4 of the AIMS Indigenous Partnerships Plan See the Introduction and 'Stage 5' of the Collaborative Science on Kimberley Saltwater Country Guide See Section 'Consultation and Negotiation Strategies' of A Procedural Framework for Researchers in the Torres Strait See Section 5 of the OKOW Guidelines See Section 'Developing the research idea' of the NHMRC 'Keeping Research on Track II' Companion Document

	Ensure Free, Prior and Informed Consent (FPIC)	See Section 'Reviewing and revising a partnership' of the NESP Indigenous Partnership Principles See Section 5.2.3 of the OKOW Guidelines See Section 2.1 of the AIATSIS Guide See Article 6 of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization to the Convention on Biological Diversity (henceforth termed the Nagoya Protocol) See Rourke et al. 2023 (Access and benefit-sharing for Australian Synthetic Biologists: Best Practice Guidelines for compliance and risk management (csiro.au)) for benefit-related considerations
	Clarify and be transparent about risks and benefits: manage expectations as an obligation	See Section 2 of the National Statement on Ethical Conduct in Human Research See Section 'Reciprocity' of the NHMRC 'Keeping Research on Track II' Companion Document See Section 1.7 and Section 1.8 of the AIATSIS Guide See Section 'Consultation and Negotiation Strategies' and 'Issues affecting inter-cultural communication' of A Procedural Framework for Researchers in the Torres Strait See Section 'Consultation with Traditional Owners' of the Collaborative Science on Kimberley Saltwater Country Guide See Rourke et al. 2023 See Article 5 and Article 6 of the Nagoya Protocol See Recommendation 8 of the CSIRO National Synthetic Biology Roadmap
	Respect 'no'	See Section 2.1 and Section 2.2 of the AIATSIS Guide
	Respect and protect Indigenous Cultural and Intellectual Property (ICIP)	See Section 1.3 of the AIATSIS Guide See Section 1.5.3 of the OKOW Guidelines See CSIRO Indigenous Cultural Intellectual Property Principles
	Factor in payment for time	See Section 1.7of the AIATSIS Guide See Section 'Sustaining the outcomes of a partnership' of the NESP Indigenous Partnership Principles
Opportunities	Align with Indigenous-determined values and priorities	See Section 1.1 of the AIATSIS Guide See Section 'Co-created research' and Section 'Scoping and building a partnership' of the NESP Indigenous Partnership Principles
	Consider younger and future generations	See Section 5.3.2 of the OKOW Guidelines See Section 2 'Developing the Research Idea' of the NHMRC 'Keeping Research on Track II' Companion Document
	Reflect on, and measure, opportunities in culturally considered ways	See 'Principles and Performance Measures' of the NESP Indigenous Partnership Principles See Section 'Research Agreements' of the NHMRC 'Keeping Research on Track II' Companion Document
	Share information back to communities (in ways useful to communities)	See Section 7 'Sharing and translating the results into action' of the NHMRC 'Keeping Research on Track II' Companion Document See Section 5.3.3 of OKOW Guidelines
	Make time and space to (re)learn	See Section 'Learning from Experience' of the NHMRC 'Keeping Research on Track II' Companion Document

Part I Introduction

As signatory to the *United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP 2007, UNDRIP_E_web.pdf), having ratified the Convention on Biological Diversity (the CBD) and being a member of the CBD and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), Australia has shown a commitment to international conventions as "one part of a multi-level approach that guides and directs the Australian research sector to recognize the importance of Indigenous culture, practice and knowledge" (Hedge et al., 2020, pp. 1-2).

Since its first Reconciliation Action Plan (RAP) in 2007, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has committed "to invest in Aboriginal and Torres Strait Islander cultural knowledge in science and the greater participation of Aboriginal and Torres Strait Islander peoples in Australia's research and innovation landscape" (CSIRO, CSIRO's Reconciliation Action Plan). Via its current Stretch RAP (2024-2027), CSIRO continues to commit to building stronger relationships with Aboriginal and Torres Strait Islander peoples (who are, at times, also referred to as Indigenous Australians), including via scientific knowledge sharing and mutually beneficial partnerships (CSIRO's Reconciliation Action Plan - CSIRO). In 2019, CSIRO adopted the National Health and Medical Research Council Ethical Conduct in Research with Aboriginal and Torres Strait Islander Peoples and Communities: Guidelines for Researchers and Stakeholders (2018) that includes recognition for the rights of Aboriginal and Torres Strait Islander peoples to be engaged in research that affects or is of significance to them.

As the National Science Agency, CSIRO is committed to "working with Indigenous communities and organisations to create Indigenous-driven science solutions that support sustainable futures for Indigenous peoples, cultures and Country" across Australia (Indigenous science - CSIRO). While noting the concept of Country differs for different Indigenous peoples across Australia, including in the Torres Strait[1] (see Janke et al., 2021, p. 15), in this report 'Country' is used to refer to mainland Australia as well as islands, seas, skies, waterways and natural and cultural features of significance to Aboriginal and Torres Strait Islander peoples. In the Torres Strait, '*ailan*' (meaning island, or cay) and '*ples*' (meaning place, spot, position, or village) are also terms spoken as alternatives to the idea of 'Country' (for information on these terms see Shnukal, 1988, pp. 104, 183). In this report, then, we also use the term 'Country' and/or 'islands' to reflect that there is a diversity in terminologies used[2], but these terms are by no means exhaustive.

CSIRO's Future Science & Technology Plan (2020) identifies "breakthrough science" to include "Indigenous knowledge and science" as one of nine key capability areas that cross science disciplines

[1] For an example of a Torres Strait Islander specific perspective, see the Masig Statement 23 August 2022 (Malungu Yangu Wakay The Voice from the Deep) available at Anna Henderson on X: "#BREAKING Leaders in the Torres Strait are signing off The Masig Statement today. It's the "Statement from The Deep" and is designed to represent their separate coexisting interests alongside the "Statement from The Heart" from Uluṟu. This all has implications for The Voice https://t.co/H1rMO9XA2a" / X. On this topic, see also a media release by the Torres Shire Council dated 30 August 2022 (Media_Release___The_Masig_Statement_23_August_2022.pdf), Jenkins 2023 (The Masig Statement: Torres Strait Islanders unveil 'Voice from the Deep' | SBS The Point), and the Mayor's Message in the Torres Strait Island Regional Councils' 2023-2024 Annual Report (Annual Report 2023-2024 web.pdf).

[2] For an example of linguistic and cultural diversity, see the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) Map of Indigenous Australia, presented at (Map of Indigenous Australia - AIATSIS corporate website).

and to deliver impact through innovation for all Australians. As such, the way in which CSIRO scientists work in partnership with Aboriginal and Torres Strait Islander peoples to deliver innovation for impact is of utmost importance. It requires the creation of institutional structures and processes to ensure Aboriginal and Torres Strait Islander peoples' voices are included in the design and conduct of research that affects or is of significance to them. At CSIRO, Aboriginal and Torres Strait Islander peoples are increasingly being recognised as "Australia's first scientists" because of, amongst other things, their "deep knowledge, understanding, care and respect for the lands and waters of this country" (CSIRO, 2022, Indigenous science solutions for tomorrow - CSIRO).

Synthetic biology (synbio), sometimes also called engineering biology[3], is the "the rapid development of functional DNA-encoded biological components and systems through the application of engineering principles and genetic technologies" (CSIRO Roadmap, pp. iii, 3). By applying engineering principles to biology, it is "possible for biological systems (or components thereof) to be built to design" (Gray et al., 2018, p. 10).

Synbio has much potential in (and beyond) the Australian context. CSIRO and Main Sequence Ventures' *Synthetic Biology: National Progress Report* (2023, pp. 4, 10) indicates that Australia's synbio capabilities could underpin $30 billion (AUD) of revenue annually by 2040 with appropriate investment and report, potentially impacting agriculture and food, health and medicine, environment and cleantech, and industry and energy sectors. Synbio could underpin the growth of an economically and environmentally sustainable bioeconomy. While encouraging scientists to practice 'reflexivity'[4] by examining sometimes 'taken-for-granted' assumptions, Calvert and Martin note that "the synthetic biology community is remarkably open to collaboration with people from outside the field and keen to initiate discussions of their work" (2009, p. 204; see also Macnaghten et al., 2005). Synbio has an opportunity to expand and interact with certain knowledge systems, including those developed by Indigenous and local communities which, at times, have been neglected in various scientific sectors (Carter & Mankad, 2021; Mazzocchi, 2006).

The Advanced Engineering Biology Future Science Platform (AEB FSP), which hosts much of the CSIRO's current synbio research, also values the contributions of Aboriginal and Torres Strait Islander peoples and identifies Indigenous science as a key principle. The *Recommendations for Partnering with Aboriginal and Torres Strait Islander peoples in Synthetic Biology in Australia* presented here provide one mechanism for CSIRO (and other) synbio scientists and their partners to consider future avenues for 'best practice' research partnership development with Aboriginal and Torres Strait Islander peoples in synbio research.

Of note and for regional comparison is the *Vision Mātauranga: unlocking the Innovation potential of Māori Knowledge, Resources and People*. The Aotearoa New Zealand Government's Ministry of Business, Innovation and Employment stipulates that *all researchers* who seek funding from the Endeavour Fund must consider the implications, potential partnerships, impacts and benefits that may result from their research to Māori (*iwi* – tribe, *hapu* – clan). Failure to adequately and

[3] For example, Van der Kley et al. (2024, p. 5) observe that in the United States and the United Kingdom there has been a shift from using the term "synthetic biology" to instead use "engineering biology" as an adaption to the expansion of the field of science.

[4] Van der Kley et al. (2024, p. 35) define reflexivity as "the practice of holding a mirror to one's personal views", requiring a researcher to "critically examine why they are framing SynBio in a particular way and what assumptions they have about the public and SynBio". Reflexivity is key to engagement design as it "clarifies concepts and frees up the exchange of perspectives … fostering more productive deliberations" (van der Kley et al., 2024, p. 35).

appropriately respond to the Vision Mātauranga will result in loss of the opportunity to have an application reviewed as part of the competitively annual funding. Although this approach is not a requirement in Australia at present, it could become so in the future. In their outlook to 2030 regarding synbio in Australia, Gray et al. (2018, p. 102) also note that in "some jurisdictions, such as New Zealand, cultural issues, including those specific to indigenous populations, must be considered as part of the assessment process" when deciding the regulatory treatment of a new technology.

In their review of 8 key research guidelines, protocols and codes[5] that specifically address Indigenous-inclusive approaches to research and engagement, Maclean and Woodward (2021) identified that these 'best practice approaches' include:

- *A protocol, code, policy, guidelines or set of principles.*
- *A set of characteristics for Indigenous inclusion* (e.g., links to National Standards, includes practical advice and examples, clear definitions of Indigenous knowledge and Indigenous Cultural and Intellectual Property (ICIP), includes focus on capability, capacity, skills, and network development).
- *A set of tools* to put the approaches into practice/action.
- *A set of resources* for researchers (e.g., sample information sheet and consent forms, example case studies, guides) and, sometimes, for Indigenous communities who may be considering entering into research partnerships (e.g., 'how to' guides, examples of Indigenous community protocols to guide research engagements).

The principles presented in *this report* address the abovementioned points 1-2 and 4 of Maclean and Woodward's (2021) review. However, due to the current Horizon 3 (longer-term, 'blue-sky') nature of much synbio work being conducted in CSIRO and in Australia generally, a set of tools will need to be developed in the future.

As the characteristics of a partnership will differ depending on each Aboriginal or Torres Strait Islander community/entity, the project scale, the context of synbio application and other considerations, these recommendations are not a one size fits all approach. Rather, they are intended as a starting provocation and invitation to plan and undertake earlier, more inclusive and respectful partnerships with Aboriginal and Torres Strait Islander peoples in synbio related projects.

All research work that seeks to partner with Aboriginal and Torres Strait Islander peoples should aim to clearly articulate upfront the potential benefit to all partners. As part of this, research that is designed to alleviate challenges that are experienced on Country (land, islands, sea, skies, waterways), and will be tested on Country, will also require consent before being implemented on Country. As such, and as per CSIRO's commitment to work in partnership with Aboriginal and Torres Strait Islander peoples, this set of recommendations provides core principles and links to existing documentation and guidelines to support best practice partnership development with Aboriginal and Torres Strait Islander peoples.

[5] This included: the AIATSIS Code of Ethics, AIMS Partnership Policy, AIMS Indigenous Partnerships Plan (Evans-Illidge et al., 2020), A Procedural Framework for Researchers in the Torres Strait (Nakata, 2018), Desert Knowledge & Ninti One Ltd Protocol for Aboriginal knowledge and Intellectual Property, Vision Mātauranga, WAMSI Kimberley Indigenous Saltwater Science Project, Our Knowledge Our Way in caring for Country, NESP Indigenous Engagement and Participation Strategy Guidelines, and the NESP Indigenous Partnership Principles.

***Ngurupai*[6] (Horn Island) in *Zenadth Kes* (the Torres Strait). Image by Wissing (2022)**

[6] Spelling as listed on Gur A Baradharaw Kod's website Our PBCs - Torres Strait PCBs - Native Title - GBK. At times also spelt *Ngurapai* (for example, see the Torres Shire Council's website Horn Island – Torres Shire Council).

Part II Methods

These set of recommendations draw on three types of information and/or knowledge systems.

- First, a review of various frameworks, policies and recommendations within the Australian context that consider research partnerships with Aboriginal and Torres Strait Islander peoples. In addition, key documents relevant to synbio in Australia – such as the Synthetic Biology in Australia (acola.org) report (Gray et al., 2018), the CSIRO National Synthetic Biology Roadmap and CSIRO and Main Sequence Ventures' Synthetic Biology National Progress Report – were also reviewed.
- Second, information shared and documented during individual and group interviews and discussion at two meetings with the Magani Lagaugal Prescribed Body Corporate (PBC) for Iama/Yam Island, and the Directors of Wakeyama PBC for Sassie Island respectively as part of an internally funded CSIRO project titled "An application of Indigenous Australian biocultural knowledge and values in synthetic biology". The inclusion of this empirical information is to share perspectives expressed by Torres Strait Islanders as to certain values and processes that they think are important for synbio scientists to consider when seeking research partnerships with Aboriginal and Torres Strait Islander peoples.[7] While the research project focussed on the potential future application of genetic biocontrol technologies such as gene drives[8] to reduce the population of certain invasive species, synbio as a concept more broadly was introduced. For more details, see Wissing and Webb (2023).
- Third, the practical experiences of some of the reports' Indigenous and non-Indigenous authors who have worked with Aboriginal and Torres Strait Islander communities, organisations and individuals on synbio and other projects during and/or prior to their employment at CSIRO.

[7] This report includes photographs of land, sea and sky environments of some of the Torres Strait Islands visited during this project for the purposes of individual and/or group conversations with Torres Strait Islander and Aboriginal people about synbio. A description of location and the image source is included for each photograph. Images that are not accompanied with a description were sourced with a licence from Adobe Stock.

[8] For an explanation of gene drives, see Mankad et al. (2022, p. 4) or Wissing and Webb (2023, pp. 350-351).

***Iama* (Yam Island) in *Zenadth Kes* (the Torres Strait). Image by Wissing (2022)**

Part III Core Principles

We recommend a set of core principles, ordered around three priority areas identified in CSIRO's current Stretch Reconciliation Action Plan (October 2024 – June 2027) as well as the previous Reconciliation Action Plan (December 2021 – December 2023): relationships, respect and opportunities as explained in Figure 1.

Figure 1 Priority areas featured in CSIRO's Stretch Reconciliation Action Plan (October 2024 – June 2027) as explained in the summary on p. 2 of CSIRO's Reconciliation Action Plan December (December 2021 – December 2023)

Below we provide a summary of these core principles in table format, with hyperlinks to relevant resources. We then elaborate on each principle, drawing on desktop and empirical information as relevant.

Table 1 Core principles for synthetic biology scientists to consider when partnering with Aboriginal and Torres Strait Islander peoples in Australia

CSIRO Stretch RAP (2024-2027) Priority Area	Core Principles	Related Resources
Relationships	Identify appropriate Aboriginal and(/or) Torres Strait Islander partners, participants and wider communities	See Section 3 of the Australian Institute of Marine Science (AIMS) Indigenous Partnerships Plan See Section 'Scoping and building a partnership' of the National Environmental Science Program (NESP) Indigenous Partnership Principles See Section 'Cultural Competency' of the National Health and Medical Research Council (NHMRC) Ethical Conduct in Research with Aboriginal and Torres Strait Islander Peoples and Communities: Guidelines for Researchers and Stakeholders See Section 'Stage 2' of the of the Collaborative Science on Kimberley Saltwater Country: A Guide for Researchers (henceforth the Collaborative Science on Kimberley Saltwater Country Guide)
	Face-to-face interactions matter	See Section 1.6 and Section 2.4 of the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) Guide to Applying the Code of Ethics for Aboriginal and Torres Strait Islander Research (henceforth termed the AIATSIS Guide) See Section 5 of the AIMS Indigenous Partnerships Plan See Appendix 4 of A Procedural Framework for Researchers in the Torres Strait
	Build in flexibility and adaptability	See Section 5.2.3 of the Our Knowledge Our Way (OKOW) in caring for Country: Indigenous-led approaches to strengthening and sharing our knowledge for land and sea management. Best practice guidelines from Australian experiences (henceforth the OKOW Guidelines)
	Determine partnership details	See Section 4 of the AIMS Indigenous Partnerships Plan
	Consider oversight and governance structures	See Section 'Indigenous Protected Areas' of the Collaborative Science on Kimberley Saltwater Country Guide See Section 5.1.2 of the OKOW Guidelines
	Determine roles and responsibilities (which may change over the project)	See Section 'Rights about participating in research' and Section 'Research Agreements' of the NHMRC 'Keeping Research on Track II' Companion Document to Ethical Conduct in Research with Aboriginal and Torres Strait Islander Peoples and Communities: Guidelines for Researchers and Stakeholders (henceforth the NHMRC 'Keeping Research on Track II' Companion Document) See Section 'Critical Agreement Terms' of the Collaborative Science on Kimberley Saltwater Country Guide See Section 5.2.3 of the OKOW Guidelines
Respect	Create two-way knowledge sharing and learning	See Section 4 of the AIMS Indigenous Partnerships Plan See the Introduction and 'Stage 5' of the Collaborative Science on Kimberley Saltwater Country Guide See Section 'Consultation and Negotiation Strategies' of A Procedural Framework for Researchers in the Torres Strait See Section 5 of the OKOW Guidelines See Section 'Developing the research idea' of the NHMRC 'Keeping Research on Track II' Guidelines

	Ensure Free, Prior and Informed Consent (FPIC)	See Section 'Reviewing and revising a partnership' of the NESP Indigenous Partnership Principles See Section 5.2.3 of the OKOW Guidelines See Section 2.1 of the AIATSIS Guide See Article 6 of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization to the Convention on Biological Diversity (henceforth termed the Nagoya Protocol) See Rourke et al. 2023 (Access and benefit-sharing for Australian Synthetic Biologists: Best Practice Guidelines for compliance and risk management (csiro.au)) for benefit-related considerations
	Clarify and be transparent about risks and benefits: manage expectations as an obligation	See Section 2 of the National Statement on Ethical Conduct in Human Research See Section 'Reciprocity' of the NHMRC 'Keeping Research on Track II' Companion Document See Section 1.7 and Section 1.8 of the AIATSIS Guide See Section 'Consultation and Negotiation Strategies' and 'Issues affecting inter-cultural communication' of A Procedural Framework for Researchers in the Torres Strait See Section 'Consultation with Traditional Owners' of the Collaborative Science on Kimberley Saltwater Country Guide See Rourke et al. 2023 See Article 5 and Article 6 of the Nagoya Protocol See Recommendation 8 of the CSIRO National Synthetic Biology Roadmap
	Respect 'no'	See Section 2.1 and Section 2.2 of the AIATSIS Guide
	Respect and protect Indigenous Cultural and Intellectual Property (ICIP)	See Section 1.3 of the AIATSIS Guide See Section 1.5.3 of the OKOW Guidelines See CSIRO Indigenous Cultural Intellectual Property Principles
	Factor in payment for time	See Section 1.7 of the AIATSIS Guide See Section 'Sustaining the outcomes of a partnership' of the NESP Indigenous Partnership Principles
Opportunities	Align with Indigenous-determined values and priorities	See Section 1.1 of the AIATSIS Guide See Section 'Co-created research' and Section 'Scoping and building a partnership' of the NESP Indigenous Partnership Principles
	Consider younger and future generations	See Section 5.3.2 of the OKOW Guidelines See Section 2 'Developing the Research Idea' of the NHMRC 'Keeping Research on Track II' Companion Document
	Reflect on, and measure, opportunities in culturally considered ways	See 'Principles and Performance Measures' of the NESP Indigenous Partnership Principles See Section 'Research Agreements' of the NHMRC 'Keeping Research on Track II' Companion Document
	Share information back to communities (in ways useful to communities)	See Section 7 'Sharing and translating the results into action' of the NHMRC 'Keeping Research on Track II' Companion Document See Section 5.3.3 of the OKOW Guidelines
	Make time and space to (re)learn	See Section 'Learning from Experience' of the NHMRC 'Keeping Research on Track II' Companion Document

Relationships

In research, the quality of relationships has an impact on the quality of the research and vice versa, with both becoming stronger through ongoing communication and connection (see Maclean et al., 2022; Wissing & Webb, 2023; Woodward et al., 2020). The below principles are important for establishing and maintaining relationships with Aboriginal and Torres Strait Islander peoples.

Identify appropriate Aboriginal and(/or) Torres Strait Islander partners, participants and wider communities

Identifying who might be appropriate Aboriginal and(/or) Torres Strait Islander partners, participants and wider communities in which research might occur is integral to a project. Time should be dedicated in the early stages of project formation to carefully consider and understand who the correct and/or appropriate partners, participants and communities will be. Importantly, partners and/or participants involved in a research process may carry varying degrees of influence. This influence may also include what is described as 'cultural authority', which, depending on context, may or may not include the authority to speak on behalf of the people, the community and/or on behalf of a particular place or region. This may include the authority to share, or choose not to share, and contribute knowledge to a research process.

In an interview in the Torres Strait, it was emphasised that certain people, particular Elders – senior community members with cultural authority "who are able to identify the method of how cultural science has been practiced over the years" (cited in Wissing & Webb, 2023, p. 358) – should be engaged in any conversation about potential synbio projects. This interviewee defined "cultural science" as "the knowledge that gave us the wealth of how we perceive the environment" (cited in Wissing & Webb, 2023, p. 358) that is transmitted from generation to generation. Terms used for similar types of knowledge, with varying scope, include "Indigenous Knowledge" (e.g., the OKOW Guidelines, the AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research (henceforth the AIATSIS Code of Ethics) and the related Guide to Applying the Australian Institute for Aboriginal and Torres Strait and Torres Islander Studies Code of Ethics for Aboriginal and Torres Strait Islander Research to applying this code (henceforth the AIATSIS Guide)), "Indigenous Knowledge systems" (e.g., the AIATSIS Code of Ethics), "Indigenous biocultural knowledge" (e.g., New Australian Indigenous Biocultural Knowledge website - Ecological Society of Australia (ecolsoc.org.au)), and "Indigenous science" (e.g., Indigenous science - CSIRO). Another person interviewed noted that Traditional Owners as a larger group are key to engage as well as certain people employed as Indigenous Rangers, Environmental Health Workers and similar roles who may offer unique perspectives as they work across different knowledge systems.

Aboriginal and Torres Strait Islander peoples involved may encompass a broad spectrum, ranging from Native Title holders (both current and future, see National Native Title Tribunal website) and Traditional Owners under other land tenure legislation, especially Elders, rangers, workers with specialised knowledge, and the First Point of Contact (FPOC), a term used in the *Collaborative Science on Kimberley Saltwater Country: A Guide for Researchers* (Lincoln et al., 2017, henceforth the Collaborative Science on Kimberley Saltwater Country Guide) as selected by the community to represent them. Prospective partners, potential participants and their wider community may also include groups that do not have formal or recognised Native Title and/or state-/territory-level

Indigenous tenure status[9], but despite this, are locally and/or regionally recognised as the First Peoples of that Country. Although it can be challenging for researchers to locate and engage with such groups (due to a lack of institutional structures), it is essential that researchers make provision for this.

The section titled 'Cultural Competency' of the NHMRC Guidelines emphasises that finding mentors and knowledge holders before and during research projects can ensure that researchers stay on the right path. Additionally, guidelines such as that from the Australian Institute of Marine Science (AIMS) Indigenous Partnerships Plan (Evans-Illidge et al., 2020, (Section 3)) and the National Environmental Science Program (NESP) Indigenous Partnership Principles (Section 'Scoping and Building a Partnership') discuss the significance of identifying the appropriate Traditional Owner group/s in a specific area, particularly those with authorisation and interests in a place. The Collaborative Science on Kimberley Saltwater Country Guide (Section 'Stage 2') also advocates for discussions with the relevant FPOC to determine suitability, project direction, timing, seasonality, and budget requirements.

Face-to-face interactions matter

As noted in Section 1.6 of the AIATSIS Guide, face-to-face meetings are crucial in facilitating effective information exchanges, especially in the initial phases of negotiating a partnership agreement. This is because face-to-face meetings, allowing immediate visual and non-verbal communication, offer more opportunity to build rapport and trust. Rapport and trust are both critical to encourage and enable feedback (both positive and negative) and to provide new or different perspectives that can broaden research in positive ways. Section 2.4 of the AIATSIS Guide notes that face-to-face meetings are also important during the reviewing, revising and finalising stages of a project to discuss your research results and analysis.

Section 5 of the AIMS Indigenous Partnerships Plan also encourages face-to-face meetings as a method of becoming a considered and trusted advisor and reliable partner to Traditional Owners. Appendix 4 of the A Procedural Framework for Researchers in the Torres Strait (Nakata, 2018. prepared for the Protected Zone Joint Authority Torres Strait Scientific Advisory Committee) notes that face-to-face consultation might also be requested by communities, some of whom feel strongly that face-to-face approaches are best.

It is important to note that *where* face-to-face interactions happen also matters. Sometimes a community meeting on certain Country or islands, where Aboriginal and Torres Strait Islander peoples have a connection with and related authority to speak for a place, might be the appropriate conditions for those people to speak more confidently about an issue than might occur in a meeting room in a town or city, and/or a place away from their Country or islands. Synbio research spaces – such as laboratories – might also be appropriate spaces for two-way learning to occur subject to discussion with partners and/or participants.

When considering face-to-face interactions, also consider what language(s) will be most appropriate for Aboriginal and(/or) Torres Strait Islander partners, participants and wider communities and organise for translation (and interpretation) services if necessary. Regionally-

[9] For example, Aboriginal Land Trust members as related to the *Aboriginal Land Rights (Northern Territory) Act 1976* (Commonwealth), or Local Aboriginal Land Councils as related to the New South Wales *Aboriginal Land Rights Act 1983* (New South Wales).

specific cultural considerations – such as avoidance relationships[10] and/or protocols for conversation and interaction – should also be factored in any interactions. Some Aboriginal and Torres Strait Islander peoples might also feel more confident communicating in a group setting or, when travelling to unfamiliar places, having a relative, friend, cultural custodian or other companion to accompany and support them so that they feel more confident to speak to a topic in a new environment. Conversely, some Aboriginal and Torres Strait Islander peoples might not want to share perspectives in large group settings, so consider ways to facilitate, respect and enable confidential conversations in addition or as an alternative to group settings.

Build in flexibility and adaptability

Aboriginal and Torres Strait Islander peoples often have a range of community, cultural and other forms of responsibility that require flexibility and adaptability. Some responsibilities can be anticipated, such as key cultural events where customary rites are practised, or cultural periods such as fishing seasons. However, others cannot be planned, such as cultural protocols around the passing of relatives or community members and, at times, a related pause on meetings and other work to attend to matters of mourning (referred to in some parts of Australia as 'sorry business'). Key individuals may have additional responsibilities, including for example, meetings related to Native Title, their Prescribed Body Corporate(s), state-/territory-level Indigenous tenure organisations, their organisation(s) and/or their business(es) (e.g., Land and Sea enterprises, corporations). Further, as key leaders for their communities, they may also be in high demand with government counterparts, possibly prospective or existing research relationships and so on.

Section 5.2.3 of the Our Knowledge, Our Way (OKOW) in caring for Country: Indigenous-led approaches to strengthening and sharing our knowledge for land and sea management. Best practice guidelines from Australian experiences (henceforth the OKOW Guidelines) highlights the need to consider what flexible arrangements can built into the project plan if cultural or other responsibilities impact the availability of Aboriginal and Torres Strait Islander partners for a project. Incorporating flexible arrangements into the project plan, and making necessary adjustment to project timelines, may be essential when cultural responsibilities require partners and/or participants to be temporarily absent from the project. This is not only respectful, but also enables plans, topic focus and schedules to change as per community and individual needs.

[10] An example of an avoidance relationship is that between mother-in-law and son-in-law kin classifications. In the Central Australian context, the Central Land Council website explains that the mother-in-law- and son-in-law avoidance relationship "applies through marriage but also in a classificatory sense within the kinship system, whereby the woman and man concerned are 'classified' as these in-laws by virtue of their membership in the relevant kinship categories. This in-law relationship requires a social distance, such that whole categories of people are not permitted in the same room or car, for instance. It is important to be sensitive to the signals or code for the rule, such as being told there is no space in the car or room even though there appears to be sufficient space" (Kinship systems - Central Land Council (clc.org.au)).

Determine partnership details

An important aspect of building relationships is to discuss what sort of partnership structure a project should take. The type of partnership will be informed by the project topic, Aboriginal and Torres Strait Islander partners' interest and capacity, amongst many other things. Section 4 of the AIMS Indigenous Partnerships Plan provides information to develop the details of a co-designed and co-delivered project. This may take time, and a partnership approach may not always be appropriate for some projects as it may not be considered a priority for the community.

CSIRO also encourages its researchers to consider the type of partnership and methodologies that might be most suitable for each particular situation. Partnership approaches include Indigenous-led as best practice, as well as co-led, co-design and consultation (see Sedran-Price et al., 2022). As part of engagement discussions, researchers should also consider Indigenous methodologies, Indigenous innovation and strength-based approaches that may be most suitable for each project (Sedran-Price et al., 2022).

For researchers working in government organisations, including the CSIRO, and as good practice for all researchers, decision making must be shared as per priority reform one of the *National Agreement on Closing the Gap*, July 2020 (the 'Agreement') between the Coalition of Aboriginal and Torres Strait Islander Peak Organisations and the Australian Governments (federal and state/territory level). The Agreement defines shared decision making as:

> i. by consensus, where the voices of Aboriginal and Torres Strait Islander parties hold as much weight as the governments
>
> ii. transparent, where matters for decision are in terms that are easily understood by all parties and where there is enough information and time to understand the implications of the decision
>
> iii. where Aboriginal and Torres Strait Islander representatives can speak without fear of reprisals or repercussions
>
> iv. where a wide variety of groups of Aboriginal and Torres Strait Islander people, including women, young people, elders, and Aboriginal and Torres Strait Islander people with a disability can have their voice heard
>
> v. where self-determination is supported, and Aboriginal and Torres Strait Islander lived experience is understood and respected
>
> vi. where relevant funding for programs and services align with jointly agreed community priorities, noting governments retain responsibility for funding decisions
>
> vii. where partnership parties have access to the same data and information, in an easily accessible format, on which any decisions are made. (*National Agreement on Closing the Gap*, 2020, p. 6).

Consider oversight and governance structures

During an interview discussing gene drive research – as a sub-area of research in synbio – a Traditional Owner discussed the critical need for good frameworks, governance and accountability. He explained that:

> *Before we start messing with the genes we should be crossing our 't's and dotting our 'i's. Because if it goes wrong the question will be, well who's answerable? How will we follow it back and whose rule of law will give the penalties. … do you think you got it covered? How do you mitigate it? … we need that regulation in there, we need the legislation in there. … I am hoping that everybody is conscious that there needs to be legislation and moral and ethical thinking about it* (cited in Wissing & Webb, 2023, p. 359).

In the context of this quote, legislation, and moral and ethical thinking relate to oversight and/or governance structures. As part of larger governance debates about synbio, context-specific, culturally appropriate project governance by Aboriginal and Torres Strait Islander peoples is also key to consider. This may occur organically and informally in a project, but it is certainly not guaranteed. Deliberate discussions about what sort of governance structure might be appropriate – such as a potential Aboriginal and(/or) Torres Strait Islander Steering Committee, Advisory Board, or another structure – will help ensure that a synbio (or other) project is being undertaken in a culturally appropriate way.

There may already be existing authorities with whom synbio researchers can partner. For example, see Section 5.1.2 of OKOW Guidelines which explains how PBCs make decisions according to cultural protocols as the nominated corporation determined by the Native Title holders. See also Section 'Indigenous Protected Areas' of Collaborative Science on Kimberley Saltwater Country Guide that provides information on how to identify if research will fall within an existing Indigenous Protected Area (IPA), to then consider existing governance structures for this IPA.

Be aware that conducting work with certain Aboriginal and Torres Strait Islander partners and participants in some Indigenous areas may also require visiting, research and other types of permits or approvals as overseen by Land Councils (e.g., in the case of the Northern Territory for Aboriginal Land), or local regional councils (e.g., the Torres Strait Island Regional Council for the Outer Islands of the Torres Strait). It is important that synbio and other scientists consider existing governance structures and also discuss the potential for, and conditions of, any overseeing bodies as part of developing a project with Aboriginal and Torres Strait Islander partners.

Determine roles and responsibilities

Defining roles and responsibilities is an essential activity that should be prompted by and outlined in a research agreement, as emphasised in the Section 'Rights about participating in research' of the NHMRC 'Keeping Research on Track II' Companion Document. Agreements should include how researchers, organisations and communities will work together respectfully and define roles and responsibilities throughout the research process.

This delineation may continue to change throughout the research process, due to shifts in areas like publishing, intellectual property, and confidential information. Such changes require a re-assessment of the research agreement in accordance with the mutual understanding between the researcher and Aboriginal and Torres Strait Islander partners (Section 'Critical Agreement Terms' of the Collaborative Science on Kimberley Saltwater Country Guide). For more information, see Section 5.2.3 of the OKOW Guidelines (a chapter by Ford et al., 2020), which discusses how to establish protocols to facilitate the sharing of knowledge, protocols and agreement about the research activities, the responsibilities of each partner, and open discussion on the budget.

***Warraber* (Sue Islet) in *Zenadth Kes* (the Torres Strait). Image by Wissing (2022)**

Respect

Underpinning good relationships, and culturally safe and appropriate opportunities, is respect. This is emphasised in the Executive Summary of the OKOW Guidelines which states that "[r]espect for Indigenous knowledge, culture and Country are critical for the development of trust and relationship-building, which underpin strong partnerships" (Woodward et al., 2020, p. xxi). Below we consider some practice-based principles that help contribute to respectful and robust research relationships with Aboriginal and Torres Strait Islander peoples.

Create two-way knowledge sharing and learning

Two-way and other forms of knowledge sharing and learning are integral components of Indigenous-led, co-led, co-designed and other styles of research, allowing a culturally safe way of working. This kind of collaborative exchange enables partners to initially identify areas of mutual research interest, as highlighted in Section 4 of the AIMS Indigenous Partnerships Plan. The 'Introduction' of the Collaborative Science on Kimberley Saltwater Country Guide addresses the research needs of all research partners to ensure equitable distribution of work and funding resources. Section 'Consultation and Negotiation Strategies' of A Procedural Framework for Researchers in the Torres Strait (Nakata, 2018) emphasises the ongoing nature of consultation and negotiation processes. It also emphasises that these processes are not confined to specific time frames but are continuous, serving as an essential component of decision-making concerning Indigenous affairs.

At the start of a project, what could be described as the 'building stage' or 'project inception', it is essential to take the time to discuss what the project will involve, who will and could be involved, opportunities for mutual knowledge sharing and learning, and so on. At the start of the project, and throughout the project, there is great potential to factor in opportunities for mutual knowledge sharing and learning. This might include, for example, recognising formal opportunities for deliberate learning, and also acknowledging how incidental learning will occur throughout the entire project life. Clearly any such learning will be two-way and may occur at different times during the project life for each project member. This is the essence of this kind of partnership, to create spaces to work and learn together from each other. For example, in the initial building and other stages of a research project it is essential to discuss what the project entails to allow knowledge sharing and ongoing learning. This also includes understanding and acknowledging Indigenous science and other types of science and reflecting on the possible crossovers between differing knowledge systems. This can be referred to as weaving knowledge systems where it is separate but complimentary.

There are a range of examples of how two-way (or more) knowledge sharing and learning may occur. Section 5 of the OKOW Guidelines outlines how various Indigenous, scientific and other knowledge systems in Australia can weave together to build a richer picture of situation (Figure 2). The OKOW Guidelines also advise that co-developed tools are most appropriate for sharing and weaving knowledge. Such weaving can occur deliberatively as well as iteratively.

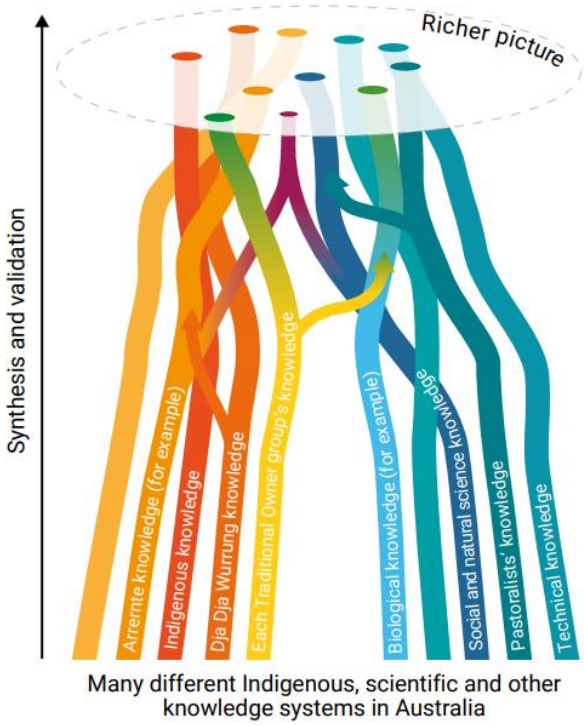

Figure 2 Many different Indigenous, scientific and other knowledge systems that exist in Australia, as part of the Our Knowledge Our Way in Caring for Country (OKOW) Guidelines (in a chapter by Ford et al., 2020, p. 106)

The Section 'Developing the research idea' of the NHMRC 'Keeping Research on Track II' Companion Document emphasises the need for each party to fully understand what is expected of them and of each other. To facilitate this, the section has a set of questions the researchers and Aboriginal and Torres Strait Islander groups could ask one another. See also Section 'Stage 5' of the Collaborative Science on Kimberley Saltwater Country Guide regarding how Western and Indigenous science must be seen as equal contributions to a project.

As part of any two-way knowledge sharing and learning, it is critical to have respectful conversations about what is known, and what is not yet known about other knowledge systems. This is even more important in Horizon 3 types of science such as synbio, as this type of research may not currently be familiar to some Aboriginal and Torres Strait Islander peoples yet must work with, rather than at the exclusion of or against, existing understandings of environmental responsibility. As one Traditional Owner explained during an interview discussing the case of gene drives, the "synthetic genetic approach" might be a new and unfamiliar concept in the Torres Strait, but it "has to tie into the cultural science in order for things to work" (cited in Wissing & Webb, 2023, p. 358). A different Traditional Owner with experience in 'Western' environmental management practices highlighted the need to recognise, find overlaps and respect differences between Indigenous and other forms of scientific knowledge, including synbio knowledge. He explained the need for:

> *co-existence and co-management … how they overlap. How they complement with each, but how they also destruct each other. The art is to find where the balance is* (cited in Wissing & Webb, 2023, p. 355).

As knowledge systems interweave, it is also critical to ensure that the sharing of information is consensual and that such knowledge is appropriately protected.

Ensure Free, Prior and Informed Consent (FPIC)

Free, Prior and Informed Consent (FPIC) is a specific right granted to Indigenous peoples that aligns with their universal right to self-determination. It allows Indigenous peoples to provide, withhold, or withdraw consent at any point regarding projects impacting their territories, and is a critical part of any partnership or other form of engagement with Aboriginal and Torres Strait Islander peoples.

In the context of research partnerships, the NESP Indigenous Partnership Principles in the Section 'Reviewing and revising a partnership' mentions that FPIC should be obtained in a culturally appropriate manner before undertaking research. The OKOW Guidelines also highlight that FPIC should be used for all research proposals on Indigenous lands as part of actions towards best practice (Section 5.2.3). The AIATSIS Guide (Section 2.1) recommends adopting a consent model with periodic evaluations of consent at each project stage.

Section 5.2.3 of the OKOW Guidelines, explains that:

> *The UN Declaration on the Rights of Indigenous Peoples, and many other international and national laws and policies, recognise FPIC as the best practice approach to engaging with Indigenous knowledge. This includes land and sea management, research projects, knowledge partnerships and engagement in decision making around conservation and development proposals. The FPIC process requires that individuals and groups are provided with sufficient, accessible information, including full consideration of risks and benefits of the proposal, for them to make an informed decision about whether to consent to the proposal* (Ford et al., 2020, p. 113).

Critical to the FPIC process is being provided with complete and comprehendible information in order to make an informed decision to agree (or not agree) to conditions of a partnership or other relevant decisions. Some Aboriginal and Torres Strait Islander peoples speak a range of languages and may feel more confident communicating and comprehending in a language that is not English. Relatedly, Section 5.2.3 of the OKOW Guidelines states that "[p]artners should ensure that their project budgets accommodate payment of interpreters where appropriate, to ensure that Indigenous partners are adequately informed when giving consent" (Ford et al., 2020, p. 113).

As noted in the Section 'Reviewing and revising a partnership' of the NESP Indigenous Partnership Principles, when conducting (and partnering in) research, it is important to ensure that "prior, free and informed consent is obtained in a culturally appropriate manner from all research participants and stakeholders *before* undertaking research with and about Indigenous peoples and communities" (NESP, 2021, p. 7, emphasis added). However, FPIC can and at times should also be revisited over the course of research.

Synbio scientists and Aboriginal and Torres Strait Islander research partners, participants and wider communities should see FPIC as a live and ongoing process throughout a project, being open to revisit conditions if/as required through the progression of a project. In the context of discussing consent models, such as research agreements based on FPIC, the AIATSIS Guide emphasises that "negotiation will continue throughout the project and that reformulating the research project is always a possibility" (p. 14). An example of this is doing a staged process whereby the scope of, and related consent within, a project is revisited across multiple times across the project's lifespan.

Synbio scientists, as well as some other scientists, also use genetic materials which may have FPIC implications. Article 6 of the National Secretariat to the Convention on Biological Diversity's *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity* (2011, p. 7, henceforth the Nagoya Protocol) states that "each party shall ensure that the FPIC or approval and involvement of Indigenous and local communities is obtained for access to genetic resources". For a consideration of the Nagoya Protocol for Australian synbio scientists, see *Access and Benefit-Sharing for Australian Synthetic Biologists: A Tool for Risk Management* by Rourke et al. (2023). Obtaining consent and ensuring ethical research practices may require the provision of independent legal (and/or other) advice to proponents/partners in some situations. Related to FPIC is clarifying risks known as well as unknown but anticipated risks and benefits.

Clarify and be transparent about risks and benefits: manage expectations as an obligation

In research projects, and as a critical component of the FPIC process, there is an obligation to manage expectations from all parties involved while understanding that perceptions of and exposure to risks and benefits can be culturally specific. To achieve this, there is a need to clearly discuss, identify and outline risks that are justified by the potential benefits of the research. This is articulated in Section 2 of the National Statement on Ethical Conduct in Human Research (2023), a joint publication by the NHMRC, Australian Research Council and Universities Australia.[11] This can be accomplished by presenting a capacity-building plan that demonstrates how Aboriginal and(/or) Torres Strait Islander communities will directly and indirectly benefit from the project. This ensures that Aboriginal and(/or) Torres Strait Islander peoples define the benefits according to their values, interests, and priorities (see Section 'Reciprocity' of the NHMRC Guidelines). Additionally, the AIATSIS Guide (Section 1.7) emphasises the importance of avoiding overstatement of the benefits associated with the research.

However, some synbio technologies are still in the research and design stage of Horizon 3 or 'blue sky' science, and years away from regulatory approval and implementation. As such, some but not all risks and opportunities are known, as more will be understood as the research progresses. It is therefore important to explain what is currently unknown and *also* discuss the inherent uncertainty about synbio applications in the future. This will help to manage expectations and to assist Aboriginal and Torres Strait Islander peoples to determine when, on what terms, and with what level of time, energy, knowledge and other resources to partner and/or participate (or not) with synbio projects.

[11] For an earlier but related publication, see also the NHMRC, ARC and University Australia's co-authored *Australian Code of Responsible Conduct of Research, 2018*.

Risks

For a summary of what is a risk, assessing risk, understanding harm, discomfort and inconvenience, considering low risk or negligible risk and gauging risk more generally, minimising risk, weighing up benefits as justifying (or not) risks, and managing risks, see Section 2 (pp. 12-15) of the National Statement on Ethical Conduct in Human Research (2023). While noting that a more equitable application of synbio will mean "respecting diverse cultural, religious and ethical perspectives", van der Kley et al. (2024, p. 15) also acknowledge that "risks are unlikely to be evenly distributed". There are risks in taking action as well as not acting in a situation, e.g., "risks of failing to develop and implement SynBio tools across a range of industries and environments" (van der Kley et al., 2024, p. 36). Both risk categories should be considered. In the context of partnering with Aboriginal and(/or) Torres Strait Islander peoples, it is also important to emphasise that perceptions and understandings as well as exposure to risk is not universal but culturally specific. Section 1.8 of the AIATSIS Guide explains that "perception and experience of risk may be different from an Indigenous perspective so if you are a non-Indigenous researcher you should seek advice in identifying and managing risks" (p. 13).

In a discussion of genetic biocontrols (like gene drives, as part of synbio science) Carter et al. (2022, p. 10) have argued that the "[i]nclusion of alternate knowledge categories so that conclusions about how risk at community level, for example, reflect reality, is essential to informed decision-making". Listening to and (co-, or otherwise) designing projects around Indigenous-determined values and priorities, is part of this process.

Differing concepts of risk can be seen within an example from the Torres Strait. Synbio scientists have been considering islands broadly as likely initial sites for gene drive trials (for example, see Harvey-Samuel et al., 2019). The rationale is that such terrestrial sites, being somewhat isolated by seawater, reduce the risk of gene edited species escaping containment (see Wissing & Webb, 2023). However, as one Traditional Owner explained, it is the marine rather than terrestrial environment in the Torres Strait that is "the most important to us not only in a cultural sense, but also for economic development" (cited in Wissing & Webb, 2023, p. 358). This person urged synbio scientists to consider cultural and economic values of sea environments – and the risks of not taking efforts to protect the sea from climate change events – even if this complicates issues of containment as another concept of risk control (Wissing & Webb, 2023). This comment also highlights the importance of talking with partners, participants and wider communities early, and addressing any assumptions that scientists may hold in regard to Aboriginal and Torres Strait Islander peoples' values and connection to place.

It follows, that it is crucial to be aware of potential dissimilarities between multiple and differing cultural ways of viewing the world, as emphasised in Section 'Consultation and Negotiation Strategies' of A Procedural Framework for Researchers in the Torres Strait. Furthermore, the Section 'Issues affecting inter-cultural communication' of A Procedural Framework for Researchers in the Torres Strait highlights that acknowledging cross-cultural risks facilitates effective communication, working to prevent misunderstandings, misinterpretations, or breakdowns in communication. This proactive approach enables the implementation of measures to prevent conflicts and ensures more effective resolution when they do arise.

In the Collaborative Science on Kimberley Saltwater Country Guide, Section 'Consultation with TOs' mentions the importance of understanding and meeting conditions outlined by Traditional Owners

during consultations. This ensures that researchers adhere to guidelines that prevent harm to places of significance and connection to Aboriginal and Torres Strait Islanders peoples and effectively mitigate any perceived risks to people or culture. A discussion about what the anticipated risks are, and the weighted importance of concerns for each risk, should be undertaken at the initial stages – and revisited as necessary in later stages – of research.

A final point is that, for some Indigenous (and other) Australians, risks may not only be physical, social or economic but also spiritual. Risks to spiritual places of value and connection to Aboriginal and Torres Strait Islanders peoples also directly impact the health and wellbeing of custodians of those areas. This is due to the understanding of 'healthy Country, healthy people' that encapsulates the notion that when the environment is in good condition, its people are also in good physical and mental health (e.g., Parlee et al., 2005). As Metcalfe and Costello (2021, p. 47) explain, "Country supports healthy people", including by affording opportunities for cultural reinvigoration, knowledge transfers between generations, connection to Country for Aboriginal and Torres Strait Islander peoples' wellbeing as well as intergenerational engagement and learning (see also Darug et al., 2019; Janke et al., 2021; McKemey et al., 2019; Smith et al., 2018). The opposite is also true: people who see degraded environments and who feel responsible (realistically or not) for their decline can also feel spiritually and emotionally depleted (Maclean et al., 2013). Two examples of spiritual concerns are expressed below. One interviewee in the Torres Strait explained that.

> *The one that we are really concerned about is the L O R E, it's the spiritual law. You can say lore or law but it is the spiritual law. … There are repercussions. There are rules, and we suffer the repercussions. You might be looking at the benefits but we know the risks. Because whatever the spirituality it has rules* (cited in Wissing & Webb, 2023, p. 357).

While the argument of "Playing God" has been considered in a larger social sense for synbio (e.g., Carter et al., 2021), it is important to note that Christianity – as an introduced but also embraced belief by some Aboriginal and Torres Strait Islander peoples – and/or other spiritual beliefs may also be a key consideration in individual's assessment of risk. This same interviewee who spoke about the L O R E was a Christian, and raised spiritual concerns about how far gene drives, as one example of synbio, might be too far. He asked

> *You know morally where do we draw the line? Because every year it looks like we can justify doing something that is just a little bit more funky but we are heading to an area where we are asking a lot of questions. Is it safe? What are we doing? The moral standard of where that is: are we conscious of what that is? Where is it? What is it? Because in a sense we are messing with creation, playing God. How far is too far?* (cited in Wissing & Webb, 2023, p. 357).

Another Traditional Owner saw gene drives and the idea of engineering biology more generally as a "'no no' threshold" to cross, fearing spiritual retribution by a Christian God for "when we cross Him, He'll put His finger in" to intervene (cited in Wissing & Webb, 2023, p. 357).

As part of project development being led by Indigenous values and priorities, risks – of a physical and non-physical (including spiritual) nature as understood by Aboriginal and Torres Strait Islander partners and participants – need to be discussed and factored into synbio projects.

Benefits

In addition to risk, there is also an obligation to talk about and manage expectations that may result from the overarching benefits of participating (or partnering) in the research project. The Section 'Reciprocity' of the NHMRC Guidelines states that:

> *Aboriginal and Torres Strait Islander Peoples' way of shared responsibility and obligation is based on diverse kinship networks. This keeps ways of living and family relationships strong. These responsibilities also extend to caring for country and all within it, and involve sharing benefits from the air, land and sea, redistribution of resources, and sharing food and housing.*

Section 1.7 of the AIATSIS Guide provides advice on how to discuss and define benefits for a project:

> *The benefits from research should be defined through discussion with Aboriginal and Torres Strait Islander research partners, participants, or project governing bodies. This includes providing all the relevant information to allow partners to weigh potential benefits against possible risks or disadvantages.*
>
> *When you are negotiating benefits:*
>
> - *aim to make the benefits to the community, or individual participants, proportionate to the demands of their participation.*
> - *ensure that, where the benefits are not general (for example, employment on the project or financial compensation), they are allocated in cooperation with the group.*
> - *be prepared to pay those contributing to the research in recognition of the value of their contributions, particularly where significant time or expertise is given (including the expertise of traditional knowledge holders), beyond normal personal or community commitments.*
> - *ensure that payments or financial benefits accruing to the participants are considered by a human research ethics committee.*
> - *consider indirect benefits to Indigenous communities such as support for the archiving of materials relating to intangible cultural heritage, including (but not limited to) field notes and recordings that document language, cultural practices and ethnobotanical knowledge.*
> - *ensure that, if such benefits are provided, appropriate measures are in place and access is managed to protect secrecy and/or confidentiality of materials.*
> - *do not overstate the benefits of the research to the participants, organisations or communities.*
> - *discuss the potential for unexpected outcomes and how they will be addressed and communicated.*

One key benefit emphasised by various Torres Strait Islanders during interviews and group meeting discussions was employment and training opportunities. While each partnership will differ, examples suggested within the Torres Strait context included potential training of Aboriginal and

Torres Strait Islander people in synbio in various laboratories and other sites in Australia.[12] It might also involve employing and training Aboriginal and Torres Strait Islander peoples in any implementation of synbio in a region (such as assisting to implement and monitor an environmental release of gene drives).

Reciprocal sharing of benefits may also extend into formal agreements regarding Access and Benefit Sharing (ABS). In particular, see Article 5 and Article 6 of the Nagoya Protocol regarding ensuring that benefits arising from the utilisation of genetic resources are shared in a fair and equitable way as well as Rourke et al. (2023) for ABS considerations for synbio scientists within the Australian context. See also Recommendation 8 of CSIRO's A National Synthetic Biology Roadmap (2021, p. 38, footnote 138) which explains that Indigenous and local communities may receive benefits from the use of genetic resources that have been used for biotechnology research and design.

Respect 'no'

Section 2.1 and Section 2.2 of the AIATSIS Guide highlight that respecting the answer 'no' aligns with the FPIC Guidelines, acknowledging individuals' freedom to decline participation. It is crucial to ensure that individuals are aware they can say no at any time, and the absence of a response from Aboriginal and Torres Strait Islander partners, participants or communities may also signify a 'no'. It is also essential to recognise the possibility that participants may disagree with the research team's interpretation and analysis, encouraging an understanding that diverse perspectives and opinions contribute to a more comprehensive research outcome. The right to say 'no' at the beginning or during a research project should be explained, including in documents such as participant information sheets, participant consent forms, or similar.

Respect and protect Indigenous Cultural and Intellectual Property (ICIP)

Indigenous Cultural and Intellectual Property (ICIP) refers to the collective rights of Indigenous peoples concerning their cultural heritage. These rights encompass the authority to control who can use and alter this ICIP, asserting the rights of attribution, integrity, and benefit sharing (Janke, 2021, pp. 20-21). ICIP is crucial for respecting, preserving, and promoting unique cultural heritage and knowledge of Indigenous peoples and communities, fostering ethical research practices and meaningful collaboration. This includes all aspects of Indigenous peoples' cultural heritage, both tangible and intangible, as highlighted in Section 1.3 of the AIATSIS Guide.

Building on the AIATSIS Code of Ethics, CSIRO has recently created *Indigenous Cultural and Intellectual Property Principles* (Indigenous Cultural and Intellectual Property Principles). For the purposes of these principles, CSIRO defines ICIP as:

[12] CSIRO's Indigenous Graduate Program - CSIRO may be an example of one avenue in which to facilitate employment and training opportunities for Indigenous Australians in synbio.

> *the cultural heritage of Aboriginal and Torres Strait Islander people which comprises all objects, sites and knowledge, the nature and use of which has been transmitted or continues to be transmitted from generation to generation, and which is regarded as pertaining to a particular Indigenous group or its territory. This cultural heritage is a living concept that can be adaptive and includes objects, knowledge, literary and artistic works which may also be created in the future based on that cultural heritage* (CSIRO, p. 3).

CSIRO proceeds to provide examples, the most directly relevant to synbio projects being "scientific, agricultural, technical and ecological knowledge (including cultigens, medicines and phenotypes of flora and fauna)" (CSIRO, p.3).

Consistently respecting ICIP is overdue, and there is a well-founded wariness by some Aboriginal and Torres Strait Islander peoples regarding sharing knowledge based on past experiences. During an initial conversation about synbio with a Torres Strait Islander Traditional Owner, he noted that some researchers have built careers on biocultural knowledge in the past and, relatedly, he expressed a wariness by Torres Strait Islander communities regarding sharing information. This not only relates to career opportunities for individual researchers, but also larger potential commercial outcomes based on knowledge. During a PBC meeting in the Torres Strait, another Traditional Owner emphasised a need to talk about protecting ICIP early in any synbio developed project to protect the knowledge shared and/or ideas co-developed by communities and to ensure that any financial gains from such knowledge also benefits Indigenous knowledge holders and/or co-creators.

To ensure that the ICIP of Aboriginal and Torres Strait Islander peoples is respected and protected in any research partnership, protocols should be considered and agreements of how ICIP will be used and managed should be made. For guidance on how to do this, see Janke et al. (2021), the CSIRO Indigenous Cultural Intellectual Property Principles as well as Section 1.5.3 of OKOW Guidelines (in a chapter by Poelina et al., 2020) regarding how ICIP law focuses on protecting 'new' information that has been 'discovered'.

Synthetic biologists should also consider Indigenous data sovereignty when partnering with Aboriginal and Torres Strait Islander peoples. Citing Kukutai and Taylor (2016, p. 2), the "Indigenous Data Sovereignty is a global movement concerned with the right of Indigenous peoples to govern the creation, collection, ownership and application of their data" (as per a joint Communique-Indigenous-Data-Sovereignty-Summit.pdf (squarespace.com) by Maiam Nayri Wingara, the Australian Indigenous Governance Institute and the Lowitja Institute; see also Bodkin-Andrews et al., 2024, p. 165). For examples of resources that consider Indigenous data sovereignty, see the AIATSIS Code of Ethics and the AIATSIS Guide, Bodkin-Andrews et al. (2024) the joint Communique-Indigenous-Data-Sovereignty-Summit.pdf (squarespace.com) by Maiam Nayri Wingara, the Australian Indigenous Governance Institute and the Lowitja Institute, the website of Maiam Nayri Wingara (Maiam Nayri Wingara), and Williamson et al. (2022).

Factor in payment for time

Research projects require a lot of resources, including commitment of knowledge as well as time. Time that Aboriginal and Torres Strait Islander partners and participants spend on a synbio research project is usually time re-directed from other opportunities for employment (or otherwise valued) activities. Acknowledging the value of time invested by contributors to the research is considered respectful, as emphasised in Section 1.7 of the AIATSIS Guide. As such, payment for Aboriginal and Torres Strait Islander peoples' time is listed as a core principle to demonstrate what one Torres Strait Islander described as a "care and share" attitude, stating "that's the way forward" for research relationships (cited in Wissing & Webb, 2023, p. 358).

Payment for time may include the initial scoping stages even if the project does not progress. The Section 'Sustaining the outcomes of a partnership' of the NESP Indigenous Partnership Principles highlights that payment for time depends on the nature of the research and the nature of knowledge shared. This may encompass payment for research work, authorship, joint publications, and opportunities for presentations.

In addition to remunerating people for their time, one interviewee explained that investments in training, and prioritising local employment, of Traditional Owners in synbio science should also be considered (see Wissing & Webb, 2023, p. 358). He explained that this approach is not only important for the success of a project and to build respectful relationships, but that it may also prove more cost effective than employing remote contractors.

***Waiben* (Thursday Island) in *Zenadth Kes* (the Torres Strait). Image by Wissing (2023)**

Opportunities

As the field of synbio progresses, the "distribution of benefits and costs of solutions" (Interdisciplinary Decision-Making – Advanced Engineering Biology FSP (csiro.au)) should also be considered to ensure synbio and similar sciences are being conducted in increasingly inclusive and equitable ways. In this final set of principles, we outline how synbio scientists should consider cross-cultural ways of working that align with Indigenous-determined values and priorities, factor inter-generational impact, measure success in culturally appropriate ways, report findings back and afford space to (re-)learn to work effectively with and benefit Aboriginal and Torres Strait Islander peoples.

Align with Indigenous-determined values and priorities

As Section 1.1 of the AIATSIS Guide notes, it is important to address and align (synbio or other) research with priorities determined by Aboriginal and Torres Strait Islander peoples. This need to co-create research that addresses research priorities as identified by Aboriginal and Torres Strait Islander peoples is also emphasised in Section 'Co-created research' of the NESP Indigenous Partnership Principles. Importantly, this includes identifying interests and values of surrounding Indigenous communities as explained in the Section 'Scoping and building a partnership' of these same NESP Indigenous Partnership Principles.

An example of this can be seen in the case of early gene drive discussions with individuals and groups in the Torres Strait. The technical aspects of synbio (including the breeding patterns and life-span of species considered as pests) may motivate the preferred target species choice of synbio scientists for potential gene drive trials. Yet some Torres Strait Islanders consider supporting certain gene drives for certain species as informed by a different set of biocultural values and food security considerations. In the Torres Strait, feral cats and cane toads were identified by several individuals as potential targets for gene drive application. It was explained that these species are seen as 'foreign' (e.g., introduced) rather than native to the Torres Strait. Other reasons shared were that these species are not a food source in the region and have negative impacts upon the breeding of turtle species considered to be totemic and keystone. In contrast, despite also having a negative impact on the natural environment, individuals were hesitant to consider a scenario of gene drives being applied to feral pigs which have cultural and ceremonial value and offer food security for some individuals in this region.

Listening to and working with Indigenous-determined values and priorities is respectful, works to reduce adverse impacts, and increases the likely success of a project as Aboriginal and Torres Strait Islander peoples assume ownership of a project process. By incorporating Indigenous-determined values and priorities into synbio research[13], Aboriginal and Torres Strait Islander peoples are also more able to manage reciprocal relationships to their Country, islands and places of cultural significance, to other community members and to the larger tangible and intangible environments in which they live.

[13] See Carter et al. (2023) regarding engaging publics and communities in large-scale biological applications, in which they consider how social values might affect (synbio) science decisions in tangible ways.

Advisory sign in *Waiben* (Thursday Island) in *Zendath Kes* (the Torres Strait). Image by Wissing (2021)

Consider younger and future generations

For some Torres Strait Islanders interviewed, the "generation coming behind us" (cited in Wissing & Webb, 2023, p. 359) was a key motivator in their consideration of synbio's potential to improve environmental conditions. As synbio opportunities and related risks and benefits are discussed with Aboriginal and Torres Strait Islander partners and wider communities, consideration should also be given to younger and future generations who will experience the legacy and related opportunities and impact of synbio projects. So that future generations can understand the context and considerations of contemporary Aboriginal and Torres Strait Islander peoples who may choose to partner with synbio scientists for certain projects, synbio scientists and other research partners should discuss how to document the reasoning why Aboriginal and Torres Strait Islander peoples agree (or disagree) to the partnership as well as the process of decision-making. Consideration should also be given as how to safely store this documentation for future generations. In addition, contemporary projects may offer an opportunity to assist in transferring knowledge between generations. For example, 'Section 5.3.2' of the OKOW Guidelines highlights that co-developed tools that promote the inter-generational transfer of knowledge are highly valued. Section 2 'Developing the Research Idea' in the NHMRC 'Keeping Research on Track II' Companion Document also lists questions for the partnership that reflect on capacity building and future proofing.

Reflect on, and measure, opportunities in culturally considered ways

Reflecting and measuring the opportunities and effectiveness of a project (synbio or other) are culturally specific activities. What counts as success should not be assumed but rather co-created with, or led by, Aboriginal and(/or) Torres Strait Islander research partners. The NESP Indigenous Partnership Principles 'Principles and Performance Measures' has a set of performance measures against their principles. In addition to measuring success, there is a need to create culturally safe spaces and ways to identify and discuss when a project is not working successfully. Conflict management strategies should be put in place for such circumstances. See Section 'Research agreements' in the NHMRC Guidelines and also the NHMRC 'Keeping Research on Track II' Companion Document for an example of conflict resolution and complaint processes between partnerships. While it is important to take time and make space to reflect on a project (synbio or other) at its conclusion, reflecting on what counts and should be measured as success (or a lack thereof) should also happen at various stages through a project. As noted by various Traditional Owners in group meetings in the Torres Strait, any measurement of a synbio technical application needs to be considered at the beginning of a project (such as a gene drive trial), but must also be revisited at various planned milestones, and/or when mitigation measures prove necessary, along the way.

Share information back to the communities (in ways that are useful to communities)

Partnerships require that all parties benefit from a project, and this includes learning about the findings of a project in ways that are meaningful to Aboriginal and Torres Strait Islander research partners, prospective participants and wider communities. Section 7 of the NHMRC Guidelines notes

that it is important that the sharing of results reaches the right people and that they understand what it means. Section 5.3.3 of the OKOW Guidelines also emphasises the need to ensure that data collected in research is shared and returned in a usable and accessible form. This may require appropriate tools, and technologies and training where appropriate. Co-creating communication products with partners will also ensure their applicability and useability.

Make time and space to (re-)learn

As the 'design-build-test-learn' cycle has informed various practices in synbio, it is also important to emphasise that learning at times requires a *re*-learning. This may include an undoing of some (culturally produced) assumptions to listen and learn about new ways of doing (synbio) science on the values, terms and with benefit to Aboriginal and Torres Strait Islander peoples as Australia's first scientists. It is also important to take the time and make a culturally safe space to seek and receive feedback from Aboriginal and Torres Strait Islander partners, participants and wider communities as to what works or worked, what isn't or didn't work, and what might be important to do differently in future projects. For details, see Section 'Learning from Experience' of NHMRC 'Keeping Research on Track II' Companion Document.

Looking out west from *Iama* (Yam Island) in *Zenadth Kes* (the Torres Strait). Image by Wissing (2022)

Part IV Next steps

As noted in CSIRO's Stretch RAP (October 2024 – June 2027) and previous RAP (December 2021 – December 2023), it is critical to build relationships, show respect, and (co-)create opportunities for Aboriginal and Torres Strait Islander peoples who have unique relationships to and hold unique knowledge about Australia's diverse and dynamic environment. Each partnership will be unique. For example, the values, priorities and interest in entering into partnership with synbio scientists will differ from one community to the next. Each partnership will need to be informed by and from the local context, the people who could be interested, and the focus of the type of synbio application.

Any partnership can and will likely have challenges, but it is critical and important to give partnering a go. Some people are already looking to a future where synbio may be of value, if done right and with respect for Aboriginal and Torres Strait Islander peoples' ways of knowing and working. As one Traditional Owner from the Torres Strait explained, "[t]hey have to go in parallel. Both the synthetic and the cultural science" (cited in Wissing & Webb, 2023, p. 360).

Rather than a one size fits all approach, we have proposed the above core principles for synbio scientists to consider before they begin any partnership discussions. The focus of the core principles is on early and inclusive interactions with potential partners, participants and wider communities. The aim is for synbio scientists to think about, and approach potential partners in ways that build respectful relationships to discuss and co-create meaningful opportunities with Aboriginal and Torres Strait Islander peoples.

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