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Bioprospecting and decolonization of *ex situ* collections for Indigenous data sovereignty in Australia

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Abstract

Australian government herbariums and museums are repositories of flora and fauna specimens collected from across Australia. This has occurred since before Australia was colonized and to the present time, often by explorers and researchers using Indigenous people's traditional knowledge to identify and locate culturally significant species. The colonial legacy of Australia is embedded in *ex situ* collections of biological specimens and related data, which mostly predate international treaties promoting benefit-sharing with Indigenous peoples for using their traditional knowledge. Collections of culturally significant biological specimens and associated data should be recognized as cultural property and managed according to Indigenous data sovereignty principles including for attribution and nomenclature. This article presents an example of Australian native tobacco biodiscovery in Australia and pathways for integrating principles of Indigenous data sovereignty for decolonization of *ex situ* collections and for promoting a rights-based approach.

Keywords: Bioprospecting; decolonisation; Indigenous data sovereignty; *ex situ* collections; access and benefit sharing

Introduction

Australian government herbariums and museums are repositories of flora and fauna specimens collected from across Australia. This has occurred since before Australia was colonized and to the present time, often by explorers and researchers using Indigenous people's traditional knowledge to identify and locate culturally significant species.¹ The colonial legacy of Australia is embedded in *ex situ* collections of biological specimens and related data, which mostly predate international treaties promoting benefit-sharing with Indigenous peoples for using their traditional knowledge. Collections of culturally significant biological specimens and associated data should be recognized as cultural property and managed according to Indigenous data sovereignty principles including for attribution and nomenclature. This article presents an example of Australian native tobacco biodiscovery in

¹ Beaglehole 1962 citing Banks 1770; Johnston and Cleland 1934; Park et al. 2023; Cleland and Johnston 1938.

Australia and pathways for integrating principles of Indigenous data sovereignty for decolonization of *ex situ* collections and for promoting a rights-based approach.

The article first (1) provides the background to biodiscovery practices in Australia for collecting native species. This includes the use of Indigenous Australians' traditional knowledge by employing the example of Australian native tobacco biodiscovery and the role of Australian government herbariums and museums as repositories for specimens and data. The article then (2) analyses relevant existing and emerging international standards for accessing and using biological material and associated data for biodiscovery and for benefit-sharing with Indigenous Australians. Third, (3) the article briefly considers what has been done by the Australian government to implement access and benefit-sharing laws in Australia and what more could be done including to implement the provisions 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 2010.² Finally, (4) the article considers the practices and procedures of Australian herbariums and museums that do or do not align with the principles of Indigenous data sovereignty and the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) toward decolonization of collections and collections practices.³

Background of biodiscovery in Australia

Biodiscovery in Australia dates back to before the British government asserted sovereignty over Australia as *terra nullius*. Several species of Australian native tobacco widely known among Aboriginal people as *pituri* (or *mingkulpa*) were of particular interest to early explorers such as Joseph Banks, who observed Aboriginal people chewing an herb presumed to be for the effects of nicotine and that induced a "broad range of effects."⁴ Other early explorers observed *Nicotiana benthamiana*, a species of *pituri*, used by Aboriginal people as a medicine for treating skin conditions for ringworm, bull ant and yellow ant bites, itchy grub, caterpillar and spider bites, and for scabies in hair and skin sores⁵ as well as an anaesthetic.⁶ *Pituri* was observed as a resource for trade among Aboriginal tribes and groups of the central desert and for its important role in social interactions for bartering within and between groups through an extensive network of trade routes.⁷ The characteristics of *Nicotiana benthamiana* are not uniform, and variations in potency have been observed by Aboriginal women from the Central Desert of Australia near Uluru.⁸ For the Anangu people, the traditional owners of Uluru, *pituri* "was and is and will be a source of life" in the past and in the present.⁹

The earliest recorded specimen of *Nicotiana benthamiana* was collected by Bynoe in 1867 and taken to the Royal Botanic Gardens in England, where it remains today.¹⁰ Figure 1 demonstrates the timeline and extent of collections of botanical specimens of *Nicotiana benthamiana* Domin held by Australian herbaria. The oldest recorded specimen of *Nicotiana benthamiana* held by an Australian herbarium is in the National Herbarium of Victoria collected from Central Australia by C. G. A. Winnecke in 1883.¹¹ In 1936 seeds and leaves of

² United Nations 2010

³ United Nations 2007.

⁴ Banks 1770.

⁵ Ratsch 2017.

⁶ Herbert 1926.

⁷ Johnston 1934.

⁸ Ratsch 2017; Wylie and Li 2022.

⁹ Ratsch 2017.

¹⁰ Royal Botanic Gardens Kew Data Portal n.d.

¹¹ Royal Botanic Gardens Victoria n.d.a

Nicotiana benthamiana were collected from Warlpiri Country near The Granites during an expedition led by the Protector of Aborigines John Cleland.¹² The primary objective of the expedition was to study medical and cultural uses for plants and to document their uses and names.¹³ The seeds and leaves collected by Cleland were taken to Adelaide in South Australia, where they are held by the State Herbarium of South Australia to this day, and the Board of the Botanic Gardens and State Herbarium is deemed “rights holder.”¹⁴ Other Australian herbaria also hold specimens from Cleland’s expedition at the National Herbarium of New South Wales¹⁵ and the Australian National Herbarium in the Australian Capital Territory where specimens are used for DNA extraction.¹⁶ Seeds collected by Cleland from The Granites are widely considered the origin of a *Nicotiana benthamiana* variant known as *BenthLAB* used as the “chassis of choice” for testing and implementing advanced approaches in synthetic biology.¹⁷ Gene sequence information for *Nicotiana benthamiana* laboratory variants are published by the Waterhouse Group through the Queensland University of Technology for open access subject to rights of sequence owners.¹⁸ Over 80 patents have been granted in several countries using *Nicotiana benthamiana* and its variants without recognizing Indigenous peoples’ intellectual property.¹⁹

More recently since the Convention on Biological Diversity (CBD) was adopted in 1992, an international treaty for the conservation and sustainable use of biological diversity, Kew Gardens representatives leading the Hunting the Wild Tobaccos Project conducted research into Australian native tobacco species in collaboration with Curtin University and the

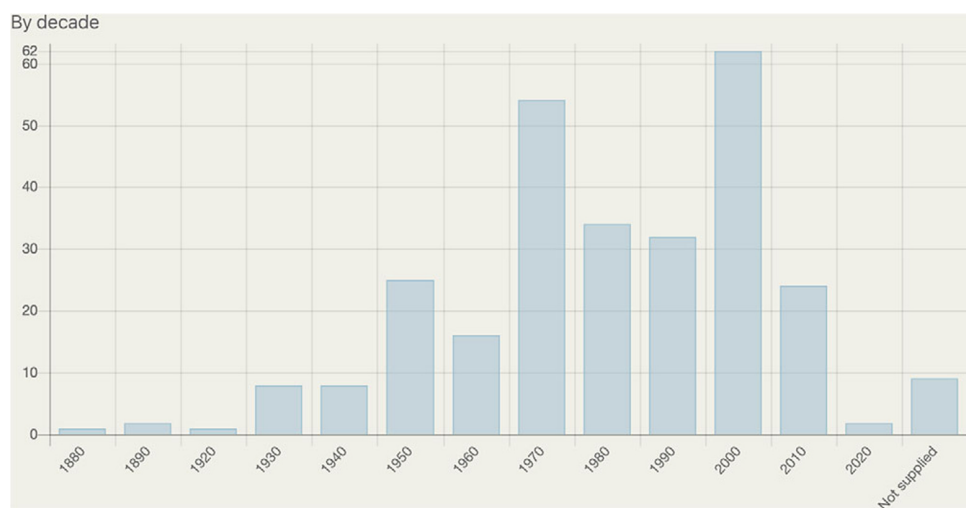


Figure 1. Botanical specimens of *Nicotiana benthamiana* Domin collected and held by Australian herbaria.²⁰

¹² Wylie and Li 2022; South Australia Department of Environment and Water n.d.

¹³ Cleland and Johnston 1939.

¹⁴ South Australia Department of Environment and Water n.d.”

¹⁵ Royal Botanic Gardens and Domain Trust (NSW) n.d.

¹⁶ Australian National Herbarium. n.d.

¹⁷ Buddhini Ranawaka et al. 2023.

¹⁸ Waterhouse Lab n.d.; BenthGenome 2025.

¹⁹ Robinson 2010.

²⁰ Wilkinson 2021.

University of Vienna over an eight-year period.²¹ The aim of the Hunting the Wild Tobaccos Project was to identify how *Nicotiana* species in Australia have adapted to arid conditions including germination characteristics, seed dormancy, water requirements, and growth.²² In 2016, Kew Gardens representatives collected specimens of Australian native tobacco species from Uluru-Kata Tjuta National Park under Australian government permit for growing plants at Kew Gardens in England and for extracting DNA.²³ This national park is Aboriginal land, and a world heritage place recognized in 1994 for its universal cultural values.²⁴

The collection of botanical specimens from Australia by colonial settlers and early explorers and their use of Australian Indigenous peoples' knowledge was justified at this time by the *doctrine of discovery* based on an assumption that Australia was *terra nullius*, meaning "land belonging to no one."²⁵ Wylie et al suggest the assumption of *terra nullius* in Australia has since been over-turned in part by the *Mabo Decision*²⁶ in 1992 which affirmed traditional use rights of Aboriginal and Torres Strait Islander peoples to their lands, waters and associated natural resources such as *pituri*.²⁷ The doctrine of discovery also applied to natural resources considered to be in the realm of the commons.²⁸ As espoused by John Locke, "the fruits [the earth] naturally produces, and beasts it feeds, belong to mankind, as they are produced by the spontaneous hand of nature"²⁹ a concept given legal status by the Convention for the Protection of the World Cultural and Natural Heritage 1972.³⁰ Accordingly, natural resources were considered "common heritage of humankind," the taking and using of which did not require benefit-sharing or consent, until the Convention on Biological Diversity 1992 (CBD) came into force in 1993.³¹

International standards and Australian laws

The example of Australian native tobacco biodiscovery provides the lens through which this article considers the procedures for involving Aboriginal people in research investigating culturally significant species collected from culturally significant areas such as Uluru. Consideration is also given to the extent to which Aboriginal people may benefit from associated data shared globally for the benefit of humanity. To understand the legal context in which these issues are framed, we first analyze relevant international standards and Australian laws for accessing biological material from Commonwealth areas and obligations for benefit-sharing including from digitally stored information derived from culturally significant species.

As the second author pointed out in 2012, the Convention on Biological Diversity 1992 (CBD) provides member nations with the opportunity to establish regimes that would "regulate foreign and domestic access to valuable genetic resources and traditional and Indigenous knowledge while establishing benefit-sharing mechanisms relating to that access."³² Australia ratified the CBD in 1993 and, after much policy debate, introduced the Environment Protection and Biodiversity Conservation Act 1999 (Cth) ("EPBC Act") and thereafter the Environment

²¹ Ibid.

²² Atlas of Living Australia n.d.a.

²³ Australian Government 2016; Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2021; Director of National Parks. 2016.

²⁴ Chase et al. 2011.

²⁵ Kirby 1994.

²⁶ *Mabo and Others v. Queensland (No. 2)* (1992) 175 CLR 1.

²⁷ Ibid.

²⁸ Lind 2020.

²⁹ Locke 1713.

³⁰ United Nations 1972.

³¹ Morgera 2014.

³² Stoianoff 2012.

Protection and Biodiversity Conservation Regulations 2000 (“EPBC Regs”). However, Part 8A of the EPBC Regs that deals with access to biological resources in “Commonwealth Areas” took almost a further six years to come into force (December 2005).³³ This legislation and regulations form part of Australia’s implementation of the CBD. As Australia is a federation, the Commonwealth could only legislate in relation to Commonwealth land and waters, hence the restriction to “Commonwealth Areas.” Meanwhile, the states have constitutional powers to legislate in relation to the environment and, despite attempts to develop a nationally consistent approach in the 1990s,³⁴ this has led to haphazard implementation of the CBD across the nation.³⁵ The following example demonstrates the operation of the EPBC Act and the EPBC Regs which have yet to keep step with the developments of international law.

The issue of access to genetic resources and the fair and equitable sharing of benefits arising from their utilization is the third objective of the CBD. It was recognized early on that guidance was needed to deal with such an objective. This led to the establishment of the voluntary Bonn Guidelines³⁶ in 2002, which assisted nation states in establishing the measures necessary to implement access procedures and determine how benefit-sharing might be achieved. However, voluntary guidelines are insufficient to ensure legal certainty and transparency for both providers and users of genetic resources. It was recognized that an official procedure or system of rules was needed to achieve such measures and ensure prior informed consent was obtained from relevant Indigenous and/or local communities whose knowledge was associated with the genetic resources sought.³⁷

To assist in that process 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 2010 (the “Nagoya Protocol”) was developed to provide guidance on the important aspect of obtaining prior informed consent and the establishment of mutually agreed terms. Being an international agreement, the compliance measures contained therein are binding on the parties (nation states) that have not only signed but ratified the Nagoya Protocol. However, while Australia signed the Nagoya Protocol in 2012, it has yet to ratify the agreement. This is indicative that Australia needs to introduce legislation that meets the requirements of the Nagoya Protocol before ratification can be achieved – indirect confirmation that current laws do not meet the obligations under the Nagoya Protocol.

Simultaneously, it became clear that for the CBD to operate as intended, intellectual property laws might need to be investigated to ensure that they do not work contrary to the objectives of the CBD. To this end the United Nations Environment Programme (UNEP) engaged with the World Intellectual Property Organization (WIPO) to jointly commission “a study on the role of intellectual property rights in the sharing of benefits arising from the use of biological resources and associated traditional knowledge.”³⁸ Meanwhile, after more than two decades of negotiations conducted by the World Intellectual Property Organization Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC), the Diplomatic Conference of WIPO’s 193 member states, held from 13 to 24 May 2024, adopted the WIPO Treaty on Intellectual Property, Genetic Resources and Associated Traditional Knowledge (the WIPO Treaty).³⁹ This is the first time

³³ See DCCEEW, *Access to Biological Resources in Commonwealth Areas*, last updated 11 October 2021, <https://www.dcceew.gov.au/science-research/australias-biological-resources/access-biological-resources-commonwealth>

³⁴ See generally Stoianoff and Fox 2004, 91–114.

³⁵ Stoianoff 2012.

³⁶ United Nations 2002.

³⁷ Convention on Biological Diversity Secretariat 2016.

³⁸ WIPO General Assembly 2000, 2.

³⁹ United Nations 2024. The WIPO Treaty, RATK/DC/7 will come into force three months after there have been 15 ratifications and accessions. At the time of writing only one ratification has occurred.

that treaties under the auspices of WIPO have included provisions specifically for Indigenous peoples and local communities.

The objectives of the WIPO Treaty are concerned with the interactions between the patent system, genetic resources, and the traditional knowledges of Indigenous and local peoples as they relate to those genetic resources. The aim is to “enhance the efficacy, transparency and quality of the patent system” and thereby prevent the granting of patents over inventions that do not meet the requirements of novelty and inventive step having regard to the genetic resources and associated traditional knowledge related to those inventions.⁴⁰

If the patent application claims are “based on” genetic resources and/or associated traditional knowledge, then the WIPO Treaty requires the application to disclose the country of origin or source of the genetic resources and/or the Indigenous peoples or local community providing the associated traditional knowledge.⁴¹ A failure to do so, however, may attract sanctions and remedies but may not result in a revocation or invalidation, or render unenforceable the conferred patent rights.⁴² To invoke sanctions and remedies requires that the failure to disclose was fraudulent.⁴³ Careful consideration needs to be given as to how national laws should be drafted, and further, it raises many questions. What rights do countries of origin have in these circumstances? What rights do Indigenous peoples and local communities have in such circumstances? Does the WIPO Treaty address the issues associated with failure to comply with the Nagoya Protocol? The list goes on.

In earlier negotiations over the WIPO Treaty provisions, specific mention was made of the need to include provisions that

prevent the erroneous granting of patents with regard to claimed inventions that include genetic resources and traditional knowledge associated with genetic resources where, under national law, those genetic resources and traditional knowledge associated with genetic resources:

- (a) Anticipate a claimed invention (no novelty); or
- (b) Obviate a claimed invention (obvious or no inventive step).⁴⁴

Further, it was also submitted that patent opposition and supporting measures be included in such a treaty.⁴⁵ What the WIPO Treaty does include is a provision which essentially encourages the establishment of

Information systems (such as databases) of genetic resources and traditional knowledge associated with genetic resources, in consultation, where applicable, with Indigenous Peoples and local communities, and other stakeholders, taking into account their national circumstances.⁴⁶

Such databases remind us of the Indian Traditional Knowledge Digital Library, which was deployed to patent offices worldwide and enabled patent examiners to search for information that might demonstrate that a purported invention is not novel as it is based on prior

⁴⁰ United Nations 2024, Article 1.

⁴¹ United Nations 2024, Article 3.

⁴² United Nations 2024, Article 5.

⁴³ United Nations 2024, Article 5.

⁴⁴ WIPO IGC 2017.

⁴⁵ Ibid.

⁴⁶ United Nations 2024, Article 6.

Indian traditional knowledge.⁴⁷ Databases of digital sequence information of genomes might also serve in a similar capacity and work toward ensuring genetic resources and their associated traditional knowledge are not misappropriated. However, it is important to note that Article 4 of the WIPO Treaty is not retroactive. That is, the obligations under the WIPO Treaty cannot be imposed on patent applications that were filed before the treaty comes into force unless there are pre-existing national laws in place. The WIPO Treaty has been described by Okediji as a “symbolic and moral acknowledgment of Indigenous knowledge systems,” and it “validates Indigenous ways of knowing and fulfills a moral imperative to reflect the value of [genetic resources] and [traditional knowledge] in legal systems.”⁴⁸

As the WIPO Treaty is yet to come into force, Australia still has the EPBC Act and EPBC Regs to consider where Indigenous genetic resources and associated Indigenous knowledge are being accessed and commercialized. The following section demonstrates the operation of Commonwealth Australian law by way of example and demonstrates the integral role of Australian collections institutions for publishing data about species collected, locations where they are collected, and by whom.

Australian Commonwealth legislation for access and benefit-sharing

Uluru Kata-Tjuta National Park is a Commonwealth area where permission to access and collect specimens of biological resources, and the use of associated traditional knowledge, is subject to requirements of the EPBC Act and the EPBC Regs. Section 301(1) of the EPBC Act provides that regulations can stipulate the rules necessary for the “control of access to biological resources in Commonwealth areas.” This includes equitable sharing of benefits from the use of those resources, facilitating or denying access to those resources, or granting access and setting the terms and conditions for access.⁴⁹ Part 8A of the EPBC Regs provide the mechanism for obtaining access to biological resources in Commonwealth areas. The mechanism is divided into two parts – one for access that has potential commercial purposes⁵⁰ and the other for access that has noncommercial purposes.⁵¹

In 2016 an access permit was granted to Kew Gardens by the Commonwealth government to collect specimens of Australian native tobacco species for a noncommercial purpose from Uluru Kata-Tjuta National Park in the Northern Territory of Australia during the period 28 July 2016 to 16 August 2016 of the following: *Nicotiana gossei* (commonly known as rock pituri), *Nicotiana benthamiana*, *Nicotiana rosulata* ssp. *Ingulba*, *Nicotiana megalosiphon* ssp. *Sessilifolia*, *Nicotiana rosulata* ssp. *rosulata*, *Nicotiana velutina*, *Nicotiana simulans*, and *Nicotiana excelsior*.⁵² Permission was also granted by several Indigenous communities to collect specimens from their land.⁵³

Application forms to obtain permission to collect specimens from Commonwealth areas requires applicants to disclose any use of “Indigenous knowledge” associated with specimens collected.⁵⁴ This is relevant to potential future entitlements for reasonable

⁴⁷ Council of Scientific & Industrial Research, Traditional Knowledge Digital Library, Ministry of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy, available on 5 September 2025 at <<https://www.tkdlib.res.in/tkdlib/LangDefault/Common/Abouttkdl.asp?GL=Eng>>

⁴⁸ Okediji 2005.

⁴⁹ Environment Protection and Biodiversity Conservation Act 1999, s. 301(2).

⁵⁰ EPBC Regs Div. 8A.2.

⁵¹ EPBC Regs Div. 8A.3.

⁵² EPBC Regs Part 8A17.02(2)(ga)(v); Australian Government Director of National Parks, ‘Application to Conduct Scientific Research in Uluru-Kata Tjuta National Park’ <<https://www.dcceew.gov.au/parks-heritage/national-parks/uluru-kata-tjuta-national-park/permits-licences-and-leases/researchers>>.

⁵³ Chase et al. 2021.

⁵⁴ EPBC Regs Part 8A17.02(2)(ga)(v); Director of National Parks 2025.

benefit-sharing, which applies if biological material associated with such knowledge is used for a commercial purpose, for example by obtaining a patent.⁵⁵ The permit application submitted by Kew Gardens obtained via the Freedom of Information Act 1982 (Cth) (FOI Act) and approved by the Commonwealth government states “no” in answer to the use of “Indigenous knowledge” for locating and collecting samples from Uluru Kata-Tjuta National Park in connection with the permit.⁵⁶ After the permit was granted during their expedition to Uluru, the Kew Gardens team were assisted by Aboriginal guides from the area as a condition of the access permit to offer traditional owners opportunities to be involved.⁵⁷ During the expedition Aboriginal guides provided assistance and reportedly shared information about their uses of different *Nicotiana* species.⁵⁸ Research findings published by Kew Gardens of *Nicotiana gossei* and *Nicotiana ingulba* from Uluru refer to Aboriginal peoples’ traditional knowledge as follows:

It [*Nicotiana gossei*] is most commonly encountered at sacred sites, such as those at Uluru and Watarraka where local people still go to harvest leaves for private use and use in rituals.⁵⁹

Nicotiana ingulba is now considered inferior to *N. gossei* for purposes of chewing, as stated to us by members of the indigenous community at Uluru-Kata Tjuta National Park during our visit there in 2016.⁶⁰

Permit holders for collecting specimens from Commonwealth areas are required to offer a taxonomic duplicate of specimens collected with an “Australian public institution who holds related collections” for “permanent loan” rather than as a gift.⁶¹ Australian public institutions are herbariums and botanic gardens for each Australian jurisdiction. This is in recognition that “samples provide a way to share valuable biodiversity knowledge from research activities conducted in Commonwealth Areas.”⁶² For newly described species, permit holders are to “take all reasonable steps” to lodge a specimen with an Australian herbarium in the state or territory where the species were found as nominated in the permit application.⁶³ The access permit application submitted by Kew Gardens obtained through Freedom of Information (FOI) by the first author nominates the Alice Springs herbarium in the Northern Territory as the relevant Australian public institution for loaning duplicate taxonomic samples.⁶⁴ There is no public record of duplicate specimens for *Nicotiana* species collected from Uluru by Kew Gardens with the Alice Springs herbarium or through the aggregated Australian herbarium database of the Atlas of Living Australia (ALA). It may be that duplicate specimens were not deposited for reasons of cultural sensitivity or because specimens collected are not “newly described.”⁶⁵

⁵⁵ EPBC Regs Part 8A.07.

⁵⁶ Director of National Parks 2016, Question 16.

⁵⁷ Director of National Parks 2016; Director of National Parks “Application to Conduct Scientific Research in Uluru-Kata Tjuta National Park” requires applicants to consult with traditional owners and the Park Australia Board of Management.

⁵⁸ Chase et al. 2021.

⁵⁹ Chase and Christenhusz 2018.

⁶⁰ Chase et al. 2021.

⁶¹ Director of National Parks 2016; Director of National Parks 2025, Question 33.

⁶² Department of Climate Change, Energy, the Environment and Water n.d.

⁶³ EPBC Regs s8A.13.

⁶⁴ Director of National Parks 2016.

⁶⁵ Director of National Parks 2016; Chase et al. 2021.

However, specimens collected from Commonwealth areas by permit are not consistently included in such databases as confirmed in email correspondence with the office of the ALA.⁶⁶ This point is demonstrated by the fact that specimens collected from Uluru by Kew Gardens are not recorded in the database for the Alice Springs herbarium or the ALA database, which aggregates specimen data held by Australian herbariums. Nor does the database for Kew Gardens list specimen data from Uluru with the Global Biodiversity Information Facility (GBIF).

Email correspondence with the ALA has revealed that this data is not systematically included, which is disappointing as it could potentially provide a useful link between access permit numbers and locations and other metadata, including relevant Indigenous peoples and land tenure. And while not required to be published, a report of the results of research is required of permit holders under the EPBC Regs, but no such report was available through the FOI application. As the published list of access permits for Commonwealth Areas no longer discloses species or locations, the published records of duplicate specimens can provide this information. In this way Australian public herbariums can perform an important function of record-keeping and disclosure of access, which is relevant for benefit-sharing. Unless duplicate specimen data for access permits is shared through herbarium databases, the only other avenue for accessing this information is by FOI application. Indigenous people may wish to know who is taking what from where and whether for any potentially commercial purpose. It may be that Anangu people of Uluru are informed and this information has been shared privately.

Wider access to specimen data and images is considered by some as a significant step for decolonization by promoting transparency and enabling access to archival information otherwise held in storage.⁶⁷ However, centralization of data does not necessarily equate to resulting benefits being shared with Indigenous peoples in a fair and equitable way. Utilization of biological material and associated traditional knowledge shared through such databases and without appropriate attribution of Indigenous peoples or reasonable benefit-sharing with their communities can be considered a form of neocolonialism with the hallmarks of historical colonialism.⁶⁸

Decolonization of *ex situ* collections for Indigenous data sovereignty

Worldwide, Indigenous peoples are asserting sovereignty over Indigenous data and have developed Indigenous data sovereignty. *Indigenous data* is a term that “refers to information or knowledge, in any format or medium, [whether digital or not including specimens, and belongings about Indigenous peoples] which is about and may affect Indigenous peoples both collectively and individually.”⁶⁹ Indigenous data sovereignty principles provide high-level guidance for decolonizing data ecosystems, including data ecosystems of *ex situ* collections of biological materials and associated data originating from Indigenous peoples’ territories using their knowledges. Operationalization of data sovereignty principles involves integration of practical measures for recognizing Indigenous peoples’ right of self-determination to exercise ownership and control over Indigenous data as a pathway for decolonization. The Australian native tobacco example provides context for considering the application and integration of these principles and human rights principles of the UNDRIP into the practices and procedures of botanic gardens and herbariums for collecting and managing Indigenous data and provides a pathway toward decolonizing *ex situ* collections practices and procedures.

⁶⁶ Email correspondence from Atlas of Living Australia with first author, 9 July 2025.

⁶⁷ Smith 2025.

⁶⁸ Efferth et al. 2019.

⁶⁹ Maïam nayri Wingara and Australian Indigenous Governance Institute. 2018; Carroll et al. 2020.

The UNDRIP affirms Indigenous peoples' right to self-determination to maintain, control, and protect their knowledges and oral expressions as manifestations of their sciences, technologies, and cultures including genetic resources, seeds, knowledge of the properties of flora and fauna, and oral traditions and related intellectual property.⁷⁰ While not a binding international instrument, the UNDRIP encourages states to consult and cooperate with Indigenous peoples to achieve such ends including by taking legislative measures for ensuring laws and policies accessing biological material and for benefit sharing are aligned with the UNDRIP. Implementation and operationalization of the CBD and supplementary Nagoya Protocol aim for consistency with international instruments such as the UNDRIP for promoting fair and equitable benefit sharing with Indigenous peoples from the use of biological resources and associated traditional knowledge and for promoting effective participation.

At the international level, the CARE Principles for Indigenous Data Governance (CARE Principles)⁷¹ have been developed by Indigenous peoples through their own organizations through the Global Indigenous Data Alliance and are intended to compliment the FAIR Principles in promoting “findable, accessible, interoperable and reusable data” for open source data sharing.⁷² The CARE principles promote “collective benefit, authority to control, responsibility and ethics”⁷³ and reflect the crucial role of data in advancing Indigenous innovation and self-determination by focusing on people and purpose.⁷⁴ The CARE principles were adopted at the Indigenous Data Sovereignty Principles for the Governance of Indigenous Data Workshop⁷⁵ in 2018 with endorsement of Indigenous peoples through their own organizations from Australia, New Zealand, Canada, and the United States.⁷⁶

Canada, New Zealand, and Australia: Indigenous data sovereignty principles

In Canada the OCAP Principles[®] for Indigenous Data Sovereignty were developed by the First Nations Information Governance Centre in Canada, and they promote “ownership, control, access and possession” for data sovereignty.⁷⁷ The OCAP Principles are a set of principles for ownership, control, access, and possession. The focus of the OCAP principles is for Indigenous peoples to have control over how data they own is collected and to control how this information is used.⁷⁸ In New Zealand the Te Mana Raraunga – Māori Sovereignty Network was formed in 2015 and developed the Māori Data Sovereignty Charter, which maintains that Māori data should be subject to laws of the Māori nation when and where it is collected, which includes tribal nations.⁷⁹ This includes advocating for Māori involvement in the governance of data repositories such as *ex situ* collections, for ensuring that data for and about Māori can be safeguarded and protected, and for asserting Māori rights and interests in relation to data.⁸⁰

In Australia the National Indigenous Australians Agency (NIAA) of the Australian government has developed the Framework for Governance of Indigenous Data (FGID) that is intended to guide how data related to Aboriginal and Torres Strait Islander people is

⁷⁰ UNDRIP article 31, article 11, article 33(2).

⁷¹ Carroll et al. 2023.

⁷² Go Fair n.d.

⁷³ Carroll et al. 2023.

⁷⁴ Carroll et al. 2023; Global Indigenous Data Alliance n.d.

⁷⁵ Carroll et al. 2023.

⁷⁶ Ibid.

⁷⁷ n.d.

⁷⁸ Schnarch 2004.

⁷⁹ Te Mana Raraunga Māori Data Sovereignty Network n.d.a.

⁸⁰ Te Mana Raraunga Māori Data Sovereignty Network n.d.b.

managed through the public service.⁸¹ The FGID aims to provide Aboriginal and Torres Strait Islander people with “meaningful access to relevant Government-held data” by encouraging public servants to partner with Aboriginal and Torres Strait Islander peoples and build their data-related capabilities, provide knowledge of data assets, and build inclusive data systems.⁸² This framework is relevant for collecting and sharing Indigenous data from Australian government *ex situ* collections including duplicate specimens collected from Commonwealth areas involving administrative decisions as matters of public interest. The FGID provides guidance for public servants in their dealings with Indigenous data and interactions with Indigenous people including for vetting access permit requirements for disclosing any use of associated Indigenous knowledge, ensuring duplicate specimens are shared with Australian collection institutions, and obtaining reports of the result of research. The FGID also provides a framework for public servants to embed Indigenous peoples’ own data sovereignty principles as detailed in the following sections.

Grassroots level in Australia: Maiam nayri Winga Data Sovereignty Collective

At the grassroots level in Australia, Aboriginal and Torres Strait Islander people have developed the Maiam nayri Winga Indigenous Data Sovereignty Principles through the Maiam nayri Winga Data Sovereignty Collective, which aims to ensure that data on or about Indigenous peoples reflects their priorities, values, cultures, and worldviews.⁸³ At the first workshop in 2015, participants considered the “implications of the UNDRIP for the collection, ownership and application of data for Indigenous peoples and implications for Indigenous peoples “sovereignty.”⁸⁴ At the second workshop in 2018 the following five Indigenous Data Sovereignty Principles were articulated and adopted, which are each considered in the following sections in the context of the Australian native tobacco example and Indigenous data sovereignty: (1) the right of Indigenous peoples to control the data ecosystem including creation, development, stewardship, analysis, dissemination, and infrastructure; (2) the right to data that is contextual and disaggregated so data is available and accessible to individuals, communities, and First Nations; (3) the right for data to be relevant and empowering for Indigenous peoples’ right to self-determination and for effective self-governance; (4) the right for data to be accountable to Indigenous peoples and First Nations; and, (5) the right for data to be protective and respectful of individual and collective interests of Indigenous peoples.⁸⁵

The Maiam nayri Winga Principles offer high-level guidance rather than specific actions. Rose et al. suggest they are “yet to conform around a coherent set of policy objectives.”⁸⁶ In comparison, the Māori Indigenous Data Sovereignty charter provides specific actions for integrating these principles. Nevertheless, the Maiam nayri Winga Indigenous Data Sovereignty Principles provide a self-determined and empowered framework for embedding these principles across a range of data ecosystems involving Indigenous data including those of *ex situ* collections and associated databases originating from Australia. Steps have been taken among the network of Australian herbariums and museums toward recognizing and embedding Indigenous data sovereignty principles into the practices and procedures that pave the way for further embedding these principles, as follows.

⁸¹ National Indigenous Australians Agency *n.d.*

⁸² *Ibid.*

⁸³ Maiam nayri Wingara and Australian Indigenous Governance Institute 2018.

⁸⁴ Maiam nayri Wingara *n.d.*

⁸⁵ *Ibid.*

⁸⁶ Rose et al. 2023.

(1) The first Maiam nayri Winga Principle promotes Indigenous peoples having authority to control data ecosystems that capture Indigenous data and for recognizing Indigenous peoples' right to free, prior, and informed consent for collecting and using relevant data; for data to be made accessible to Indigenous nations and communities; and for developing cultural protocols for how Indigenous data is used.⁸⁷ An estimated 90 percent of botanical specimens and associated data held by Australian government herbariums were accumulated during periods of colonization before the CBD entered into force and were considered common property without any legal obligations for benefit sharing with states or with Indigenous peoples or for obtaining approval or consent.⁸⁸ Australian governments continue to assert ownership over *ex situ* collections and associated data subject to legally recognized rights of Aboriginal and Torres Strait Islander peoples. The Council of Heads of Australasian Herbaria have developed Guidelines for Managing Australasian Herbarium Collections adopted in February 2020, which recognize Indigenous legal ownership of collections in some jurisdictions that are otherwise legally owned by herbariums and governing bodies, and which adopts the Nagoya Protocol as a benchmark.⁸⁹ Botanical specimens collected from Commonwealth areas after the CBD entered into force, such as those taken from Uluru-Kata Tjuta National Park in 2016, are subject to the provisions of the EPBC Act for access and benefit sharing.

Australian government herbariums started capturing data (information and knowledge) about botanical specimens in their collections through in-house databases during the 1980s, a process that has accelerated in recent years with systematic digitization of images of drawings, field notes, and photographs associated with specimens in collections.⁹⁰ Australian government herbariums are also extracting DNA from specimens and digitizing genetic information. This data is shared online through public databases of each institution, through the ALA⁹¹ and Australian Virtual Herbarium,⁹² and internationally through the international Global Biodiversity Information Facility (GBIF)⁹³ at the Barcode of Life Data Systems portal.⁹⁴ Wider public access to digitized specimen data and images is considered by some as a significant step for decolonization by opening the vaults of herbariums for public viewing.⁹⁵ However, the openness and scale of *ex situ* collection databases and databases of digital genetic information limit the capacity for Indigenous people to track how data originating from their territories using their knowledges is shared and utilized for biodiscovery.

(2) The second Maiam nayri Winga Indigenous Data Sovereignty Principle promotes data that is relevant and respectful. The data ecosystem associated with biodiscovery in Australia captures Indigenous data from plant specimens that originate from their territories and associated archival materials such as diaries and field notes documenting observations of explorers and botanists. This data ecosystem also reflects Australia's colonial history through the naming practices for plant species and in the procedures for accessing data and information related to cultural property of Aboriginal and Torres Strait Islander people.

⁸⁷ Carroll et al. 2022.

⁸⁸ BGI et al. 2001; Cribb 2017.

⁸⁹ Managers of Australasian Herbarium Collections 2020.

⁹⁰ Cantrill 2018.

⁹¹ Atlas of Living Australia n.d.c.

⁹² Australasian Virtual Herbarium, "Occurrence Records," Portal for searching the database of Australasian herbaria for occurrences and locations of species, accessed 20 August 2025, https://avh.ala.org.au/occurrences/search?q=collection_uid%3Aco54#tab_mapView; Cantrill 2018.

⁹³ Global Biodiversity Information Facility 2025.

⁹⁴ Barcode of Life Data Systems n.d.

⁹⁵ Smith 2025.

Ex situ collections databases of herbariums provide information of specimens held in their collections, often named after people who identify new species in accordance with the International Code of Nomenclature for Algae, Fungi, and Plants, updated in 2017 and referred to as the Shenzhen Code.⁹⁶ Names accepted for newly discovered species are catalogued with the International Plant Names Index (IPNI) produced by Kew Gardens and the Centre for Australian Biodiversity Research (Australian National Herbarium).⁹⁷ During the Hunting for the Wild Tobaccos Project, eight new *Nicotiana* species were “discovered,” some of which are named after the researchers whose claim to have discovered them is recognized by publishing their findings as required by the Shenzhen Code.⁹⁸ The species *Nicotiana gossei* is named after William Gossei, who claimed to have discovered this species at Uluru in 1929.⁹⁹ The naming of recently discovered *Nicotiana* species *Nicotiana karijini* M.W. Chase & Christenh uses the Indigenous Country name “Karijini,” where specimens were collected together with the names of scientific authors who identified the species, signaling decolonization of nomenclature for taxonomy.¹⁰⁰

Decolonization of nomenclature considers other ways of naming things, including plants and places where they are found to grow and according to names used by Aboriginal and Torres Strait Islander people as they are known to them. Aboriginal people have their own names for several species of Australian native tobacco species that include *pituri* and *mingkulpa*, and other names are also used by different language groups of the central desert who discovered Australian native tobacco and have been collecting, analyzing, and managing *pituri*, which is used for bartering, knowledge transfer, and medicinal uses.¹⁰¹

The ALA has taken steps toward decolonizing its data ecosystem by integrating Indigenous languages for its species database through the Indigenous Ecological Knowledge Names Project and linking with the AIATSIS Language Codes.¹⁰² For example, the term “pituri” is now used as metadata for species of Australian native tobacco as it is known by Aboriginal people for *Nicotiana benthamiana*, *Nicotiana rosulata*, and *Nicotiana gossei*.¹⁰³

The ALA is linking the Noongar language from Western Australia throughout the database to apply to species as known by Noongar people.¹⁰⁴ In Western Australia, nonscientific names for plants, including the use of Aboriginal names, were sourced from Bennett’s *Common and Aboriginal Names of Western Australian Plants*.¹⁰⁵ However, little work has been done to change common names that continue to adopt the naming protocol of the Shenzhen Code.¹⁰⁶ The scientific practices for name-giving of plants are still used despite scientists “being aware of the importance of recognising Indigenous people and places.”¹⁰⁷ Under the rules the only “proper reason” for changing a name is “either a more profound knowledge of the facts resulting from adequate taxonomic study or the necessity of giving up nomenclature that is contrary to the rules.”¹⁰⁸ The development of biocultural labeling for databases such as local contexts is a way databases of herbariums can be retrofitted with Indigenous species names and place names.¹⁰⁹ Biocultural labels can be applied and retrofitted

⁹⁶ Turland et al. 2018.

⁹⁷ International Plant Names Index [n.d.](#)

⁹⁸ Ibid.

⁹⁹ Chase and Christenhusz 2018.

¹⁰⁰ Atlas of Living Australia [n.d.b.](#)

¹⁰¹ Carroll et al. 2022.

¹⁰² Atlas of Living Australia 2019.

¹⁰³ Atlas of Living Australia [n.d.d.](#)

¹⁰⁴ Raisbeck-Brown and Smith-Ali 2023.

¹⁰⁵ Bennett 1991.

¹⁰⁶ Florabase [n.d.](#)

¹⁰⁷ Nielsen 2023.

¹⁰⁸ International Association for Plant Taxonomy [n.d.](#)

¹⁰⁹ Local Contexts [n.d.](#)

to databases to identify relevant Indigenous peoples whose territories species originate from and identify relevant cultural protocols for accessing and using archival materials such as when Indigenous knowledges are documented.¹¹⁰ Labels are intended to be durable and can also attach to databases of genetic resources and digital sequence information and related research for monitoring future use for benefit sharing and attribution.¹¹¹

The ALA is also exploring the role of information management platforms to bridge gaps between traditional and Western science knowledge by supporting “Aboriginal Traditional Owners” across Australia in all Australian jurisdictions and collecting “Indigenous Ecological Knowledge” for plants and animals and for identifying Aboriginal nomenclature shared through the ALA with consent.¹¹²

(3) The third Maïam nayri Winga Principle is also one of the CARE Principles that promotes the right of Indigenous peoples to collectively benefit from the use of Indigenous data and to be empowered by such use. Australian government herbarium databases are digitized and open source; they share specimen and archival data for species and location, and they also include spatial, demographic, geographic, and cultural metadata. The objective of sharing specimen and archival metadata is to promote research and development. The CBD emphasizes the “growing recognition that biological diversity is a global asset of tremendous value to present and future generations” evident in the value of herbaria such as Kew Gardens and the National Herbarium of New South Wales.¹¹³ Most botanical specimens held by Australian government herbariums and Kew Gardens were collected prior to the CBD and do not legally require any benefit sharing with countries of origin or with Indigenous peoples for commercial utilization. For Commonwealth areas of Australia, benefit sharing is only required from commercial utilization of biological material and requires reasonable benefit sharing with Indigenous communities for the use of associated traditional knowledge as detailed previous. The permit application submitted by Kew Gardens for collecting specimens from Uluru confirms traditional knowledge is not used. The term “utilization” is distinct from “use,” which has legal meaning under the Nagoya Protocol and means conducting research and development on genetic and/or biochemical composition of genetic resources including through the application of biotechnology,¹¹⁴ whereas “use” can arguably involve publishing findings of research, extracting DNA, and sharing information with public databases for utilization by third parties. The term “utilization of genetic resources” should not be restricted to commercial or scientific use of genetic material in terms of benefit sharing with Indigenous peoples for using their knowledges.¹¹⁵

(4) The fourth Maïam nayri Wingara Principle promotes accountability to Aboriginal and Torres Strait Islander people concerning Indigenous data and concerning data ecosystems of herbariums relating to procedures for the way specimen data and associated archival materials are used and shared. This also applies to DNA extracted from specimens and how this is used and shared. The Nagoya Protocol also promotes transparency and legal certainty for accountability aimed at creating more “predictable conditions” for when genetic resources leave a country.¹¹⁶ For Indigenous peoples, access to information is vital for promoting accountability.

¹¹⁰ Ibid.

¹¹¹ Golan et al. 2022.

¹¹² Atlas of Living Australia 2025.

¹¹³ Botanic Gardens of Sydney n.d.

¹¹⁴ Secretariat of the Convention on Biological Diversity 2011, “Use of Terms.”

¹¹⁵ Bystrom, Einarsson and Nycander 2009.

¹¹⁶ Secretariat of the Convention on Biological Diversity 2011, Introduction.

However, in Australia, transparency of decisions of the Commonwealth government granting access to collect biological material from Commonwealth areas including from Indigenous territories has decreased in recent years. Access permits that are granted no longer publish the location and names of specimens collected. The only information collected is the permit date, applicant name, and permit number. When the access permit was granted to Kew Gardens for collecting specimens from Uluru-Kata Tjuta National Park, permits were published disclosing the location and each of the species permitted to be collected. This information is important to specify what further information may be obtained by FOI, and the permit application discloses any use of associated traditional knowledge.

(5) The fifth Maïam nayri Wingara Principle promotes data that protects and respects Indigenous peoples' individual and collective interests articulated by the UNDRIP to govern their peoples, Country, and resources and the "creation, collection, ownership and application of their data."¹¹⁷ There are a wide range of measures for embedding a rights-based approach for Indigenous data sovereignty, and this article suggests three pathways. The first is by promoting Indigenous peoples' participation in governance and institutional decision making of *ex situ* collections for developing policy and procedures and for allocating resources to support their communities with accessing and interpreting resources and associated data held, used, and shared by *ex situ* collections institutions. In Australia the board of directors of the South Australian Botanic Gardens and State Herbarium and Royal Botanic Gardens Victoria, two of the most substantial and oldest collections, do not appear to have Indigenous representation.¹¹⁸

A further measure for promoting a rights-based approach for Indigenous data sovereignty is for *ex situ* collections of materials and aggregated data to recontextualize physical and digital records. This is achieved by embedding metadata for Indigenous nomenclature for taxonomy, including Indigenous peoples' own language names of their lands and waters where specimens are taken, stating whether DNA is extracted, and sign-posting cultural sensitivity aiming to ensure researchers are on notice when botanical specimens are accessed and used. Examples include local contexts labeling as outlined previously and other labeling systems. Databases of Australian public herbariums, and virtual databases that aggregate *ex situ* collections species and location data, should reliably and consistently synchronize with Australia's access and benefit-sharing permit system so that specimens collected by permit are listed with occurrence searches for locations, subject to cultural and ecological sensitivity for confidentiality. A user-friendly helpdesk with a telephone line for each herbarium would also provide much-needed support for members of the public with navigating databases as laypersons and finding such information. Access to such information may potentially assist Indigenous people with demonstrating entitlements to apply for funding from the newly formed Cali Fund established under the framework of the CBD from which 50 percent of the fund will be allocated to Indigenous peoples and local communities.¹¹⁹ The Cali Fund is intended to receive and distribute 0.1 percent revenue or 1 percent annual profits from companies meeting asset, sales, and profit thresholds from the utilization of digital sequence information not subject to international and domestic laws. The funds are for benefit sharing such as from utilizing digital information from Australian native genomes.¹²⁰

¹¹⁷ UNDRIP, articles 3, 4, 5, 15(i), 18, 19, 20(i), 23, 31, 32, 33, 38, and 42.

¹¹⁸ Botanic Gardens and State Herbarium [n.d.](#); Royal Botanic Gardens Victoria [n.d.b.](#)

¹¹⁹ Conference of Parties to the Convention on Biological Diversity [2024](#).

¹²⁰ See Convention on Biological Diversity [2025](#).

Conclusions

This article has utilized the example of Australian native tobacco biodiscovery in Australia to demonstrate pathways for integrating principles of Indigenous data sovereignty for decolonization of *ex situ* collections and for promoting a rights-based approach. After providing a detailed background to this example and providing the international and domestic legal context for dealing with biodiscovery of genetic resources and associated Indigenous knowledges, this article explores the failings of past and current systems to adhere to the objectives of the CBD and Nagoya Protocol as well as the UNDRIP. Specifically, the authors look to the significance of Indigenous Data Sovereignty principles as a mechanism for the decolonisation of *ex-situ* collections. While exploring Indigenous Data Sovereignty principles and their integration with the human rights principles found in the UNDRIP, this article demonstrates the importance of a grass roots approach with the example of the Maiam nayri Winga Data Sovereignty Collective. This then leads to the three suggested pathways to embedding a rights-based approach to achieving decolonisation of *ex situ* collections. The first is encouraging Indigenous peoples' participation in governance and institutional decision-making. The second is the recontextualization of physical and digital records by embedding metadata utilising Indigenous language and culture. And finally, there needs to be a reliable and consistent synchronisation between databases of Australian public herbaria and virtual databases which aggregate *ex-situ* collections species and location data with Australia's access and benefit-sharing permit system.

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