



Australia's National
Science Agency

Caring for Indigenous Knowledge in the ANH

Preliminary guidelines for managing Indigenous Knowledge
in the Australian National Herbarium



Cultural sensitivity

This document refers to Indigenous ecological and cultural knowledge that has been recorded on specimen labels that are part of the collections of the Australian National Herbarium (ANH). In recognition of CSIRO's commitment to protection of Indigenous Cultural and Intellectual Property, the permissions status of the knowledge contained within the ANH is currently unknown. As such, explicit examples of use and preparation have been redacted in this report.

CSIRO acknowledges the historical research practices referenced throughout this document do not align to CSIRO's current ways of working with Aboriginal and Torres Strait Islander communities and is working to address this in partnership with Aboriginal and Torres Strait Islander peoples.

For more information refer here:
www.csiro.au/about/Policies/Science-and-Delivery-Policy/Indigenous-Cultural-and-Intellectual-Property-Principles

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Acknowledgement of Country

CSIRO acknowledges the Traditional Owners of the lands, seas and waters of the areas that we live and work on across Australia. We acknowledge all Aboriginal and Torres Strait Islander Peoples and their continuing connection to their culture. We pay our respects to Elders past and present. CSIRO acknowledges and thanks the Bininj People in West Arnhem Land who have contributed their Traditional Knowledge to support this publication.

Dr Alexandra Marley/the author would like to especially thank and pay respects to the Djalama clan who gave her permission to stay and work in their family outstation of Mamardawerre. As speakers of the Kunwinjku variety of Bininj Kunwok, it is their dialect that is referenced here with permission.

CSIRO is committed to reconciliation. We recognise that Aboriginal and Torres Strait Islander people have made, and will continue to make, extraordinary contributions to all aspects of Australian life including culture, economy and science.

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HERBARIUM OF THE NORTHERN TERRITORY
Alice Springs, AUSTRALIA

Ipomea costata
F. Muell ex Benth.

Family Convo.

Coll.

Locality 21° 22' 130° 53'
20 km NNW of Chilla Well,
Tanami Desert.

Notes Viney shrub 1m high, flowers pink.
(Virus affected) (Waripiri).

Infrequent on spinifex sand plain.

Reps. NT CBG

IBIS
DATABASE

CBG

1 Introduction

This document has been prepared in response to an audit of Indigenous plant knowledge in the Australian National Herbarium (ANH).

The audit, completed in December 2021, reported on the nature of Indigenous Knowledge (IK) in the Australasian Virtual Herbarium and described the process of how the knowledge was found in existing specimen data (Appendix A.4). This document builds on that initial audit and provides recommendations for how the Australian National Herbarium can begin to better manage and care for IK in the collection.

In addition to the audit, the recommendations here draw from literature by Indigenous scholars working in the fields of museum decolonisation, data governance and sovereignty, and Indigenous Cultural and Intellectual Property (ICIP). I have also drawn from my own work and discussions with Bininj People in West Arnhem Land, with whom I have been working to develop a community owned and controlled medicinal plant encyclopaedia. I am not of Aboriginal or Torres Strait Islander descent myself, and although these recommendations have been informed by Indigenous writers and community members, they will require further development with Indigenous collaborators, stakeholders and advisors to represent Indigenous perspectives.

You may note that I frequently refer to ‘managing’ and ‘caring for’ IK, but I do not use these terms synonymously. By the term ‘managing’, I refer to infrastructural changes that can be made to better find and link IK, such as making a field in a database searchable for IK. I use ‘caring for’ to refer to changes that will ensure respectful and culturally appropriate engagement with the IK, such as identifying the Traditional Knowledge Owners.

The structure of this report is as follows:

1. This **introductory chapter** will provide a rationale for this work and refer to best practice guides for institutions working with and caring for IK.
2. **Chapter 2** will present and discuss the nature of IK in the ANH, including the methodology for tracking down the information, and the current management practices.
3. **Chapter 3** will draw on Chapters 1 and 2 to outline some strategies for beginning to sort through and create a coherent system for managing IK in the ANH.
4. The final chapter, **Chapter 4**, will discuss some of the questions and challenges that arise in developing IK management and care guidelines, and will present some future directions and applications of the project.

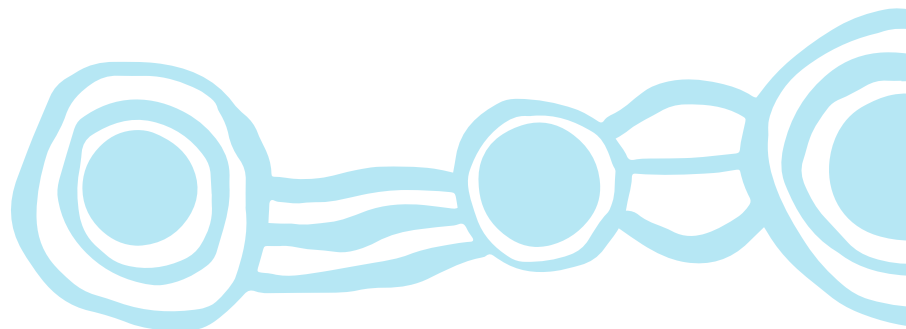


Photo of herbarium sheet showing how indigenous knowledge has historically been recorded on a specimen label. Indigenous plant name, information on use, and specimen accession number have been redacted. Image © CSIRO, Australian National Herbarium.

1.1 Rationale

There is a range of reasons why the Australian National Herbarium should address how IK is cared for. First, IK ultimately belongs to the Indigenous communities and Traditional Knowledge Owners (TKOs) from whom it was collected. Contemporary approaches to data sovereignty and governance (see more in §1.1.1), Indigenous Cultural Intellectual Property protocols (see §1.1.2) and CSIRO's own Reconciliation Action Plan (RAP) all direct and support the development of IK care and management in the ANH. As the ANH now has an understanding of the IK in its collection (thanks to the audit), it is well-positioned to begin the process of acting on these standards of best practice and lead the way in management and care for IK in herbaria in Australia.

Beyond accessibility, attribution and protection, managing IK in the collections also raises questions about how the knowledge is framed, particularly with regard to faithfully representing epistemological differences between knowledge systems. The IK in our collection is structured according to the knowledge frameworks of the herbarium (i.e. a focus on genetic relationships) which means the IK we hold is not being accurately represented. Linking contrasting knowledge systems is not a case of identifying equivalences across languages and cultures, but rather involves navigating multidimensional networks of many-to-one, one-to-many and many-to-many connections between concepts. See section 1.1.3 for more detailed discussion on connecting concepts from disparate epistemologies.

Importantly, this document is not advocating for the collection of more IK but rather is about demonstrating that this institution can be trusted to care for the science and biocultural knowledge of Indigenous peoples that it already has. This report provides recommendations for how the ANH can better manage and care for IK in its collection based on research and consultations, and specifically aims to show how we can:

- Uphold the principles of Indigenous data sovereignty and governance
- Lead the way for Australian herbaria in terms of caring for IK
- Lay down groundwork for future Indigenous-led and two-way science by making data findable, accessible and attributable
- Deliver a measurable step in CSIRO's Reconciliation Action Plan.

1.1.1 Indigenous Data Governance and Sovereignty

Indigenous data sovereignty networks in Australia, Aotearoa New Zealand, Canada and the USA have developed a set of global principles for the governance of Indigenous data (Carroll et al 2020). The two sets of principles – 'CARE' (Collective Benefit, Authority to Control, Responsibility, and Ethics) and 'FAIR' (Findable, Accessible, Interoperable, and Reusable) – are designed to complement each other and intended to be implemented in tandem to any sort of research, governmental or data institute (Carroll et al, 2020: 5). Each element of these principles is outlined below.



Figure 1: The FAIR and CARE principles
(Global Indigenous Data Commons. <https://www.gida-global.org/careprinciples>)

FAIR principles

Findable

The data has sufficiently rich metadata and a unique and persistent identifier to be easily discovered by others. This includes assigning a persistent identifier (like a DOI or Handle), having rich metadata to describe the data and making sure it is findable through disciplinary local or international discovery portals.

Accessible

The data is retrievable by humans and machines through a standardised communication protocol, with authentication and authorisation where necessary. The data does not necessarily have to be open. Data can be sensitive due to privacy concerns, national security or commercial interests. When it's not able to be open, there should be clarity and transparency around the conditions governing access and reuse.

Interoperable

The associated data and metadata use a 'formal, accessible, shared, and broadly applicable language for knowledge representation'. This involves using community accepted languages, formats and vocabularies in the data and metadata. Metadata should reference and describe relationships to other data, metadata and information through identifiers.

Reusable

The associated metadata provides rich and accurate information, and the data comes with a clear usage licence and detailed provenance information. Reusable data should maintain its initial richness. For example, it should not be diminished for the purpose of explaining the findings in one particular publication. It needs a clear machine readable licence and provenance information on how the data was formed. It should also use discipline-specific data and metadata standards to give it rich contextual information that will allow reuse.

CARE principles

Collective benefits

Data ecosystems shall be designed and function in ways that enable Indigenous peoples to derive benefit from the data.

Authority to control

Indigenous peoples' rights and interests in Indigenous data must be recognised and their authority to control such data be empowered.

Responsibility

Those working with Indigenous data have a responsibility to share how those data are used to support Indigenous peoples' self-determination and collective benefit.

Ethics

Indigenous peoples' rights and wellbeing should be the primary concern at all stages of the data life cycle and across the data ecosystem.

Australian Research Data Commons (ARDC)

<https://ardc.edu.au/resource/the-care-principles/>

<https://ardc.edu.au/resource/fair-data/>

The principles provide a framework for ensuring that the ANH is adhering to the global standards of data governance. Currently, we are meeting *none* of these principles, although at a stretch, one could argue that the 'A' (Accessible) in the FAIR principles is sort of achievable but only by those who know how and where to look (discussed further in Chapter 2).

1.1.2 Indigenous Cultural and Intellectual Property

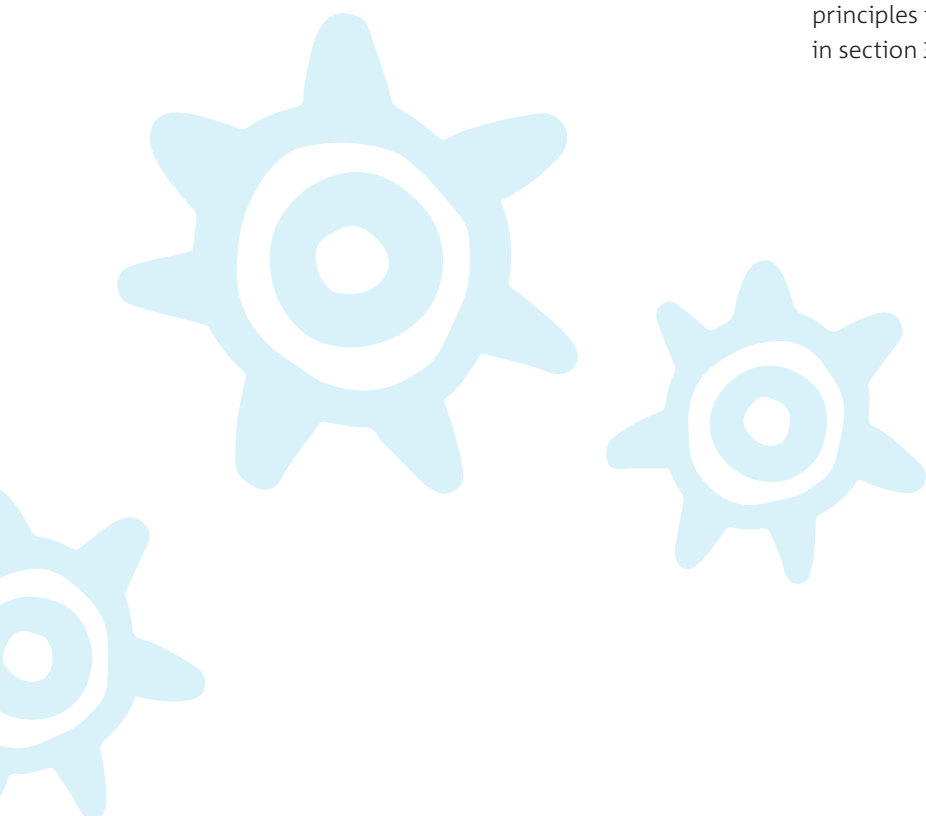
Indigenous Cultural and Intellectual Property (ICIP) rights refer to the rights that Indigenous peoples have to maintain, control, protect and develop their heritage and culture, both tangible and intangible (Article 31, [UN Declaration on the Rights of Indigenous People](#)). This includes, but is not limited to, languages and names, cultural practices, knowledge about plants, animals, land and sea, stories and their meaning, cultural practices, laws, values and governance (see ICIP notice in *Our Knowledge Our Way*) (Woodward et al 2020). The disjunct between Intellectual Property laws and customary Indigenous laws means that ICIP may not be recognised by the legal system and is unprotected from exploitation (Kearney & Janke 2018). For this reason, ICIP protocols need to be developed and adopted by institutions such as CSIRO to ensure that Indigenous peoples maintain authority and control over their ICIP and are appropriately acknowledged and remunerated.

CSIRO has been developing ICIP principles with Terri Janke & Co. Figure 2 outlines the four core guiding principles of ICIP rights at CSIRO. In 2023, CSIRO published its new [Indigenous Cultural and Intellectual Property Principles](#).

It is beyond the scope of this project to explore in depth how these principles can be applied to the IK in the ANH, but there are measures presented here that will help us address them. Importantly, these principles are intertwined, so by working on one we can also facilitate or improve another. For instance, correctly attributing IK (Principle 4) not only addresses the principles of recognition and respect (Principle 1) but informs who can have access to the IK and how it should be engaged with (Principles 2 and 3).

Knowledge in many Aboriginal and Torres Strait Islander cultures is something that is carefully maintained and curated; not everyone in a community has the right to certain knowledge, and access to information may be based on socio-cultural factors such as gender, age, hereditary rights, clan and country affiliation, or role and standing in the community. Furthermore, different people may have different rights and responsibilities as to the knowledge; some may know it but not have the authority to disseminate, while others may have a very specific relationship with the item or concept and so have highly specialised knowledge.

Attributing the IK to not just a community or language group, but to the individual(s) who provided the knowledge (or item), helps maintain the cultural and intellectual integrity of the IK as well as providing more detail as to the sharing rights and accessibility. A discussion on applying the ICIP principles to the IK in the ANH is presented in more depth in section 3.3.6 of this report.



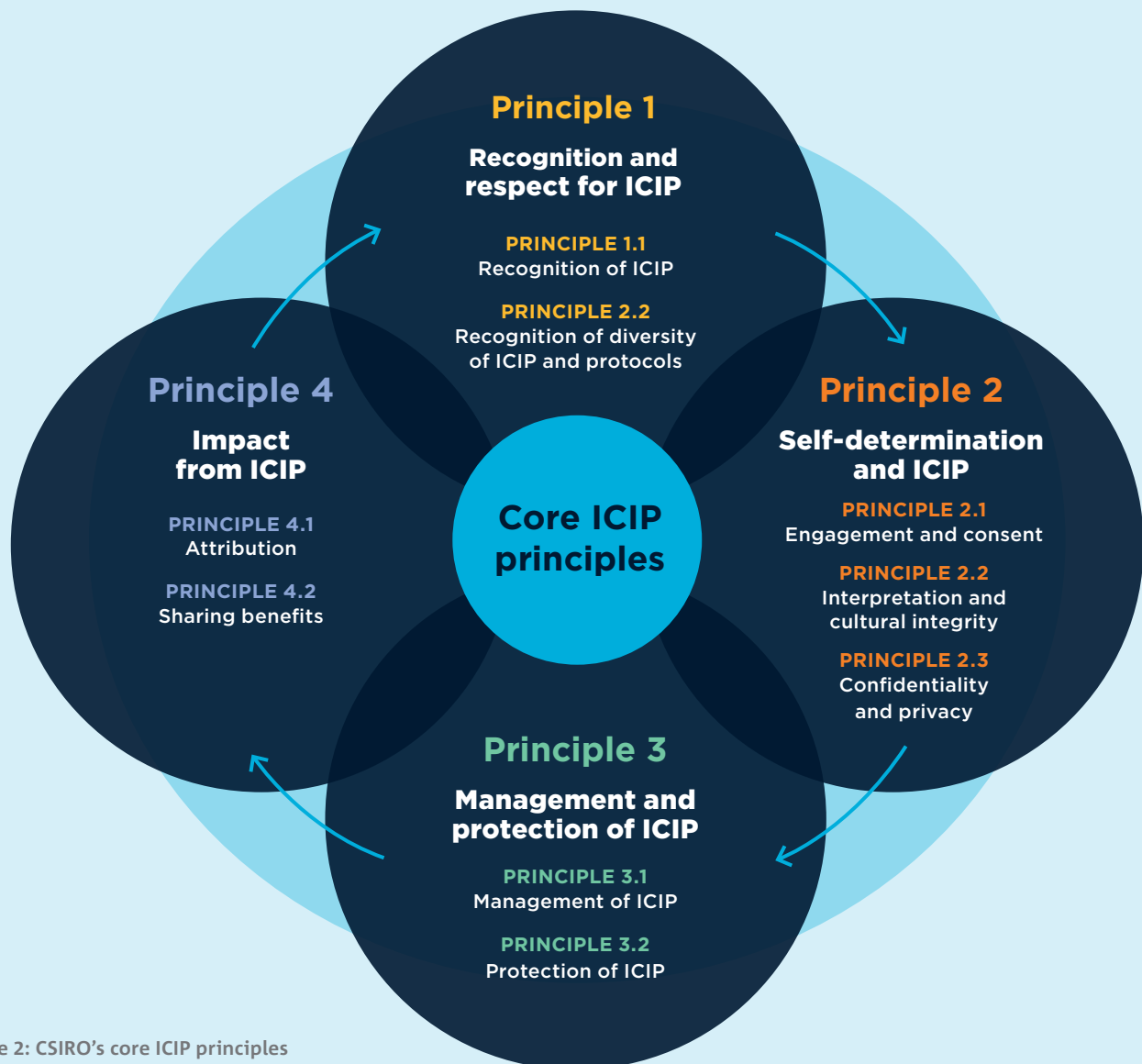


Figure 2: CSIRO's core ICIP principles

1.1.3 Linking epistemologies

Another aspect to consider when engaging with and caring for IK is being cognisant of the different epistemologies that shape and frame the knowledge. A hierarchical and genetic relationship-based taxonomy is but one way in which humans can categorise the natural world, but it is by no means the only way, and crucially it is not a better or truer way. Aboriginal and Torres Strait Islander people have an unsurpassed wealth of experience and knowledge about this continent's environment and natural world, which has been developed over dozens of millennia. How this knowledge relates to and is represented in a natural collection such as the herbarium is by no means straightforward.

IK is not a translation or an 'Indigenous' equivalent of a Western concept but rather embodies and references a whole separate set of experiences, relationships and understandings of the world. Knowledge and understanding are intimately tied to culture, and although there may be parallels or overlaps between these different epistemologies, there is not always a one-to-one relationship between concepts, but rather often a one-to-many or many-to-many relationship.

Some examples of these relationships can be seen when comparing the Linnaean system with that of the Bininj People (West Arnhem Land). A simple one-to-one relationship in the Bininj and Linnaean systems is the classification of *Allosyncarpia ternata* (known as *manbinik* in Bininj Kunwok¹), where there is a unique identifying term for the concept of this plant. *Grevillea decurrens* and *Grevillea heliosperma* provide a more complex example of how systems may differ. In the Linnaean system these are considered two separate (albeit very similar) species, distinguished yet linked by their genetic relationship. For the Bininj, these two species are both called either *manbardbard* or *djenkererr* and differentiated on the basis of whether they grow in lowland woodland (*manbardbard*) or whether they grow up in the sandstone escarpment (*djenkererr*) (Figure 3).

Furthermore, one-to-many relationships between classification systems occur in both directions between IK systems and western taxonomy: *djalamardi* is the common Bininj Kunwok term for local tree orchids (*Dendrobium dicuphum* and *Cymbidium canaliculatum*), while *Acacia sublanata* has two names in Bininj Kunwok depending on whether the specimen is prostrate (*manminem*) or erect (*manbodjdjimiri*)².

We see then that the different knowledge systems are drawing distinctions for classification and nomenclature along disparate lines which don't necessarily correspond. We currently do not have an effective way of representing the complex links between these knowledge systems, as the structure of the herbarium database has been organised to reflect Western/global scientific concepts and knowledge structures, while Indigenous systems group plants and fungi according to their own cultural and scientific frameworks. Armed with this information, we can see why listing *manbardbard* and *djenkererr* as the Kunwok terms for *G. decurrens* and *G. heliosperma* in our collection is not reflecting the nuances salient to Bininj People. Accurately representing IK in a way that is truly representative of IK structure is a much larger project and would involve creating a whole separate database, which could ostensibly link the ANH (we return to this in Section 4.4).

1 Bininj Kunwok means 'Bininj language' and is the name often used to refer to all dialects that the Bininj people speak. Permission to use Bininj plant knowledge granted by members of the Mamardawerre community of West Arnhem land.

2 Permission to share this information granted to the author by members of the Mamardawerre community of West Arnhem land.

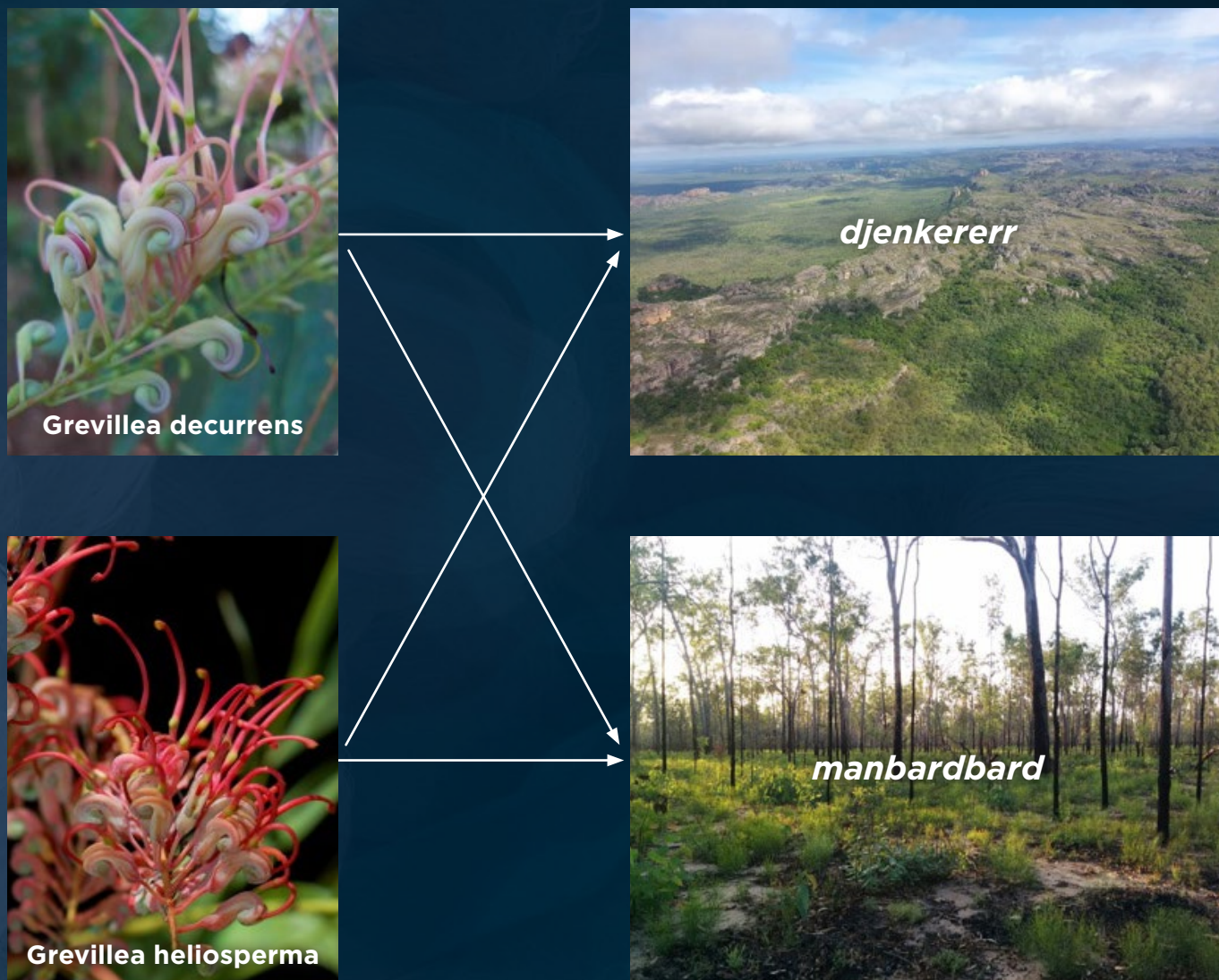


Figure 3: Concept alignment of *Grevillea* species in Bininj culture. *Grevillea* photos credit: Nicolas Smith (www.territorynativeplants.com.au). Landscape photos credit: Alexandra Marley. Permission to use Bininj plant knowledge granted by members of the Mamardawerre community of West Arnhem land.



1.2 What are other collections and archives doing?

To better understand how to address IK in the ANH, we can consider how other departments and institutions are managing and caring for IK. I contacted some of the other herbaria in Australia (§1.2.1) and referred to other CSIRO projects, namely the *Our Knowledge Our Way* document (§1.2.2) and the Atlas of Living Australia's Indigenous Ecological Knowledge project (§1.2.3). Beyond herbaria and CSIRO, there is the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), which is a central resource for learning how to manage and care for IK. Another document that can provide direction is the Indigenous Roadmap for Enhancing Indigenous Engagement in Museums and Galleries developed by Terri Janke & Co and commissioned by the GLAM (Galleries Libraries, Archives and Museums) (§1.2.3).

1.2.1 Australian Herbaria

What are other herbaria doing in this space?

Discussion with staff at a few herbaria around Australia revealed similar experiences, perhaps best summarised by the following response:

We do not currently have any guidelines for the management of IK – we made an executive decision to move all data into a field not shared with data aggregators – largely as we don't have the resourcing to manage the data any other way at this point in time. I proactively did this earlier in the year and may still have missed a few records... Unfortunately, this does now make the data 'dark data' – even if the information is in or has been in the public domain (e.g. was in a published report, previously online, etc). It does, however, remain on the label – and potentially visible on images.

– Staff member at WA Herbarium, 2022

The Australian Tropical Herbarium, which is home to the Tropical Indigenous Ethnobotany Centre, is an exception as it keeps all IK in a separate database run by Miromaa Database system, an Indigenous owned content management system (CMS) that specialises in supporting IK and culture. This database is closed to anyone outside of the community who commissioned or collaborated on the work, but the herbarium houses the specimens which were collected to support the IK.

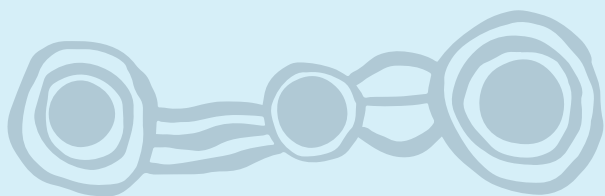
1.2.2 CSIRO

CSIRO has also conducted its own review into supporting IK, particularly with regard to Aboriginal and Torres Strait Islander peoples' expertise in caring for land and sea. In 2020, a publication called *Our Knowledge Our Way* was published jointly by CSIRO, the North Australian Indigenous Land and Sea Management Alliance (NAILSMA), the National Environmental Science Program (NESP), and federal government organisations. The document gives voice to Aboriginal and Torres Strait Islander land and sea Traditional Owners and outlines best practice guidelines for establishing Indigenous-led science and for working with IK. Included in it is a series of case studies which present clear recommendations for IK management that can guide the ANH.

Case study 3-1 (p.63f) by Ngangiwumirri Elder Patricia Marrfurra McTaggart and CSIRO employee Emma Woodward looks at building trust between Indigenous communities and researchers when sharing knowledge. The three main points about Aboriginal and Torres Strait Islander peoples' relationship to knowledge they wished to drive home were:

1. Custodians of knowledge feel an obligation and responsibility to the ancestors to treat knowledge the right way.
2. There is a process to sharing knowledge which may require complex negotiations.
3. It takes time for trust to build between knowledge holders and outsiders before knowledge might be shared.

– McTaggart & Woodward, 2020, p.63–64



These points highlight the importance of appropriately attributing and acknowledging the people who contributed the knowledge and that collections that hold IK have a great responsibility to ensure that the knowledge is being cared for in an appropriate manner. As Patricia Marrfurra McTaggart explains further, her community has granted her the role of custodian of important and sacred knowledge that she has an obligation to care and maintain it, to share it judiciously, and to ensure that whomever she shares it with can be trusted to also respect it (p.63).

This means that while IK is present in our database, it is not necessarily being cared for in the way that the traditional knowledge holders require it to be, and we are failing in our duty of care. To engender trust between the ANH and Indigenous peoples, we need to demonstrate that we are responsible with the information that has ended up in our collection by adhering to basic standards.

1.2.3 The Atlas of Living Australia

The Atlas of Living Australia (ALA) is also examining how IK is shared and represented in its systems. The ALA is a data aggregator and so is not home to records and specimen collections, but it has begun to include IK into its platform through its [Indigenous Ecological Knowledge program of work](#). The IK that herbaria have shared with the ALA, if any, is not currently viewable via the ALA specimen or record pages but can be accessed via the ALA if the whole record is downloaded as a CSV formatted file. (Note that the ANH/CSIRO is not presently sharing its IK with the ALA; see also §2.)

The ALA provides two routes for engaging with IK. The first is via the species profile page (e.g. *Antidesma ghaesembilla*), which centres the western scientific taxonomy and nomenclature and lists Indigenous names associated with that species. IK about the species (such as uses, cultural significance, distribution etc.) are also documented on the page with references to the published sources that this information has been extracted from. Searching for Indigenous terms will only provide results from pages where the term has been lodged in one of the Indigenous plant and animal encyclopaedias created by project leader Nat Raisbeck-Brown and communities (see next paragraph). For example, the *A. ghaesembilla* profile linked above will list at the top of the page a number of Aboriginal language names for the plant, common to Ngukurr NT, and these are searchable in the ALA (e.g. search for *Jubi* (Alawa language) and you will find this *A. ghaesembilla* page again³).

Further down the page in the ‘Habitat and Ecology’ and ‘Uses’ sections, references are made to the names of the plant in a number of other languages (not just Australian languages). Searching for these terms, however, will not yield any results (e.g. *ngujiyi* in Jaru language). So, IK is partially findable in the ALA providing it has been incorporated as a part of the Indigenous Ecological Knowledge project, but any IK documented in the ALA separate to this project is only findable if the user searches via the western scientific taxon.

The second way in which the ALA holds IK is by Indigenous-centred plant and animal encyclopaedias hosted on a ‘Profiles’ page (e.g. the [Southeast Arnhem Land Plants and Animals encyclopaedia](#)), created by Indigenous communities and Nat Raisbeck-Brown. These link Indigenous terms, concepts and IK to the species data in the ALA and allow the user to search via the Indigenous language term. An ICIP rights notice is attached to the encyclopaedia, and the names of the contributors of the IK are also documented.

These encyclopaedias are made by and with communities after extensive consultations and months of dedicated work by Raisbeck-Brown and TKOs, and any limitations with them lie with the underlying structure of the Profiles page, which is templatic and ultimately designed to host less multidimensional knowledge systems than IK. For instance, *A. ghaesembilla* has many names in Ngukurr depending on the language spoken, but unfortunately due to the rather rigid infrastructure of the Profiles page, only one of those terms can act as the entry header and thus be the search term. This means for *A. ghaesembilla*, the user will get a result if you search for *Jupi* (the Kriol term), but no results for *Jubi* (Alawa), *Gumirr* (Marra) or *Djupi* (Ritharrngu).

In any case, the encyclopaedias are useful resources for the communities who created them and provide valuable insight into the shape a relational database would need to take in order to accurately host and represent IK.

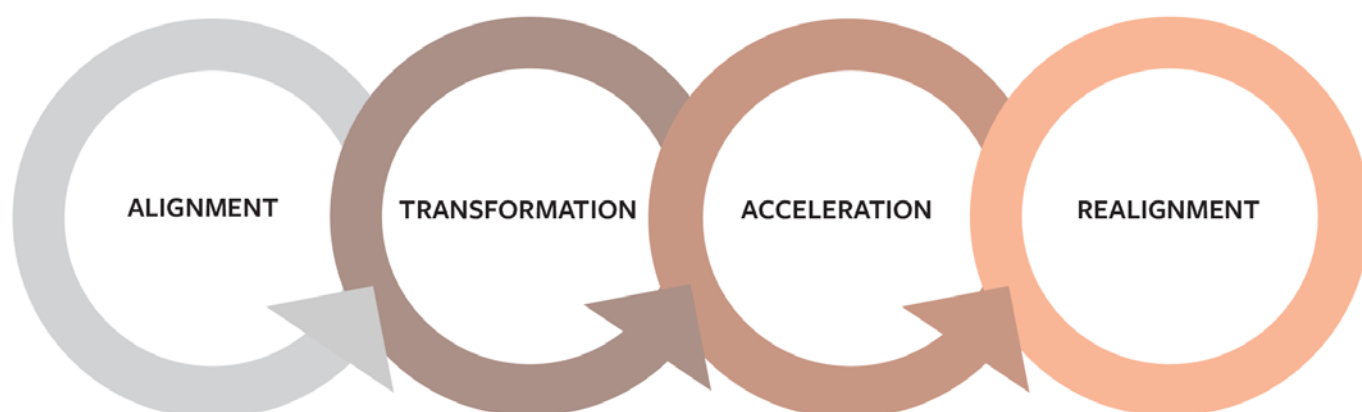
1.2.4 AIATSIS

In addition to preserving and providing access to a repository of Aboriginal and Torres Strait Islander culture and heritage, AIATSIS is a vital resource for providing guides for [ethical research](#) and [policies for engaging with Traditional Owners and IK](#). Access to their collection is either via remote request or in-person at the site in Canberra but is mediated through an archivist and requires signing usage and ICIP agreements. Access rights are individually negotiated between the depositor, the community, and AIATSIS, which means there are many different arrangements that we can draw from to inform our own approach to ICIP. They have also developed a system of content warnings and notices, some of which have been adapted in this report to illustrate how we might go about phrasing our own notices (Chapter 3).

1.2.5 GLAM sector

In 2018, Australian Museums and Galleries Association commissioned Terri Janke & Co. to develop guidelines for improving Indigenous engagement with GLAMs (Galleries, Libraries, Archives and Museums). The resulting document, [First peoples: A roadmap for enhancing indigenous engagement in museums and galleries](#) (Janke and Grant, 2018) identifies four processes in the ‘Critical Pathways’ towards achieving their goals: Alignment, Transformation, Acceleration and Realignment (see Figure 4).

3 Unfortunately, searching by language, e.g. searching for Alawa, will not lead to a comprehensive list of results with all the entries that contain Alawa language.



CRITICAL PATHWAYS

Alignment

1. Statement of Reflection
2. Create Reconciliation Action Plans
3. Run Cultural Competency Workshops
4. Update Policies
5. Indigenous Cultural and Intellectual Property Protocols
6. Identify all cultural material and create inventories for Indigenous communities

Transformation

7. Create National Indigenous Staff networks
8. Create National Coordinated Programming
9. Amplify Truth Telling Exhibitions
10. Develop Indigenous education to employment opportunities
11. Champion Indigenous staff in leadership roles
12. Continue increasing Indigenous employment

Acceleration

13. Develop relationship agreements with Indigenous communities
14. Indigenous led and designed projects
15. Repatriate all ancestral remains
16. Establish National Keeping Place
17. Create Workshops to train communities
18. Develop partnerships with Aboriginal Keeping Places

Figure 4: Critical Pathways, Janke and Grant (2018: 9). Used with permission.

Some of the steps listed here are not necessarily applicable to the ANH – for instance, it is unclear what the demand for repatriating plant specimens would be – while others are being dealt with at an institutional level (the creation of a Reconciliation Action Plan). Nevertheless, some of the goals outlined here are useful for helping the ANH map a way forward. The audit of IK in the ANH has initiated step 6 of the Alignment process: identify cultural material and create inventories for Indigenous communities, but a future step would be suitably applying CSIRO's draft ICIP protocols (Step 5) to our database and practice.

2 IK in the Australian National Herbarium

The data discussed here was collected from the Australasian Virtual Herbarium (AVH) in October 2021 and therefore does not include some additional records found to contain IK after this time. A full report on the nature the IK in the AVH at that time is available in appendix A.4. From this dataset, the relevant information about IK in the ANH has been extracted. It should be noted that since this extract has been obtained, CSIRO has moved IK of its herbarium records out of database fields that are delivered to the AVH and other aggregators, so that they are no longer public. This means that they can now be managed and cared for appropriately, but also that the approach taken to produce the present report is no longer reproducible.

2.1 Where is the IK?

In the ANH, there are at least 800 records with some sort of associated IK (see Table 1). The number is approximate because there is no straightforward and reliable way to identify records that have IK. Historically, as there were no dedicated fields to hold IK, registrars have tended to put IK notes into one of three fields – ‘occurrence records’, ‘event remarks’ or ‘location remarks’. These fields are unsearchable via the usual search portals (i.e. [ALA](#), [AVH](#), or [ANHSIR](#)), and the only way to get at this data is to

download the records themselves (e.g. as a CSV/TSV file) and then scour that file for key words that may indicate some sort of IK.

For the audit, I ran keyword searches in the relevant fields (listed above) to identify records that might reference IK. These keywords included terms such as ‘clan’, ‘food’ or ‘Indigenous’, as well as partial terms such as ‘Aborigin*’ or ‘medicin*’. I also ran searches for combinations of letters often found in Australian Aboriginal and Torres Strait Islander languages: ‘ng-’, ‘yn’ or ‘nj-’. These captured the majority of the records with IK, but as this method does not guarantee that all the records with associated IK are found, there may be a small number yet unidentified in the ANH. Another limitation to this process is that it only captures IK that has been databased, so there may be IK recorded on the specimen voucher sheet that has not been typed into the database and accounted for.

(Note: Since the original drafting of this report in 2024, the ANH conducted another search for any IK that may have been missed previously. It identified another 83 ANH database records and 65 specimen images containing IK. They are not included in the audit results presented below and in Appendix 4, but their IK has also been removed from public databases.)

Table 1: Records with IK in Australian herbaria (from AVH) in October 2022

HERBARIUM/COLLECTION	FUNGI	PLANTAE	TOTAL
Australian National Herbarium		800	800
Australian Tropical Herbarium		11	11
iNaturalist		5	5
James Cook University Herbarium		15	15
N.C.W. Beadle Herbarium		6	6
National Herbarium of New South Wales		342	342
National Herbarium of Victoria	1	2	3
Northern Territory Herbarium	18	1378	1396
Queensland Herbarium		218	218
State Herbarium of South Australia		25	25
Tasmanian Herbarium		5	5
The Janet Cosh Herbarium		2	2
Western Australian Herbarium	7	575	582
TOTAL	26	3384	3410

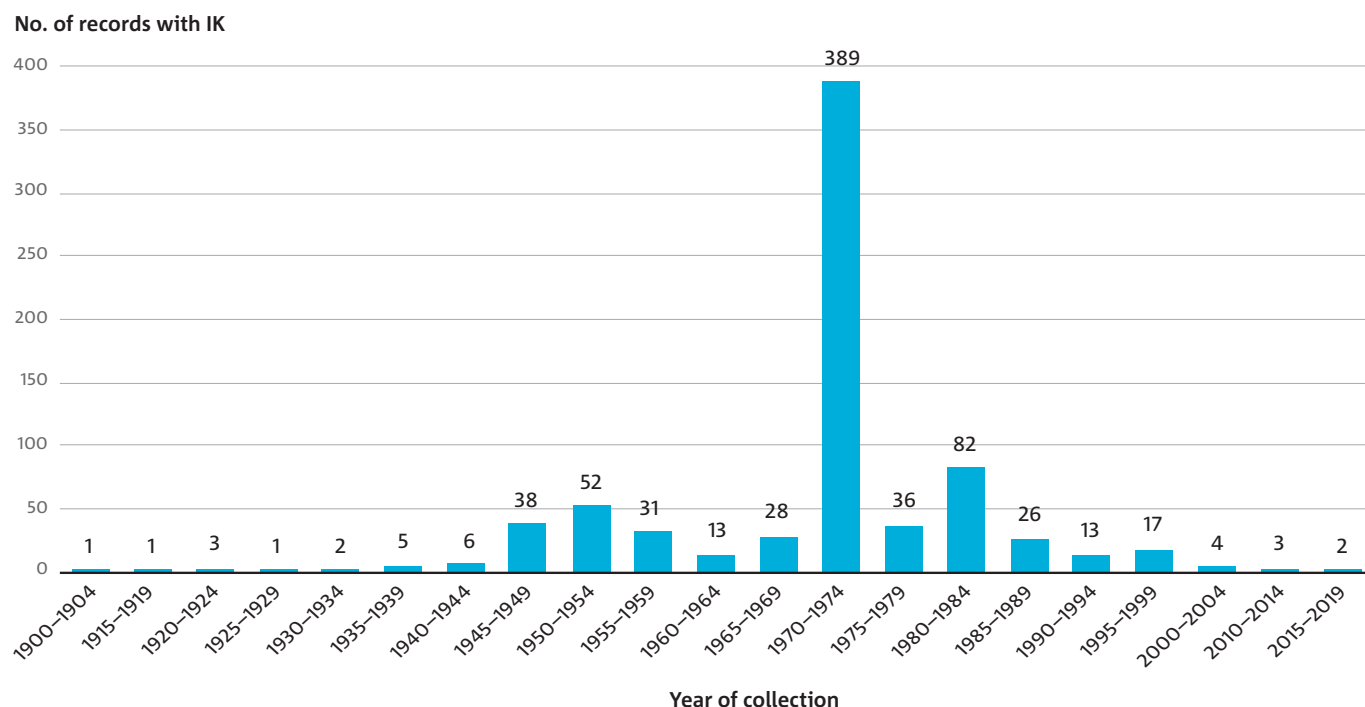


Figure 5: Distribution of IK records by collection year. Blank records mean no date was recorded.

The majority of the records were collected between 1945 and 1990 (see Figure 5). A number of records do not have a collection date attached, but a good proportion of these (42 of the 47) were plants vouchered for L.J. Webb's paper on Indigenous medicine and poisons published in 1969, so were likely also collected in the mid-20th century.

H. Reeve was particularly productive in 1972 and 1973, collecting close to half ($n=366$) of all the IK records in the whole ANH from Yolŋu communities in East Arnhem Land. Due to the age of some of the records, I also found references to IK using terms now considered offensive. This is discussed further in section 3.2.

2.1.1 Defining IK

For the purposes of the audit, the definition of IK was kept broad, and anything that mentioned Aboriginal or Torres Strait Islander language, knowledge or a community in any way was included as containing IK. Not all the records collected in this manner have IK explicitly recorded but may link to another source. For example, a specimen at the ANH collected by L.J. Webb notes that this specimen

is the 'Voucher for identity of plant mentioned in: Webb, L.J. (1969). 'The use of Plant Medicines and Poisons by Australian Aborigines'. *Mankind* 7, pp. 137-46.'

In terms of sorting through the IK itself, I created new fields in the dataset to be able to code for:

- Traditional Owners of the IK, language, and country where the plant was collected
- the Indigenous name(s) of the plant
- the uses of the plant
- whether a description of preparation of plant is included
- whether the name of the person who provided the IK had been recorded
- whether the IK includes reference to ceremonial functions or men's and women's business.

While this was very useful for gaining an understanding of the type of information that has been captured in the collection over the years, for the immediate purposes of designing preliminary guidelines for caring for IK in the ANH, the most pertinent information fields are the last two on this list: Traditional Owners and Traditional Knowledge Holders.

2.1.2 Traditional Owners and Traditional Knowledge Holders

There are around 116 Aboriginal and Torres Strait Islander peoples⁴ who have data represented in the ANH (a full list available in appendix A.1), the most frequently attested being Yolngu clans⁵ from East Arnhem Land, NT with around 368 records.

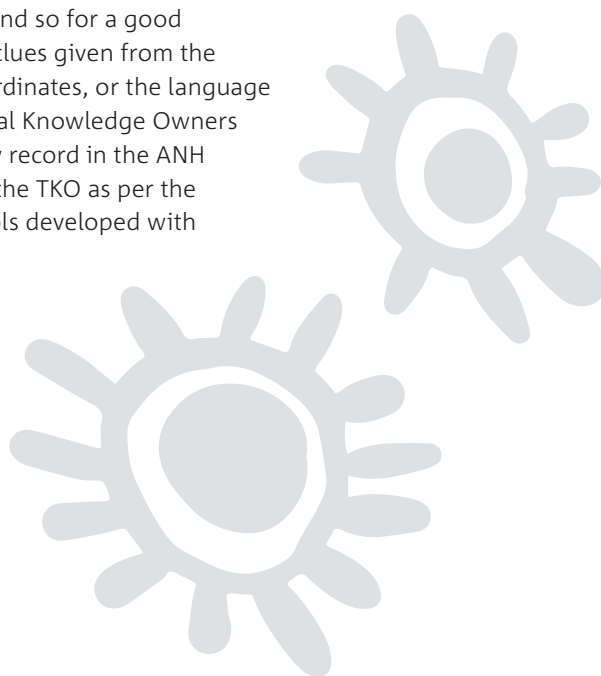
Table 2: 10 most common Traditional Owners in the ANH

PEOPLES	NO. RECORDS IN ANH
Yolngu (East Arnhem Land, NT)	368
Anangu (Uluru & Kata-tjuta NP, NT)	98
Ngarinyin (Kimberley, WA)	62
Djagaraga (Cape York, QLD)	19
Nyikina (Limberley, WA)	16
Warlpiri (Tanami Desert, NT)	16
Bunuba (Kimberley, WA)	15
Bininj (West Arnhem Land & Kakadu NP, NT)	13
Anindilyakwa (Groote Eylandt, NT)	11

Collectors did not always include the name of the peoples from whom they had collected IK, and so for a good portion of the dataset I had to use clues given from the community name, the location coordinates, or the language data to ascertain who the Traditional Knowledge Owners (TKOs) were likely to be. Ideally, any record in the ANH with IK would include the name of the TKO as per the acknowledgement and ICIP protocols developed with the Indigenous community.

For some communities, this may be at a clan level, while for others the knowledge might be attributed to a broader ethnolinguistic group. In any case, it is for the Indigenous owners to decide, but as that information has not been included in many of the records, I have identified as best I can the TKOs of the unattributed IK in the records.

In a small number of instances (n=30), the collector⁶ included the name of the person(s) who provided the IK (e.g. example 3). For the purposes of this document, I make a distinction between the community or group who own the IP (the TKOs) and the person(s) who provided the IK to the collector, the Traditional Knowledge Holder (TKH). The Appendix of this document contains a full list of the TKOs in the ANH dataset. Sections 3.3.1 and 3.3.2 will discuss how this information can be more clearly represented in the ANH.



⁴ This is a rough estimate, as how groups identify themselves differs. Language or dialect is a common but not necessarily truly representative way to group Indigenous peoples, as clan, moiety or community may be a more salient identity marker for the peoples in question. In instances where the only identifying information available was language or a community, I deferred to the broader endonym for speakers of that language. In cases where multiple languages were spoken in that community, I listed all the endonyms for those speakers.

⁵ Yolngu clans that are listed in the ANH: Buthugurrulili, Buyuyukululmirri, Dabi, Djambarrpuyngu, Djinarj, Djinba, Gamalaja, Ganalbiru, Gupapuyngu, Guyamirrili, Garku, Liyagalawumirri, Mildjini, Murrungun, Ritharrngu, Wanjurri, Warramiri, Warrnga, Wolkpuy, Wulaki.

⁶ Arpad Kalotas being the most diligent record keeper in this regard.

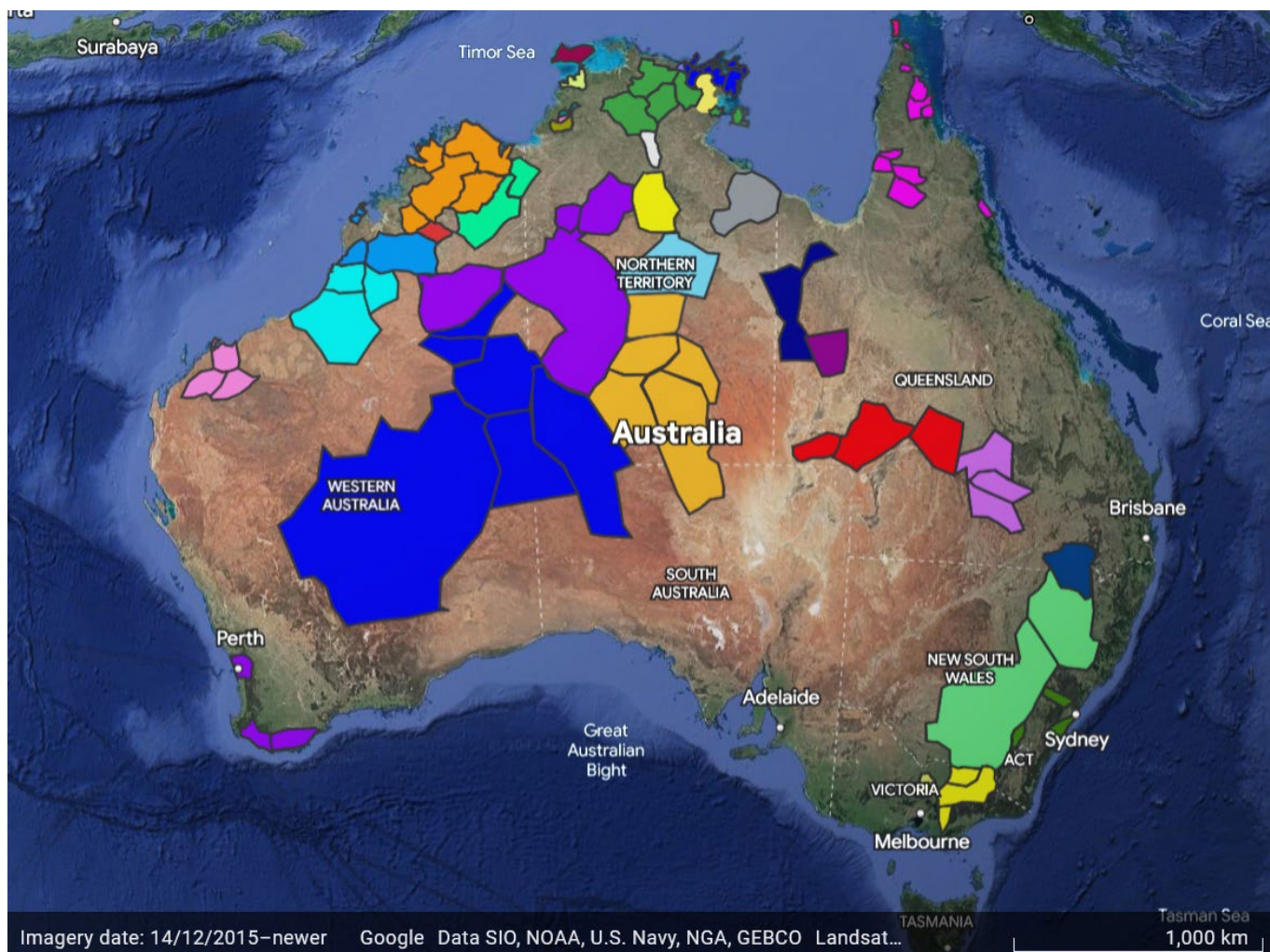


Figure 6: Language data represented in the ANH

2.1.3 Plant name and languages

Over three quarters of the records with IK included at least one term for the plant in an Australian language (n=602). Occasionally, the collector would include the name of the plant in several of the local languages or dialects (example 1) or would provide terms referring to specific parts of the plant (example 2):

Example 1: Bardi and Nyulnyul languages

Vine. Bardi name = (██████ = ██████).
Food: edible fruit ('██████').

Example 2: Yolŋu Matha

The berries are black and pointed towards the end.
See ██████ for details of use etc.
██████ = fruit ██████ = tree

Unfortunately, as can be seen in Example 2, the collector did not always include the name of the language(s) that the term(s) came from, and so determining that required some linguistic detective work. Of the 602 entries with a language term in the ANH dataset, around a third (n=213) had the language name(s) included (as in Example 1).

Around 116 languages or dialects are in the ANH, shown in the map in Figure 6. Each language is represented by a polygon roughly aligning with the region where that language is spoken. The colours represent language families. A list of the languages in the ANH dataset is available in the A.2.

2.1.4 Preparation and use

Collectors also often included some basic information about the use of the plant and occasionally even went into specifics about how it was prepared for use (example 3).

Example 3: Use and preparation of [REDACTED] by Burarra speakers

From a number of plants within 5 m of another. Tubers. Not 'poisonous' / 'cheeky'. Cooked in ashes and eaten after short time. Aboriginal name: [REDACTED]. Informants: [REDACTED] and [REDACTED]. Nature of sample: storage organ. Purpose: anatomical studies.

Around 43% of the ANH IK records (n=340) mention the use of the plant, and I categorised the uses so that the records could be sorted by this field. The most common reported use was food, followed by medicinal purposes. Some records mention the cultural or spiritual function of the plant, and in a handful of cases, the collector explicitly notes that the plant has sacred knowledge associated that is not documented there. All but one of the records with spiritual and cultural uses documented (n=24) are from Yolŋu clans in East Arnhem, collected by H.R. Reeve in 1972⁷. A full list of the uses is available in appendix A.3.

Notes on how the plant was prepared for use was only included in a little over a quarter of the ANH IK records (n=210), and I separately coded for this information on the basis that while some TKOs may be happy to share information about what the plant is used for, the actual way in which it is prepared may be information that they wish to restrict. This may not just be for protecting IP, but also due to the TKH's responsibility to protect people from harming themselves or others through misuse of the knowledge.

Ultimately, whether or not this information should be accessible to researchers or the public is a question only the TKOs can answer, but we will return to this issue in Chapter 3 to discuss possible approaches to better caring for such knowledge.

2.1.5 Cultural functions and gender restrictions

The last element I coded for was whether the IK included by the collector could be construed as restricted, either because it references confidential cultural practices or on the basis that the IK is privileged to a certain gender. A number of plants, for instance, are mentioned as being pertinent to particular ceremonies. As an outsider, I cannot judge whether reference to these ceremonies and the uses of the plants within them is permitted by the communities, but again it is up to the TKOs to decide the access rights to this information.

The same goes for knowledge which is restricted on the basis of gender. Often knowledge about the application of plants and fungi for 'women's business' and the information about the identification and preparation of these remedies is protected. Likewise, 'men's business' is also kept safely guarded from members of the opposite gender. Of the ANH dataset, only 8 records were flagged for containing some sort of reference to gender-restricted knowledge and for all but three of these, the collectors have not included any detail except that there are gender restrictions about the use of the plant (e.g. example 4).

Example 4: Reference to men's business

Tree. [REDACTED] Clans: probably several. The tree is very important in songs but its role is secret and known only to men.

For the remaining three that do have more information about the uses of the plants, we will need to consult with community members about what the appropriate measures are regarding access (discussed further in §3.3.6).

⁷ The other record is from Nyikina people in the Kimberley, NT, collected by L.J. Webb in 1968.

3 Immediate ways forward

This is a preliminary guide for how the ANH can begin the task of caring for IK in its collection. The suggestions here are open to amendment and further development, especially as we learn what works and what will not. In the first draft of this document, I had proposed auditing the other NRCA collections for IK as a next step for expanding the scope of the plan of management/care for IK. However, after a quick survey of the Australian National Wildlife Collection’s (ANWC) ca. 217,000 records available from the ALA, there is no indication that the ANWC currently has any IK in its possession. The same applies to the records in the Australian National Insect Collection (ANIC). The scope of these recommendations for caring for IK has hence been limited to the ANH, but with the intention of being applicable to other Australia herbaria.

In developing a system of management, I have identified the following steps:

The first two steps in this process, identifying IK in the ANH and identifying IK fields, have been completed (discussed in Chapter 2). The third step, tagging of the records in the collection with IK, has been completed since the first draft of this report (see §3.1).

With these steps completed, the ANH is in a position to roll out stage 2 (see Figure 8 below). This will include cultural safety measures, specifically by including notices informing people that some of the records may contain names of deceased peoples or may contain language or terms that may cause offense (§3.2). This stage will also involve determining how to appropriately acknowledge and attribute the IK to the TKOs in the record and developing a strategy for managing community requests to update TKO attribution or hide the record from public viewing. This latter task will also depend on how the new Specify 7 specimen database system can hide sensitive information (i.e. at a record level or individual field level).

I consider these the fundamental steps in developing guidelines or a charter for managing IK in Australian herbaria. These will ensure the herbarium meets the F (Findable) and A (Accessible) of the FAIR principles and go towards achieving the A and E in the CARE principles (Authority to Control and Ethics) (refer back to §1.1.1 for these concepts).

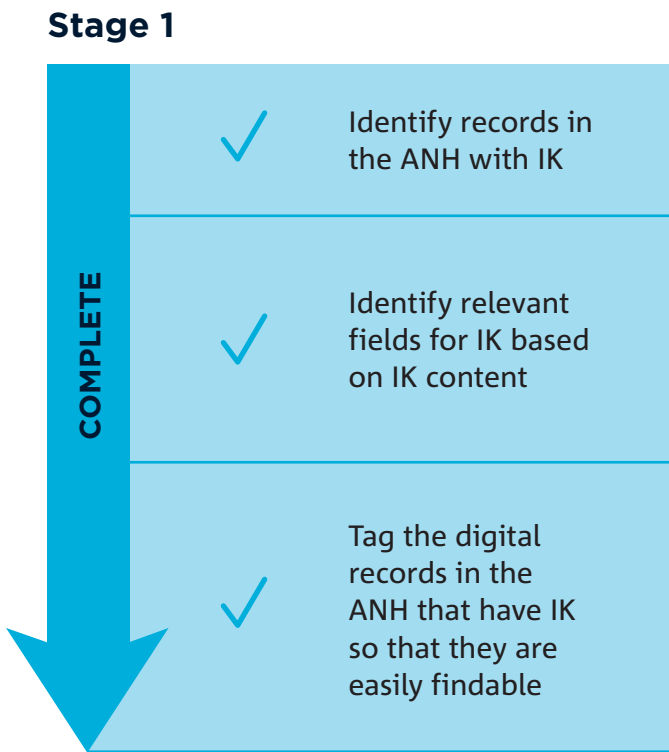


Figure 7: Stage 1 of developing an IK management plan for the ANH

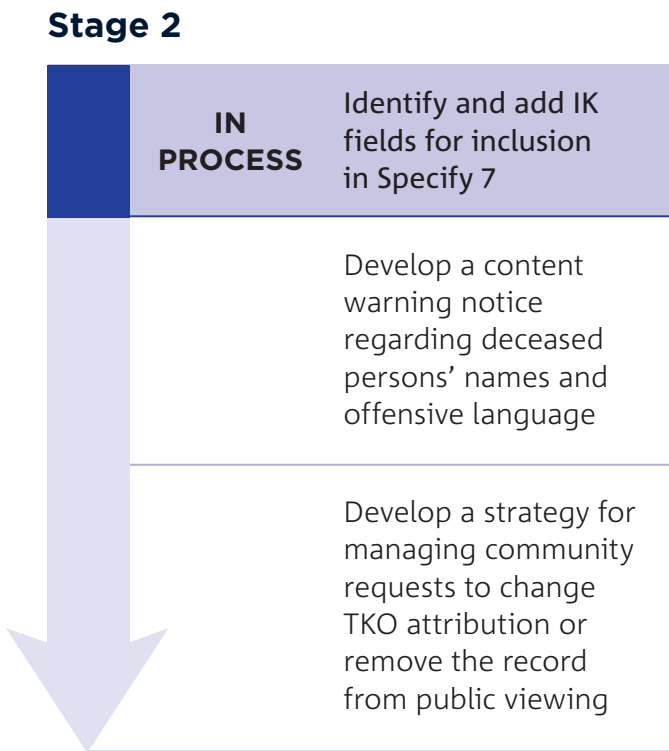


Figure 8: Stage 2 of developing an IK management plan for the ANH

3.1 Tagging records with IK

The ANH has recently migrated its Content Management System (CMS) from ANHSIR to Specify 7, and so this review has come at a convenient time. After consulting with colleagues involved in the rollout of the new system, one relatively straightforward first step for tagging IK has presented itself. In the previous CMS, there was an option to tag records as containing ethnobotanical information by clicking a check box on the record entry screen (Figure 9).

This option is not frequently used but indicates that there is at least a rudimentary mechanism already in place for tagging records with such information.

There was also no way to search for records that have this field toggled (either within the CMS or via one of the online search pages) except for contacting the database manager to run a query⁸. Migrating this toggle across to the Specify 7 CMS has ensured that not only are the entries now easy to extract but also records containing IK that had previously been missed have now been flagged accordingly.

The screenshot shows the ANHSIR entry form for the Australian National Herbarium (CANB). The form includes fields for herb_code, Acc_no, collector (Brooker, M.I.H.), field number (1627), habit, notes (Duplicate from GAUBA herbarium. Lat/Long is a Precision 4.), comment, Hort label, and suffix. Below these are tabs for Collection Detail and Collection Metadata. The Collection Metadata tab is active, showing fields for Plant origin (wild collection), herb. items (2), herb. material (H), replicate no., gardens material, replicates to, local abundance, naturalized?, ethno? (circled in red), vernac?, exsic?, and ROTAP voucher. The bottom status bar indicates 'Record: 1/1'.

Figure 9: Screenshot of ANHSIR entry fields with ethnobotanical information option (circled in red)

⁸ Many thanks to Dan Baker for running a search for me. His search found 732 records in the ANHSIR with the 'ethno' field toggled on; 144 of those were the same as those that I identified in my initial search (n=768), meaning there were 588 records flagged as containing ethnobotanical information that I did not find. Only 62 of these were Australian specimens (the rest mostly collected from PNG, Indonesia, the Philippines and the Solomon Islands). 13 of the Australian records had IK explicitly mentioned, while 19 were vouchers for printed manuscripts on ethnobotany but with no actual ethnobotanical data noted in the record. This brought the total ANH records found with IK from 768 to 800 records. The records with no obvious IK in the occurrence remarks field but tagged as having ethnobotanical information may have been tagged because many of them were collected close to Aboriginal communities or in an Indigenous Protected Area (IPA) or because there is IK data on the voucher sheet that has not been databased.

In addition to making records containing IK quickly findable, this step also puts the herbarium in a better position to hide records (and potentially fields) that contain sensitive information. Historically, the ANH could only hide *the whole record* from public viewing rather than individual fields that might contain sensitive information such as location data. Collection managers flag the record to be hidden from outside viewing by entering 'restricted access due to sensitive locality' into the 'Comments' field of the CMS. All records going into the AVH/ALA from the ANH are then filtered for this key phrase (providing it is in the correct field) and are not included in the upload to the public system. This is a little clunky, but as managing records with sensitive information is a broader puzzle for the ANH, it is being addressed by the migration team during the transition to Specify 7.

Whether or not to hide records that contain IK is not just a technical question but also an ethical one. The Western Australian Herbarium and National Herbarium of Victoria have opted to hide all records with IK until they can establish a way to share the knowledge safely and respectfully in the records, and this is a route which the ANH could have taken too, given that we now know the records that have some sort of IK. However, this creates dark data, which will make it even harder for anyone to find, not just the TKOs.

Removing the whole record removes knowledge of its existence, and acting as a gatekeeper for information which is not ours puts us in a very dubious moral and legal position. An option is to instead keep these records open and findable but flag them with a warning about containing IK. This will allow a space for TKOs and the herbarium to discuss how to proceed with the records, and there is precedent for this at AIATSIS. AIATSIS have a page allowing for concerned parties to contact them regarding the public availability of content (<https://aiatsis.gov.au/about/connect-us/contact-us/takedown-request>), which we can model our own on.

The notification wording would need to be developed through a consultative process but should provide a contact for people to reach out to, for example:

This record has been tagged as containing Indigenous Knowledge. Indigenous Knowledge is recognised by CSIRO as Indigenous Cultural and Intellectual Property. If you feel that this information should not be public, please contact info@canbr.gov.au, and we will remove it from public viewing.

The third option, taken by the ANH, is to keep the specimen records that contain IK open but restrict access to the IK itself. To do this, the herbarium has transferred IK to a new database field that is not delivered to aggregators like the ALA. However, specimen images containing IK are being hidden in their entirety from CSIRO's Data Access Portal.

3.2 Dealing with derogatory and outdated language

Some of the records with IK make references to Indigenous peoples in ways that may be considered offensive. This is not a problem unique to the ANH or herbaria, and we can turn to AIATSIS for guidance on how to warn people of possible offensive content. A first step is to include a notice with the one above that the record may contain language or terms that are considered offensive. The exact phrasing will need to be formulated by an appropriate team of people, but I have included the following as an example (adapted from [this AIATSIS notice](#)):

Some records contain words, descriptions and terms which may be culturally sensitive and that reflect collectors' views, or those of the period in which the content was created, but may not be considered appropriate today.

Terms and annotations which reflect the collector's attitude or that of the period in which the item was written may be considered inappropriate today in some circumstances.

These views are not necessarily the views of CSIRO. While the information may not reflect current understanding, it is provided in an historical context.

3.3 IK fields

Although all IK in the ANH has now been transferred into a dedicated database field, new fields could be introduced into the CMS to help refine searches for specific IK information. To start caring for IK properly, the most important step is to attribute it to the right community and knowledge holders. There are other fields that can be added, such as the language, the language term(s), preparation and use, and even ISO or Austlang codes to link the data to external sources, such as AIATSIS.

Not all of these IK fields may be adopted, as it will depend on how many ‘spare’ fields are available in Specify 7. Table 3 lists the priority level of each of these fields, with 1 = imperative, 2 = important, 3 = useful. I will address each of these in turn in sections §3.3.1-3.3.5 and then discuss some additional fields for consideration (§3.3.6).

Table 3: Priority list of IK fields

FIELD	PRIORITY LEVEL
Traditional Knowledge Owner (TKO)	1
Traditional Knowledge Holder (TKH)	1
Language(s)	2
ISO-639 code/Austlang code	2
Language Term(s)	3

3.3.1 Traditional Knowledge Owners

The first field that should be introduced is ‘Traditional Knowledge Owner(s)’. This refers specifically to the clan, community or mob to whom the intellectual property belongs. Being able to search by this field would also allow for Indigenous communities to track down records that are relevant them.

Unless the collector has included the name by which the TKOs have identified themselves, there is the potential to misidentify the TKOs. As covered in section 2.1.2, many of the records in the ANH provide sufficient information to be able to narrow the TKOs down to a peoples or language group, but there are records where I have listed multiple possible TKOs. Depending on future engagement with Indigenous communities and advisors regarding care and management of IK, there may be opportunities to address these speculative TKO attributions.

3.3.2 Traditional Knowledge Holder

A second field is ‘Traditional Knowledge Holder(s)’ (TKH), and unlike the TKO field, it will not be possible to retroactively fill for most records where this information is missing. This field will provide the name(s) of the person(s) who provided the information. This is particularly important for the management of IK, as for many Aboriginal and Torres Strait Islander cultures, it is very important to know who provided the information (as covered in §1.1.3).

Including the name of the person(s) who provided the information will also require a notice about the possibility of encountering the name of a deceased person to ensure some measure of cultural safety. The following has example has been adapted from the AIATSIS website:

Aboriginal and Torres Strait Islander people should be aware that this record may contain the name of a deceased person.

3.3.3 Language

If the Indigenous name(s) of the species is provided, the name of the language or dialect should also be provided. Of the IK data in the ANH, around a third provided the language name when an associated Indigenous plant name was provided (n=213/594). For some of the remaining records, I have been able to identify the language, but in other instances, I have had to guess which language it may be, based on the location of where the specimen was collected or the linguistic structure of the term. In these instances, the language name is marked by a ‘?’. There are also cases where a number of languages are potential candidates; this is particularly so in areas of high linguistic diversity (such as Maningrida).

In cases where there are multiple languages or dialects recorded, all are listed in the ‘Languages’ field, but the accessor will need to view the ‘Notes’⁹ field of the record if the need to clarify which term matches to which linguistic variety. This is not a very elegant solution to matching terms and languages, but given that the database is not designed for representing this kind of data, and that there is so little of it, this seems to be the simplest approach until the ANH or NRCA are at a stage to consider a separate but linked database for IK.

⁹ At the time of writing, it was not clear what the fieldnotes/collector’s comments field would be called in the Specify 7, so it is here referred to as ‘notes’.

3.3.4 Term(s)

This field will include the names or terms in language of the specimen, if the collector has included that information in the record (e.g. see examples 1, 2 and 3 on pp15–16). Collectors have often included multiple Indigenous names or terms for a species, for a variety of reasons. Some of the nomenclature differences may be due to dialectal distinctions (e.g. example 3 on p16). Sometimes the collector has included the names for parts of the plant (e.g. example 2 on p15). Different terms may also reflect a different classification system with distinctions drawn between, for example, phenotype, habit, maturity or size (as discussed in §1.1.3), but I have no confirmed example of this in the ANH dataset.

I have checked the language term in 354 of the 594 records with linguistic data by cross-checking the term with relevant language resources. To clarify, this process *does not* involve assessing the meaning or application of the term, but rather, involves confirming the language or dialect, or updating the spelling to make the term consistent with the modern orthographic representations of the language. In cases where I have been unable to confirm the language, I have left the spelling as the collector wrote it. Further cleaning of this data may be required at a future date.

This field would not provide any other information except for the term, and so to clarify the meaning of the term or identify the language, one would have to turn to the ‘Notes’ field (where the collector’s original comments will be held) or the ‘Language’ field respectively.

3.3.5 ISO and Austlang codes

ISO 639-3 codes are the three-letter international standard nomenclature for languages. Including this code allows for the linguistic data in the record to be connected to related data regardless of language name changes, spelling differences, or dialectal distinctions. In a similar fashion, Austlang codes are also unique identifying alphanumeric combinations that AIATSIS has developed for Australian languages. These allow for more nuance than the ISO codes as they make finer distinctions between Australian languages and dialects, and they also potentially allow for the record to be linked to the AIATSIS database.

Linking to AIATSIS would grant Indigenous people searching for information about their communities a greater chance of finding IK in the ANH. Linking to AIATSIS will require liaising with a team at that institute, but from discussions with the AIATSIS Languages team, this is something that they would be keen to support.

3.3.6 Other IK fields

In addition to these categories, there are more detailed fields or tags that can be added, depending on feedback from reviewers of this document and those involved directly in the structure of the ANH’s new CMS. While auditing IK in the ANH, I was interested in understanding what sort of IK collectors had documented and tagged each of these records for the uses collectors listed and whether the collector had provided more detailed instructions on the preparation. There are a few ways to proceed if there is a need to have information about ‘Use’ and ‘Preparation’ marked in some way, which I discuss below.

Use

The first approach is to have a simple Yes/No tag on the record as to whether any mention of use is included in the ‘Notes’ field, which the accessor will then have to look up themselves. The second is to draw from a list of uses (as shown in A.3) to append to the record, but which the actual details of are still in the ‘Notes’ field. For example, if the collector has mentioned that the leaves of the plant in question can be used as a decongestant, and the wood is used to make woomeras, the record may record use as ‘medicine’ and ‘weapon’. People accessing the record will still need to read the ‘Notes’ field for more detail, but it would potentially allow for filtering of the records by uses, such that you can pull out all records where a plant is used for, say, making dyes.

Marking the record by ‘Use’ is a step I have already taken as a part of the audit, primarily so that I could have a better understanding of the type of IK that was in the ANH. If this is the path that is decided upon, it may be desirable to review of the uses listed in the A.3, as perhaps there are categories of uses there that can be expanded or collapsed.

Preparation

In addition to 'Use' there is the possibility of marking whether the record mentions how the plant is prepared. Here, as with the 'Use' field, there is the option to just flag whether or not the collector has discussed how the plant is prepared with a simple Yes/No tick box and leave the accessor to find the information for themselves in the 'Notes' field. This is my current approach, as the descriptions of the preparation provided by collectors are often embedded in their other comments, and so creating a whole new text field for describing preparation requires manual extraction and potentially re-writing if the relevant excerpt is ungrammatical by itself.

Two arguments for marking the record for documentation of the preparation are to provide TKOs with more control over visibility and access to the information and to provide a level of cultural safety. In the first instance, while it may be acceptable for outsiders to know what a plant is used for, the knowledge of how to prepare it may be restricted. This is often grounded in IK holders and custodians' responsibility to ensure that others are not harmed by misusing the plant. Essentially, some preparations should only be done by an expert, so it is safer to not include any instructions at all.

Another facet that may affect access is whether the information should only be known by certain groups, e.g. men or women. Information regarding menstruation, childbirth, contraception, and abortifacients are often considered women's business, and while men may be aware that there are natural products available for addressing these, it may not be considered appropriate for them to access or view this information, particularly if there are details regarding preparation. Coming across this information unexpectedly can cause shame and embarrassment, so warnings or restrictions need to be in place to ensure the record is respectful and culturally safe.

For example, some records in the dataset make mention of which plants are used for treating infection after circumcision. This may not be knowledge that is appropriate for women to know, and so a warning (example below) or restriction may need to be in place to ensure to cultural safety and adhere to ICIP protocols.

This record has been flagged as it may contain restricted information specific to men's or women's business. Please proceed with care.

Indigenous Cultural Intellectual Property (ICIP)

Ideally, agreements with Traditional Knowledge Owners (TKOs) about data sharing and accessibility are done with full consultation with relevant Indigenous stakeholders and in line with the corporate ICIP principles at the time of collection. Unfortunately, as much of the IK data in the ANH predates the development of CSIRO's current ICIP policies and modern ethics protocols for working with Indigenous peoples, we cannot guarantee that the IK in the collection is adhering to contemporary standards.

A first step towards addressing this is to work out how an ICIP notice is to be displayed on or connected to the IK in the ANH. The most expedient option is to include a generic statement regarding ownership and authority that will cover all entries, either on the herbarium webpage or on the herbarium Specify 7 landing page or both. Alternatively, an ICIP notice can be attached just to the records that have been tagged as containing IK.

For more tailored ICIP details or instructions, a specific open ICIP field could potentially be included at the record level, however this would need to be manually filled out and require consultation with TKOs of the IK in the collection.

Ethics protocol

I have included an ethics protocol here as optional extra because it is intimately tied to ICIP, and there is merit to the record being connected to an HREC (Human Research Ethics Committee) approval number. However, many of the older collections may not have any ethics paperwork that can be tied to the records.

Nevertheless, it is prudent to include this as a field, as it means that in future, any IK included in a record in the ANH can be tracked to a project's ethics protocol agreement, potentially making it easier to contact the community or persons involved in the project at a later date. It also means that in the event that the community decides it would like to review or change something in the access rights of the record, there is a paper trail for them to follow.

3.4 Roles for supporting the project

Achieving the goals outlined here requires the input from people from a range of backgrounds (in no particular order):

- Database (i.e. Specify 7) developers and data managers
- ANH collection curators
- IK consultant(s)
- ICIP consultant(s)
- Project overseer.

3.4.1 Database developer(s) and managers

Stage 1 – finding and tagging all records in the ANH with IK – was completed in collaboration between the curatorial team of the herbarium and the Data Management Team of CSIRO's research collections. After moving IK to a database field that is not provided to biodiversity data aggregators, they became unpublished with the next delivery of ANH data. Stage 2 – specifying and adding more detailed IK fields to the database will likewise depend on involvement of the Data Management Team.

3.4.2 Indigenous consultants

Consultation with Aboriginal and Torres Strait Islander advisors and communities about what care and management of IK in the ANH looks like has been ongoing throughout the guidelines' development. Working with Warddeken Rangers in West Arnhem on building a bush medicine encyclopaedia has, for example, reaffirmed that including the name of the person who provided the knowledge (the Traditional Knowledge Holder, TKH) is a very important database field.

Further input from and collaboration with Indigenous colleagues at CSIRO is sought after and will strengthen the guidelines by imbuing them with Indigenous voices and perspectives.

3.4.3 ANH collection team

Involvement of experts in collection management will be instrumental to the success of this project. Input from those working in this area at the ANH will ensure that the management plan for IK in the ANH does not interfere with the primary functions of the herbarium.

3.4.4 ICIP consultants

One of the main goals of this project is to bring the ANH into line with the CSIRO's ICIP principles. Consultation with the ICIP internal working group regarding IK representation, acknowledgement and protection will be integral to ensuring that the ANH is adhering to the CSIRO's ICIP policies. This document will be forwarded to the ICIP team and feedback, guidance and suggestions from them will be readily received.

3.4.5 Project overseer

During the preparation of this report, this was my role. It involved:

- Auditing the collection
- Researching:
 - Indigenous governance and sovereignty principles
 - Indigenous knowledge structures and epistemologies
 - Decolonisation.
- Liaising with key people at the ANH and data management team to better understand what's possible
- Contacting other herbaria to learn how other collections manage IK
- Developing guidelines for caring and managing IK in the ANH.

3.4.6 Addendum

Since 2023, CSIRO has publicly launched the Indigenous Cultural and Intellectual Property Principles as an overarching framework to honour and respect the cultural heritage of Aboriginal and Torres Strait Islander Peoples. In the same year, a CSIRO project dedicated to Indigenous Science and National Biodiversity Collections was established and tasked with realising many of the goals outlined in this report, some of which have already been progressed. The project is focussed on cultural capability uplift for staff, improved metadata practices, culturally appropriate management of the Indigenous knowledge detailed in this report, and improved future collecting practices.

An external Indigenous Reference Group has been created and had its first in-person meeting in July 2024. An internal advisory group has also been established, with representatives from CSIRO Legal, IM&T (Information Management and Technology), ALA and collections.

4 Future developments

The steps outlined in Chapter 3 are those we can begin taking immediately to begin the process of improving how the ANH manages and cares for IK, and in turn materially contribute to CSIRO's RAP and Indigenous Engagement goals. There are a number of questions that have been raised during this project that are addressed here.

4.1 Best practice for fieldworkers and collectors

One question that arose during a conversation with a collection manager was regarding future collection practices for fieldworkers. The concern was that there would be a requirement for specimen collectors to gather IK for inclusion in the collection, but it is important to understand that these guidelines for IK management are not intended to encourage or compel people to document IK, nor is the herbarium today documenting IK on its specimen labels. The present guidelines are instead intended to introduce to the herbarium basic infrastructure and standards for dealing with the IK already in the collection because of the practices of past collectors.

However, CSIRO's collections are conducting two-way science projects where researchers encounter IK. Ensuring that anyone working with Aboriginal and Torres Strait Islander communities has appropriate training and support necessary for meaningful engagement is the responsibility of the CSIRO, and there is a clear need for NCMI (and CSIRO generally, perhaps) to develop a cultural competency training course for biologists who will be working with Indigenous communities and Indigenous knowledge.

4.2 The remainder of the FAIR and CARE principles

The steps proposed here will only bring herbaria part of the way to addressing the FAIR and CARE principles of good Indigenous data management. They can build on these first steps and begin to work on the missing principles. A potential third stage of this project would involve:

- Develop a strategy for managing community requests to change TKO attribution
- Consultations with Indigenous communities and representative bodies as to how the ANH can provide further support for IK (if wanted).

4.3 TK and BC labels

There is some interest in CSIRO adopting the [Traditional Knowledge \(TK\) labels](#) and [Bio Cultural \(BC\) labels](#) at some point in the future, so I will briefly comment on them here. TK and BC labels are a metadata labelling system developed by the global initiative [Local Contexts](#) to facilitate better management of cultural heritage materials in archives and repositories. The system uses universal icons which are included with the item or knowledge metadata and allow communities to express the conditions for sharing and engaging with their intellectual property and data.

From my own understanding of the TK labels and the nature of the IK in the ANH, this seems to be a system that is going to be more easily applied to hypothetical incoming IK in the future (which it is not the intention of the ANH to obtain) rather than applying it to the pre-existing IK in the ANH. Retroactively applying TK labels to IK already in the collections would be a difficult task, as it effectively would require someone to identify and contact every community to whom a record is connected, establish who has the authority to speak on and for the specimen and knowledge, and then negotiate a new understanding of our rights and responsibilities with regard to their IK within the TK system.

Scoping for how to apply BC and TK labels to the national collections is a task for the Indigenous Science and CSIRO's National Research Collections and Digital Infrastructure Project Team, but it is my understanding that they will be exploring the application of these labels to the whole of the collections, not just ANH, and not just those records that make explicit mention of IK. This survey of IK the ANH and draft guidelines for managing existing data provides small but useful first steps in the project team's broader plans.

4.4 Further supporting IK

It's important to remember that the ANH is a colonial institution, purpose-built to house 'Western'¹⁰ scientific knowledge and to support Western scientific research methods. While IK has found its way into the herbarium, it is, as discussed in section 1.1.3, not necessarily the best place for caring for and representing the science and knowledge of cultures with different epistemologies. Tagging and creating some rudimentary fields for the existing knowledge is a way the herbarium can help manage IK, but ultimately, we have removed the knowledge from its cultural frames of reference and are not currently able to provide the appropriate digital infrastructure for accurately representing IK.

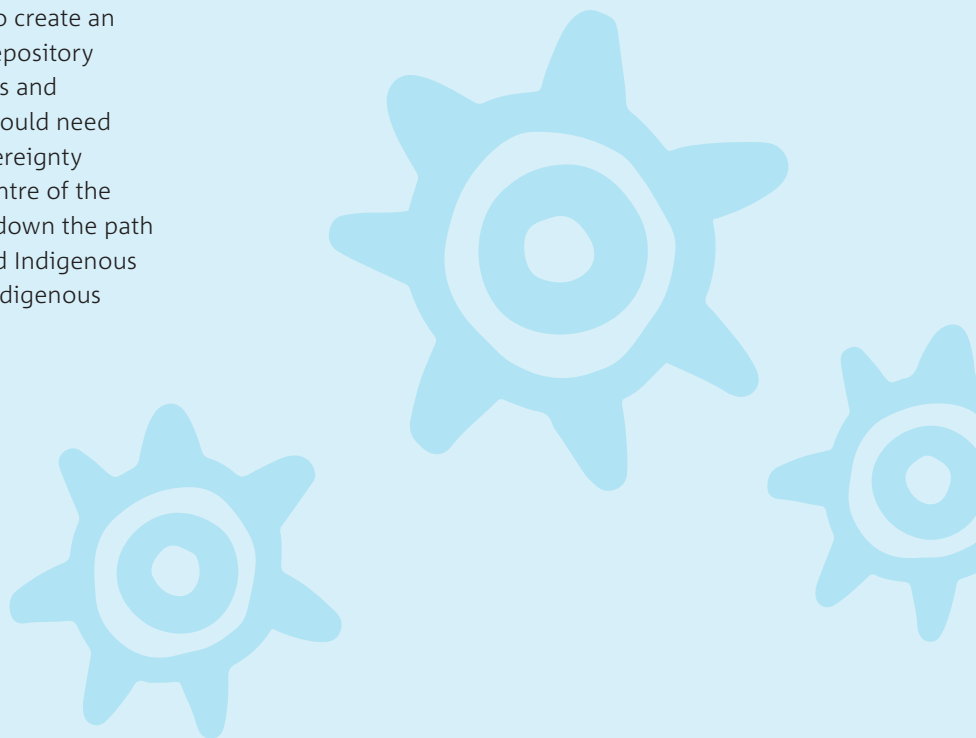
If there are long term goals to support IK in collections, then separate but linked databases may be a better way forward than trying to make the current system organise information that it simply does not have the capacity to accurately or respectfully represent.

With regards to decolonising¹¹ the ANH and other natural collections, it would perhaps be better to instead support and build something bespoke and free from the cultural, historical and infrastructural constraints that are intrinsic to the ANH (see Christie 2005 and Duarte & Belarde-Lewis 2015). The initiative to create an Indigenous-centred natural collection or IK repository would need to come from Indigenous peoples and communities, and the digital infrastructure would need to be designed with IK frameworks, data sovereignty and governance, and ICIP principles at the centre of the database design. If the ANH does wish to go down the path of further supporting Indigenous peoples and Indigenous knowledge, then we need to listen to what Indigenous communities are asking for.

4.5 Beyond ANH

As other herbaria in Australia are also trying to work out how to better care for and manage IK in their collections, there is the opportunity here to develop these guidelines for more general application beyond the ANH. This document will be available to interested parties external to the CSIRO, and thoughts and feedback from them, particularly as regards the features unique to their collection or their herbarium, are welcomed.

Furthermore, there is the potential for these guidelines to be turned into a charter or set of recommended guidelines for adoption by CHAH (Council of Heads of Australasian Herbaria), MAHC (Managers of Australasian Herbarium Collections), and HISCOM (Herbarium Information Systems Committee).



¹⁰ I.e. from Western Europe, which, with its long tradition of colonialism and imperialism, resulted in its own philosophies and epistemologies overriding those of other cultures.

¹¹ For some great preliminary readings see Tuhiwai Smith 2012 and Tuck & Yang 2012.

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Dr Alexandra Marley/the author would like to especially thank and pay respects to the Djalama clan who gave her permission to stay and work in their family outstation of Mamardawerre. As speakers of the Kunwinjku variety of Bininj Kunwok, it is their dialect that is referenced here with permission.

The report was updated by Alexander Schmidt-Lebuhn in 2026 to take into account the transition to the ANH's new specimen database, the identification of additional specimens with IK, and the redaction of IK from publicly available data since its original preparation in 2024. Louisa Warren and CSIRO's Indigenous Science and Engagement team provided invaluable advice during the preparation of the report for publication.

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Appendix

A.1 Traditional Owners in the ANH

As a large proportion of the records with IK did not include the name of the Traditional Knowledge Owners, many of the names here were arrived at looking at the language, the community name, or the location coordinates of the specimen. This means there is a degree of error, but this is something that can be addressed at a later stage.

Alngith	Djagaraga	Koko Dhawa	Martuthunira	Taungurong	Waywurru
Alyawarre	Djalgandi	Kukatj	Meriam	Thanakwithi	Wilyakali
Anangu	Djerait	Kukatja	Miriwoong	Thubi Warra	Wiradjuri
Anathangayth	Dyirbal	Kulkagal	Mithaka	Tiwi	Woolna
Anindilyakwa	Gamilaraay	Kungkari	Mudburra	Tjupan	Worla
Anmatyerre	Garrwa	Kunjen	Nakako	Torres Strait Islander	Wunambal Gaambera
Arrernte	Gija	Kurnai	Ngajanji	Unduyamo	Wuthathi
Bardi	Gkuthaarn	Kurtjar	Ngan'gityemerri	Unggumi	Yadhaykenu
Bidjara	Gunya	Kuuku Ya'u	Ngarinyin	Wadja Wadja	Yalarnnga
Bigambul	Gurindji	Kuungkari	Ngarluma	Wadyiginy	Yawuru
Binbinka	Jabirrjabirr	Kuwarra	Ngunnawal	Wajarri	Yindjibarndi
Bininj	Jaitmathang	Kwini	Noongar	Walmajarri	Yinhawangka
Bulway	Jawoyn	Larrakia	Nunggubuyu	Wambaya	Yir Yoront
Bunuba	Jingili	Limilngan	Nyamal	Wangkatha	Yirrkanydji
Burarra	Karajarri	Malak Malak	Nyangumarta	Warlpiri	Yolngu
Dalabon	Kariyarra	Mandandanji	Nyikina	Warluwarra	Yunggor
Darug	Karuwali	Mangala	Nyulnyul	Warray	Yungulu
Dharawal	Kaytetye	Mangarrayi	Peppan		
Dhudhuroa	Kokatha	Margany	Pindiini	Warumungu	
Dhuwal	Koko Bera	Martu	Rembarrnga	Wathyn	

A.2 Languages in the ANH

This is a list of languages found in the ANH. Not all of these have been confirmed, as some communities speak multiple languages, and it is not clear which of the languages the collector has recorded the term in. There are also cases where I have identified the language family broadly (e.g. Yolŋu Matha), as there is either not enough information to identify a specific language or the term is common to multiple languages in that linguistic group.

Anindilyakwa	Gurindji	Kwini	Ngan'gityemerri	Warluwarra	Yolŋu Matha: Ganalbinu
Anmatyerre	Jaitmathang	Larrakia	Ngarinyin	Warumungu	Yolŋu Matha: Gupapuyŋu
Arrernte	Jawoyn	Luritja	Ngarluma	Waywuru	Yolŋu Matha: Guyamirrilili
Bardi	Jingulu	Mandandanji	Ngunnawal	Wiradjuri	Yolŋu Matha: Guyamirrilili
Bibbulmun	Kaanju	Mangala	Nunggubuyu	Worla	Yolŋu Matha: Guyamirrilili
Bidjara	Kala Lagaw Ya	Mangarrayi	Nyangumarta	Wunambal	Yolŋu Matha: Liyagalawumirri
Bigambul	Kamu	Margany	Nyikina	Wuthathi	Yolŋu Matha: Murrŋun
Bulway	Kanthanumpu	Marramanindji	Nyulnyul	Yalarnnga	Yolŋu Matha: Mildjingi
Bunuba	Karajarri	Martu Wangka	Pindiini	Yankunytjatjara	Yolŋu Matha: Murrŋun
Burarra	Karuwali	Martuthunira	Pintupi	Yawuru	Yolŋu Matha: Ritharrŋu
Dalabon	Kaytetye	Matngele	Pitjantjatjara	Yindjibarndi	Yolŋu Matha: Wangurri
Darug	Koko Bera	Mayali	Rembarrnga	Yir Yoront	Yolŋu Matha: Wangurri
Daungwurrung	Krauatungalang	Meriam Mir	Tiwi	Yolŋu Matha	Yolŋu Matha: Warramiri
Dharawal	Kukatja	Miniafia	Umpila	Yolŋu Matha: Buthugurrulili	Yolŋu Matha: Wolkpuy
Dhudhuroa	Kulkalgaw Ya	Miriwoong	Unggumi	Yolŋu Matha: Dabi	Yolŋu Matha: Wulaki
Djalgandi	Kungkari	Mirnang	Uutaalnganu	Yolŋu Matha: Djambarrpuyŋu	Yunggor
Gamilaraay	Kunwinjku	Mithaka	Uw Olkola		
Garrwa	Kunwok	Mudburra	Uw Oykangand		
Gija	Kuuku Ya'u	Nakako	Wajuk		
Gudang	Kuungkari	Ngaanyatjarra	Walmajarri		
Gunya	Kuwarra	Ngaatjatjarra	Warlpiri		

A.3 Uses in the ANH

This is a list of the uses of the plants in the ANH dataset. It is not a definitive list of all the possible uses of plants, only the uses listed in the ANH records.

USE	DEFINITION
animal food	Food known to be eaten by animals, insects, fish etc.
canoe	Plant used to make rafts and canoes
ceremony	Used for spiritual and ceremonial purposes
decoration	Used as bodily ornamentation (e.g. necklaces, beard adornments, armbands etc.)
didgeridoo	Used to make didgeridoos
drug	Used as a narcotic or stimulant
dye	Used to make dye (typically for dying pandanus for weaving)
firestick	Used to transport fire
food	Eaten
glue	Used to make adhesive or fixative
grubs	Known for having edible grubs
ichthyocide	Used to poison fish
indicator	Indicates season change or availability of another resource
medicine	Has medicinal properties
no use	Explicitly stated that it has no use
not eaten	Explicitly stated that it is not eaten
paint	Used to make paint
poison	Toxic or very dangerous to touch or consume
shelter	Used to build shelter or shade
smoke	Used specifically for making smoke
soap	Used as a soap
tobacco	Chewed or smoked like tobacco
tool	Used to make tools (e.g. handles, containers, rope, pipes, paintbrushes, etc.)
toy	Used by children to play with
water	Known source of water
weapon	Used to make weapons (e.g. woomeras, spears, clubs, boomerangs etc.)
weaving	Used in weaving

A.4 AVH Audit

This audit of IK in the Australasian Virtual Herbarium was conducted in 2021 and was a precursor to the final report and guidelines. The exact figures will be out of date, but the general trends regarding distribution and information fields will still stand. It is included for transparency and reproducibility purposes and provides a clear starting point for monitoring progress of IK management.

Introduction

This report discusses the Indigenous Ecological Knowledge (IEK) on plants and fungi found (thus far) in the Australasian Virtual Herbarium (AVH) and has been put together as part of a post-doctoral project, *Linking Indigenous Botanical Knowledge: Supporting IEK and Indigenous languages with the Australian National Herbarium*. There are several parts to this project, the first of which is an audit of IEK in the Australian National Herbarium (ANH) and AVH, with an eye to determining how to respectfully manage pre-existing IEK in the collections.

The AVH contains the data of vouched specimens from Australian herbaria, including the ANH, where I was based. This audit focuses on IEK that links to physical specimens and as such does not include records from the Atlas of Living Australia (ALA), which is a far larger dataset thanks to contributions from community projects and citizen science efforts (Table 4).

Table 4: Records in ALA and AVH (as of 22/12/2021)

DATABASE	PLANTAE	FUNGI	TOTAL
AVH	4,850,293	283,363	5,088,656
ALA	20,378,498	1,653,373	22,031,871

This report will present an outline of the methodologies used to identify and extract IEK from the AVH and then discuss the shape and nature of the data.

Identifying IEK in the AVH

Plant and fungi records were downloaded from <https://avh.chah.org.au/> by using the advanced search function and filtering by ‘Botanical group: Plants/Fungi’ (see Figure 10). To more easily manage the data, it was downloaded in batches, divided by state/territory. Separating the data by state and territory was also useful for identifying the language used when there was an Indigenous name included.

The datasets were downloaded as CSV files and imported into Microsoft Excel, where they were cleaned and trimmed. Many of the fields in the files were not relevant for this report (e.g. soil type, event time, etc.) and so were removed. The remaining fields include taxonomic information, scientific name, collector name, latitude and longitude of the sample, catalogue, and several fields that include the IEK notes of the collectors.

Simple search

Advanced search

Batch taxon search

Catalogue number search

Event search

Spatial search

Full text search

Text

Taxonomy

Matched name ?

Supplied name ?

Taxon name

Taxon name

Taxon name

Taxon name

Botanical group

-- select a botanical group --

Figure 10: Screenshot of AVH advanced search

Collectors' notes on IEK were likely to be found in one of the following four fields: 'fieldnotes', 'occurrenceRemarks', 'eventRemarks' and 'locationRemarks'. These columns were concatenated into a new column (named 'Remarks_all'), which could then be searched for key words. By formatting the spreadsheet as an Excel¹² table, it is possible to filter records by strings. For instance, in the NT dataset, searching for the string 'aborigin' yielded 965 records, which were then sorted through manually to determine which of these specifically referred to some sort of IEK rather than a reference to, say, an Aboriginal land council. The most useful searches referenced names (e.g. *Dhuwa*), plant/fungus uses (e.g. spears), Indigenous cultural references (e.g. clan), and letter combinations not typical to English (e.g. <tj>):

Table 5: Top ten best search terms and results in NT subset

SEARCH TERM	NUMBER OF POSITIVE RESULTS
'name'	792
'Aborigin'	533
'itj'	313
'used'	250
'eaten'	248
'Dhu'	241
'clan'	172
'medic'	120
'edible'	96

This process of extracting relevant information could be vastly sped up by the application of Natural Language Processing (NLP). It took approximately two weeks to sort through the NT data using this method, but states and territories with little to no IEK (such as Tasmania) were processed in only a few hours. Developing an automated and intelligent process to extract records that contain IEK would greatly speed up this approach, should a similar audit be conducted on the ALA or other NRCA collections (e.g. fish, wildlife, insects etc.).

Using this method, the total number of IEK entries in AVH was 3379 out of a total of just over 5 million records. A summary of the number of vouchered specimens per state/territory with IEK data is presented in Table 6.

Table 6: Summary of AVH IEK data

STATE/TERRITORY	IEK ENTRIES	RECORDS TOTAL
QLD	354	1,004,972
NT	1670	432,058
WA	937	1,209,107
SA	324	655,164
TAS	0	330,778
VIC	13	483,648
ACT	1	60,425
NSW	80	912,504
TOTAL	3379	5,088,656

There are likely to be a few records that have been left out in this approach, as the filters are not refined enough to catch all the relevant entries with IEK. However, this is a fairly close representation of the proportion of records with IEK.

Coding IEK

Once records with potential IEK information were identified, they were coded. Again, this was a manual process, as there were many different ways that the collectors had recorded IEK. For instance, some collectors documented the name of the plant/fungus in the local Aboriginal language(s) and its uses, as well as cultural information such as the moiety and clan affiliation (example 1):

1. *Large tree, fruits purple-pink. Used to make dug-out canoes. Clan: [redacted].*
Some entries only have an Indigenous name (example 2), and some only have a comment about the uses (example 3):
2. *[redacted] name [redacted] from [redacted] of Docker R.*
3. *Reported by natives to be good food.*

Decisions about what to code the IEK for were based on the type of information that was available in the records. I began by extracting the Indigenous name and then the documented use of the plant/fungus. Several other fields were added as more snippets of biocultural information appeared. The following fields were ultimately added: language, Indigenous name, use, moiety, clan, cultural, preparation, informant, raw_recorded_by, checked, and Remarks_all.

12 I initially used R to do this, but because of the manual component, it was more manageable in Excel.

Language and IEK owners

If the collector had not noted the language of the Indigenous name they had provided, I needed to identify the language. This detective work involved scouring the record for some other identifiable information. For example, the following entry (example 4) is from a Yolŋu Matha¹³ language, which is recognisable thanks to the moiety name and the clan name.

4. *Succulent.* [redacted] *Clan:* [redacted]. [redacted]. [redacted].

Other clues included distinctive linguistic features of the word (e.g. syllable structure, spelling, affixation), a regionally characteristic name of informant (e.g. the name [redacted] is likely to be from the Western Desert region) and location (e.g. Yirrkala). In instances where it was still not possible to confirm the language, I used the GPS details and place names (e.g. 'Eniltji outstation') to locate the specimen's origin on Google Maps and then determine the likely language from there. The two main language maps used were from Dixon (2002) and the AIATSIS Horton map. While these maps are not completely accurate and should not be used for legal purposes or native title claims, they will home in close enough to a language for our purposes here.

Where possible, names were cross-referenced with entries in a dictionary or a published list of Aboriginal plant names, such as the [Yolŋu Matha online dictionary](#) (list included in references at the end of this document). This was not necessarily straightforward, as collectors were not always familiar with the local orthographic conventions, or even the sounds that they were hearing. For instance, 'numboo numbodba' as recorded on one specimen is Pitjantjatjara *ngampul-ngampulpa*.

For any record where the word could not be verified due to either no dictionary available or absence of the word in the dictionary, the language was guessed at. These are coded with a ? preceding the language name (e.g. ?Warlpiri). Occasionally, a number of possible languages are listed. This is because the record is taken from a place where several languages are in use (e.g. multilingual communities or at language boundaries) and none of them could be confirmed.

Some records contain multiple language entries because the collector has documented the plant/fungus name in several of the local languages (example 5).

5. *Pitjantjatjara name = [redacted], provided by [redacted] of [redacted] who also gave the Ngaatjatjara name of [redacted]. [redacted] gave another Pitjantjatjara name = [redacted]. Cooked in hot sand, ashes, coals and eaten.*

There are also records that include multiple words in the Indigenous name column, as specific parts of the plant/fungus have been named. Here, in example 6, Davidson has documented that a species is called [redacted] in Warumungu¹⁴ but the seed is called [redacted]:

6. *Warnmungu; [redacted]; seeds = [redacted]. Good tucker.*

Records like this that have multiple entries in a field have not been separated into distinct records. Currently, I am using punctuation marks to distinguish between entries that relate to different languages (with a semicolon) and those that provide multiple words in the same language (with a comma). This will make it easy to separate these entries in the future if needed, but I have not yet decided on how to sort this data.

In the instances where there is no linguistic data, IEK can still be attributed to an Indigenous community or group. Some entries contain the name or clan information of the people with whom the collector worked (examples 7 and 8):

7. *Twining vine with tuber that is eaten by [redacted] people.*

8. *Honey is found in the older flowers. Roots is eaten raw. [redacted]: Clan: [redacted].*

For entries that contain too little identifying information (e.g. example 3 above), locational information (GPS points, locality names etc.) were used to approximately determine the Traditional Owners of the knowledge. A separate field was created to include the name of the IEK owners, as the language name does not necessarily correspond with the name of the peoples. For instance, Kunwok is spoken by Bininj People, and Anangu People may speak Pitjantjatjara, Yankunytjatjara, Pintupi or Luritja, etc. Attribution of IEK to the Traditional Owners (TOs) still needs to be corroborated, but this process at least provides a starting point for who they may be.

Use and preparation

There were a number of uses coded, the most frequent being food. Other uses and descriptions of what these uses entail are listed below (Table 7).

¹³ The ŋ symbol here is pronounced like the 'ng' sound in the English word 'song'.

¹⁴ Davidson uses an old and now obsolete name for the language Warumungu.

Table 7: Uses listed in the dataset

USE	EXAMPLE
animal food	Known animal food (e.g. emu)
canoe	Canoes, boats and rafts
ceremony	Has a specific role in cultural practices (e.g. smoking ceremony)
clothing	Skirts, sandals etc.
decoration	Necklaces and beard adornments
didjeridu	Didjeridus and coffins (i.e hollow log/tree)
drug	Narcotic
dye	Dye for weaving or hair
firestick	Making and carrying fire
firewood	Good for making a fire (e.g. burns for a long time)
flavour	Used to flavour meat
food	Edible or used to make drink
grubs	Edible grubs or lerp found on this plant
glue	Extracted from gum or resin
indicator	Used for tracking weather, seasons, animal behaviour
medicine	Has medicinal/healing uses
no use	Identified as having no use
paint	Used to make paint
poison	Known poison, typically used to poison fish
shelter	Used for shade or shelter (e.g. paperbark)
smoke	Used for making smoke signals
soap	Soap made from it
structures	Wood used to build frames
sugarbag	Regular source of sugarbag (honey)
tobacco	Chewed or smoked
tool	Brooms, digging sticks, string, paddles, sandpaper etc.
toy	Children play with it
water	Known source of water
weapon	Spears, clubs, shields
weaving	Used for weaving or making nets

Some of these could be further refined, for example, ‘dye’ and ‘paint’ could be collapsed into a single category, and a distinction could be made between plants/fungus that are eaten and those used to make beverages.

Many records listed multiple uses for a plant/fungus, and these varied uses were listed. For instance, example 9 below has two uses coded: ‘poison’ and ‘medicine’.

9. *Tiwi name [REDACTED]; roots stock; used for fish poison and bathing medicine.*

I have also documented whether the IEK entry has more specific information about how the plant/fungus was prepared. Sometimes this is just a brief mention that it is the seed that is eaten. Other times, there is an extended description (e.g. example 10):

10. *Voucher for medicinal plants. [REDACTED] ‘[REDACTED]’ dig a hole put branches in hole lay the sick man on the branches, also cover man with the branches, light it so it smokes well. He will sweat out the sickness, good for nerves and fits.*

Cultural information has also been coded. For example, many of the entries from East Arnhem have moiety and clan affiliation information included. Other cultural information documented is the gender association of the plant or ceremonial links.

Future coding

There are a number of other ways to tag this information. For example, we may wish to be able to identify the parts of the plant/fungus that are used, e.g. fruit, leaves, bark etc., or distinguish between the different medicinal properties e.g. decongestant, contraceptive, etc. This task will again involve generating a novel field on the basis of string search results for key words in the Remarks_all field. Optimally, this will be done in collaboration with colleagues more well-versed in natural language processing techniques than I am.

One of the more complicated tasks yet to do is to tag entries for correlation to taxonomic rank, as there is not necessarily a one-to-one correspondence. For example, the Yolŋu Matha word [REDACTED] is a generic term for leafy, herbaceous plants and corresponds to 38 different species and 37 different genera. Or consider *Acacia sublanata*, which Bininj People further divide into two forms on the basis of the growth pattern of the plant: erect forms are called *manbodjdjimir* in their language (Kunwok), and prostrate forms are called *manmininj* or *manminem* depending on the dialect¹⁵.

Organising how these two systems correspond to one another will be a task for the future and will require collaboration with Indigenous communities and the development of community encyclopaedias.

15 Permission to use Bininj plant knowledge granted by members of the Mamardawerre community of West Arnhem land.

Some rudimentary analyses

Although there are other elements yet to code in this dataset, there are a number of queries that can be run to give us a sense of the shape of the data. First, we can consider the amount of IEK in the AVH, with the caveat that there is likely to be a small percentage of entries that failed to be collected in this initial data scrape. Table 8 compares the number of entries that have some sort of field notes by the collector ('entries w Remarks_all'), and the total number of specimens in the dataset ('Total AVH records'):

Table 8: AVH IEK data

STATE/TERRITORY	IEK RECORDS	ENTRIES W REMARKS_ALL	TOTAL AVH RECORDS	%IEK OF ENTRIES W REMARKS_ALL	%IEK OF TOTAL RECORDS
QLD	354	660,062	1,004,972	.04%	0.035%
NT	1670	329,384	432,058	.38%	0.39%
WA	937	771,835	1,209,107	.11%	0.078%
SA	324	85,215	655,164	.36%	0.049%
TAS	0	168,446	330,778	—	—
VIC	13	124,127	483,648	.01%	0.003%
ACT	1	47,273	60,425	.002%	0.002%
NSW	80	547,555	912,504	.01%	0.009%
TOTAL	3379	2,733,897	5,088,656	.1%	0.07%

As can be seen, the number of records in the dataset that have associated IEK is very low. Only 0.07% of 5,088,656 records have any sort of documented IEK information. There is also a notable difference between states/territories. QLD, NT, WA and SA provide the bulk of the IEK in the collections, while NSW, ACT, Victoria and Tasmania, where Indigenous communities have suffered even greater disruption to their languages and culture, have very few entries.

Fungi are very poorly represented with regards to IEK. Table 9 breaks down the AVH state and territory records by kingdom, and Table 10 shows the number of IEK records for plants and fungi per state/territory.

Surprisingly, the Queensland dataset has no fungi IEK recorded despite having the largest fungi collection (50,524 specimens) and having a proportionally high number of plant IEK entries. Tasmania has no IEK entries, but the lack of data here should definitely *not* be taken as evidence that no local Indigenous ecological knowledge persists.

Overall, there is very little IEK in the AVH. I anticipate that there is more IEK in the ALA, however given that there are also far more entries in the ALA (>22 million), the proportion of records with IEK is likely to be even smaller. Developing and standardising techniques for identifying, extracting and coding IEK in the AVH will make accessing IEK in other collections much more streamlined.

Table 9: Total records of plants and Fungi in the AVH

STATE/ TERRITORY	PLANTS	FUNGI	TOTAL
QLD	962,376	50,524	1,004,972
NT	425,486	6572	432,058
WA	1,166,891	42,216	1,209,107
SA	641,122	14,042	655,164
TAS	284,179	46,599	330,778
VIC	441,962	41,686	483,648
ACT	54,297	6128	60,425
NSW	873,980	38,524	912,504
TOTAL	4,850,293	246,291	5,088,656

Table 10: Plants and Fungi in the AVH records with IEK

STATE/ TERRITORY	PLANTS	FUNGI	TOTAL	PLANTS %	FUNGI %
QLD	354	0	354	100%	0%
NT	1659	11	1670	99%	1%
WA	928	9	937	99%	1%
SA	319	5	324	98%	2%
TAS	0	0	0	—	—
VIC	13	0	13	100%	0%
ACT	1	0	1	100%	0%
NSW	79	1	80	99%	1%
TOTAL	3353	26	3379	99%	1%

Linguistic data

Another angle is to consider the number of entries that have some sort of Indigenous term. Table 11 provides the figures of records with IEK and those that include an Aboriginal language term.

Table 11: IEK and language terms in the AVH IEK data

STATE/ TERRITORY	IEK	LANGUAGE TERMS	% ENTRIES W. TERM
QLD	354	265	74%
NT	1670	1234	74%
WA	937	822	88%
SA	324	304	94%
TAS	0	0	–
VIC	13	10	77%
ACT	1	1	100%
NSW	80	48	60%
TOTAL	3379	2684	79%

South Australia has the highest proportion of Indigenous terms (304 of its 324 IEK entries provide an Aboriginal language term), while the NT has the highest raw number of language terms recorded. The number of distinct terms comes in at 1928 (Table 12). Note that as some terms occur across state/territory boundaries, the total is less than the sum of the states/territories.

Table 12: Distinct Aboriginal language terms in the AVH and entries confirmed against vocabulary list

STATE/TERRITORY	DISTINCT TERMS	CONFIRMED
QLD	206	37
NT	880	822
WA	619	7
SA	243	21
TAS	0	–
VIC	9	0
ACT	1	0
NSW	42	0
TOTAL	1928	887

The majority of the terms only occur once, with the most frequent term being [REDACTED] (Yolngu Matha), which is recorded 55 times. Some of these terms have been checked against vocabulary lists or dictionaries, particularly entries from the Northern Territory, but many of the terms have not yet been investigated and so this list is likely to change as the data is further cleaned. Additionally, this list of terms contains both names of plants/fungi and their parts (e.g. fruit, seed, root etc.), and so more refinements are to be made to the types of Indigenous terms found.

Classifying languages

There are up to 198 Australian languages represented in the linguistic data in the AVH, 63 of which have been confirmed (either from the collectors' notes or by checking the term in a vocabulary). Table 13 lists the known and speculative languages (marked with a '?') for each state and territory. Note that the values in the table do not add up to 198, as some languages straddle several states and territories and so are listed multiple times.

This list requires further refinement as the spelling of the language names was taken from the Austlang (AIATSIS) website and may not be the spelling that speakers and communities use.

For 18 of the 2684 records with linguistic data, the only locational information was the state/territory, and so the language could not be guessed at. To better visualise the language distribution, I have created a very rough map of the languages in the AVH adapting a map from Dixon (2002:xxviii). The blue areas in Figure 11 are languages that have been positively identified in the dataset, while the yellow regions are the languages that are suspected. The borders between the language families (thick black line), languages (dotted lines) and dialects (italic letters and numbers) are only very approximate. Additionally, there are undoubtedly instances where the language term elicited is from a language of another region rather than the language where the specimen was collected.

Table 13: List of languages

STATE/ TERRITORY	POSSIBLE LANGS	DEF. LANGS	LANGUAGE LIST
QLD	53	11	Bigambul?, Bulway?, Djabugay?, Gamilaraay?, Gangalu?, Garumngar?, Gubbi Gubbi?, Gudang?, Gungabula?, Gunya?, Guugu Yimithirr, Jagara?, Jandai, Kaanju?, Kala Kawaw Ya?, Kala Lagaw Ya, Kanthanumpu?, Karuwali?, Koko Bera, Koko Dhawa, Kukuyalanji?, Kuthant?, Kuuku Ya'u?, Kuungkari?, Kuwarra?, Mandandanji?, Margany?, Mbabaram, Meriam Mir, Mitakoodi?, Mithaka?, Miyan?, Muluridji?, Ngawun?, Thaynakwith, Thayorre, Umpila?, Uradhi?, Uutaalnganu?, Waanyi?, Wakka?, Wangkamana?, Wangkumara?, Warluwarra?, Warungu?, Wik Mungkan, Wik Ngatharr?, Waanyi?, Wuthathi?, Yalarnnga?, Yandruwandha?, Yarluyandi?, Yidiny?, Yir Yoront
NT	45	27	Alawa, Alyawarra, Andegerebena?, Anindilyakwa, Anmatyerre, Arrernte, Binbinka?, Burarra, Dalabon, Djambarrpuynu, Djingili, Dyugun?, Garrwa?, Gurindji, Gurr-goni, Jawoyn, Kamu?, Kaytetye?, Kunbarlang?, Kungkarakany?, Kunwok, Larrakia?, Luritja, Malak Malak?, Mangarrayi?, Marra, Marramanindji?, Matngele?, Mudbarra, Ndjebbana, Ngandi?, Ngan'gityemerri, Ngarinman?, Nunggubuyu, Pintupi, Pitjantjatjara, Rembarrnga, Tiwi, Wagiman?, Wangkamana?, Wardaman?, Warlpiri, Warumungu, Yolngu Matha, Yunggurr?
WA	53	19	Balardung?, Bardi, Bibbulmun?, Bunuba?, Djalgandi, Dyugun?, Gija, Goreng, Jabirrjabirr?, Jawi, Kalarko?, Kaniyang?, Karajarri?, Kukatja, Kwini, Malpa?, Mangala, Mantjintjarra?, Martuthunira?, Martu Wangka, Miriwoong?, Mirnang?, Miwa?, Nakako?, Ngaanyatjarra, Ngaatjatjarra, Ngadjumaya?, Ngardi?, Ngarinyin?, Ngarluma, Nhanda?, Nyamal?, Nyanganyatjara, Nyangumarta, Nyikina, Nyulnyul, Palyku?, Panyjima?, Pindiini?, Pintupi, Pitjantjatjara, Tjupan?, Unggumi?, Wajarri?, Wajuk?, Walmajarri?, Wangkathaa?, Wawula?, Worla?, Wudjari?, Yindjibarndi, Yuat?, Yulparija?
SA	16	5	Adnyamathanha?, Antikirinya?, Arabana, Barngarla?, Dieri, Dhirari, Kokatha?, Kuyani?, Ngalia?, Ngamini?, Nukunu?, Pitjantjatjara, Wirangu?, Yandruwandha?, Yankunytjatjara, Yawarrawarrka?
TAS	0	–	
VIC	8	0	Brayakaulung?, Daungwurrung?, Dhudhuroa?, Jaitmathang?, Krauatungalang?, Ngintait? Waywurru?, Wemba Wemba?,
ACT	1	0	Ngunnawal
NSW	15	1	Darug?, Dharawal?, Gathang?, Mutthi Mutthi? Paakantji?, Ngandowal?, Nyangbal?, Wadigali?, Wemba Wemba?, Yuwaalaraay?, Bigambul?, Gamilaraay?, Ngiyampaa, Wiradjuri?, Yandruwandha?

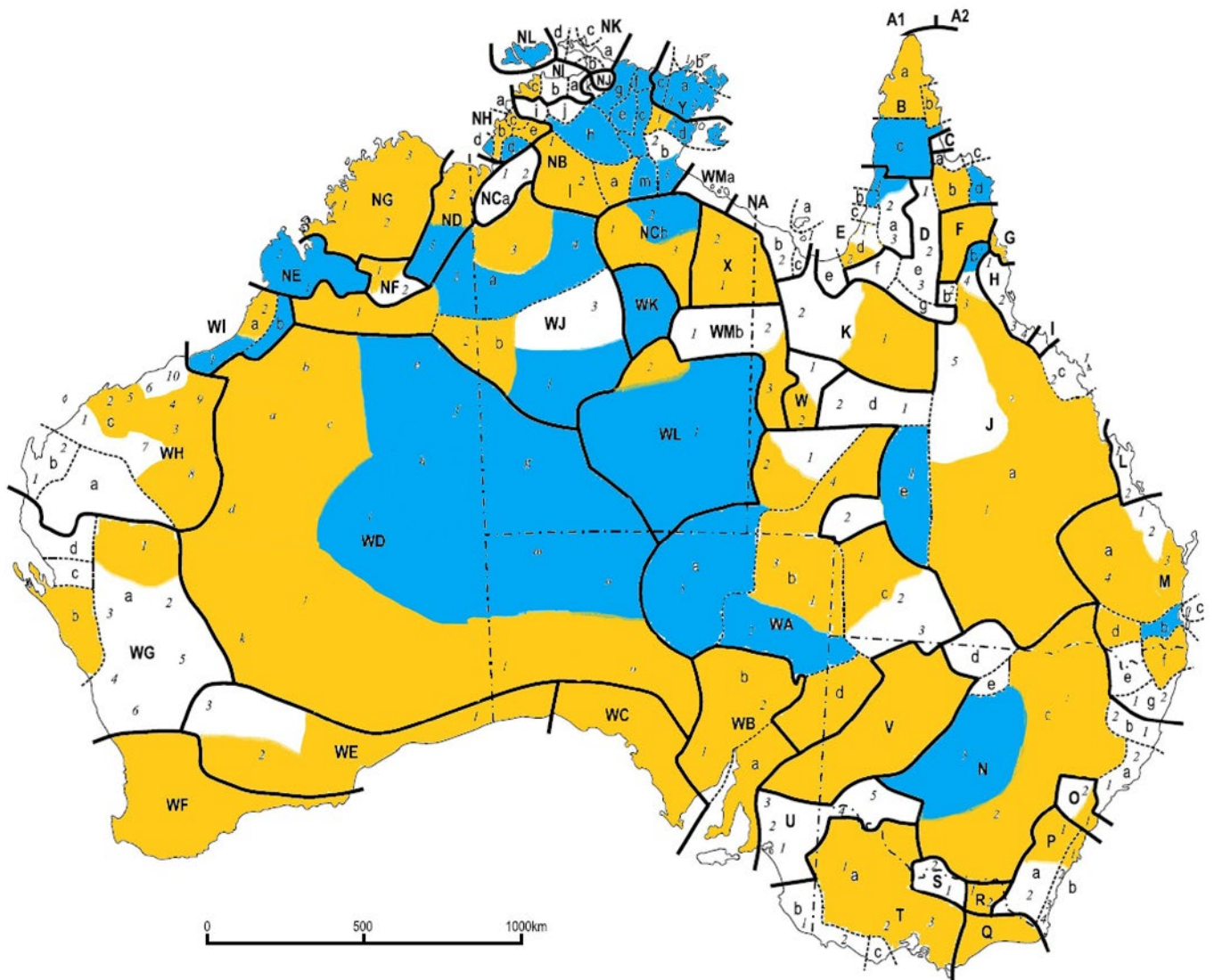


Figure 11: Map of confirmed (blue) and unconfirmed (yellow) languages represented in the AVH.
Map adapted from Dixon 2002: xxviii

The most represented language is Yolŋu Matha (East Arnhem land, Northern Territory), with 647 confirmed records and 56 suspected entries. However, as Yolŋu Matha is a coverall term for a number of different closely related languages and dialects, there is room here for further distinction. For instance, some records specified Djambarrpuyngu, a dialect of the Yolŋu language Dhuwal. A similar note can be made of Western Desert languages. In instances where the collector has identified the languages as Pitjantjatjara, Ngaanyatjatjara, Yankunytjatjara etc., the distinction has been maintained, and where the term is the same in all varieties or it has not been possible for me to confirm which language name is most accurate, I have coded the term under Pitjantjatjara.

There is a correlation between the number of languages represented in a state/territory dataset and linguistic diversity. Figure 12 is a reproduction from the *National Indigenous Languages Report* (Battin et. al 2020: 18) and outlines the state of Aboriginal languages in different regions of the country. Note that ‘L1’ means the language is being learned as a first language or mother tongue. ‘L2’ means that the language is being learned as an additional language to the L1(s). The Top End (NT), particularly Arnhem Land, the Western Desert region (NT, WA, SA), and Cape York (QLD) all have communities where an Aboriginal language is being acquired by children as an L1, and these are the regions where much of the *confirmed* language data in the AVH IEK dataset comes from.

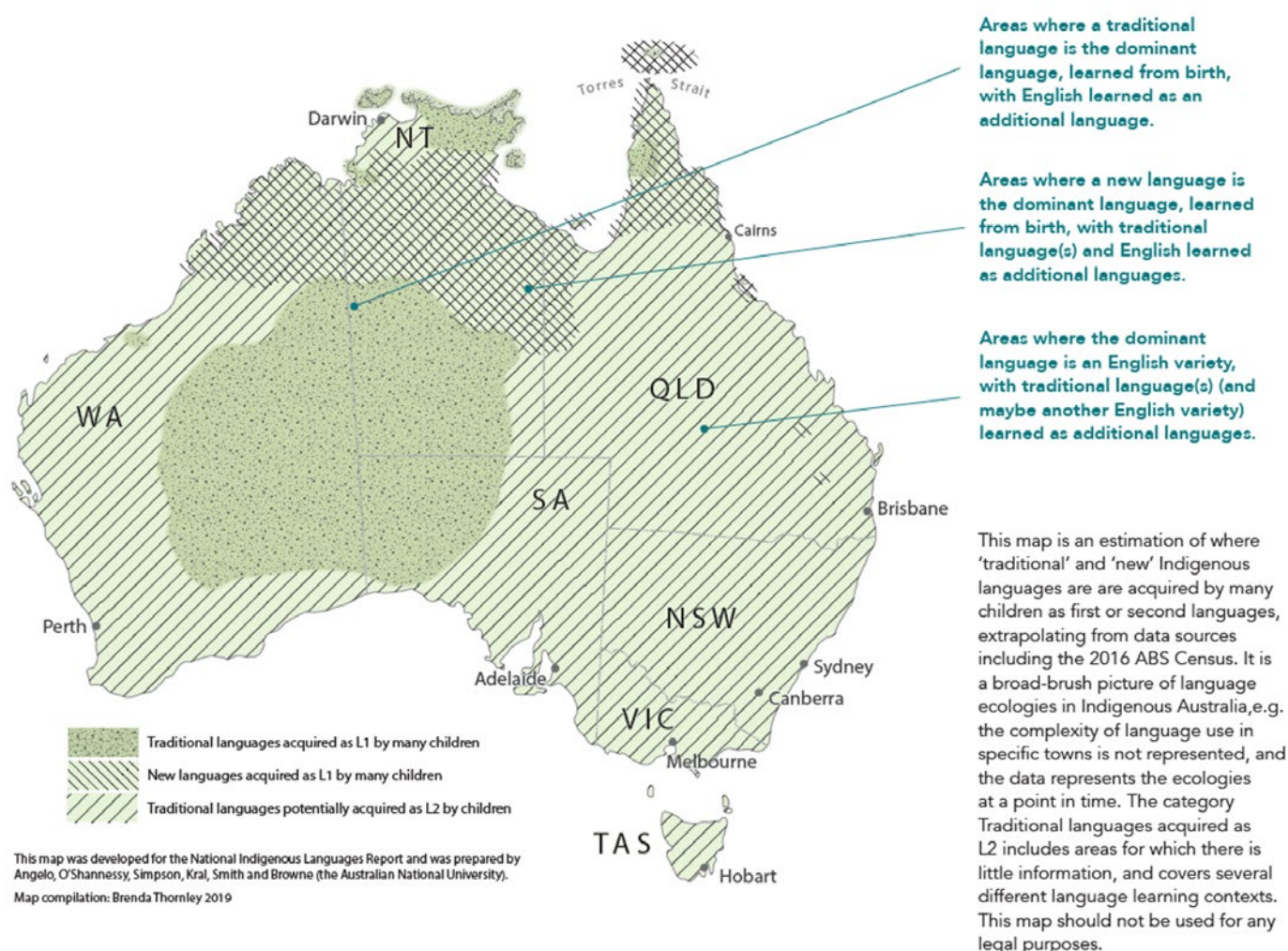


Figure 12: Language ecologies in Australia. Image and text from Battin et al. 2020: 18. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 4.0 International licence.

A closer look at the languages with the most terms confirms this; Table 14 lists the ten most well-represented and confirmed languages in the dataset.

Table 14: Ten most common languages and number of records

LANG	REGION	STATE/TERRITORY	NO. TERMS
Yolngu matha	Arnhem Land	NT	647
Pitjantjatjara	Western Desert	NT/WA/SA	212
Ngaanyatjara	Western Desert	NT/WA	173
Yankunytjatjara	Western Desert	SA	119
Meriam mir	Cape York/Torres Strait	QLD	82
Pintupi	Western Desert	NT	83
Bardi	Dampier Peninsula	WA	68
Warlpiri	Western Desert	NT	62
Kunwok	Arnhem Land	NT	49
kala lagaw ya	Cape York/Torres Strait	QLD	23

IEK data

1391 records (of 3379) include some indication of how the plant/fungus is used by communities. This tagging system is a fairly blunt instrument at this stage, currently not distinguishing between common/sought after food and drought/emergency food or between food and drink. It also does not note which part of the plant/fungus is used, but all these will be further distinguished in future. 96 of the records contain more than one use.

Food is the most common use documented, followed by medicine and weapons (Table 15).

831 entries have some sort of associated preparation or specification about the part of the plant/fungus to be used. This also needs to be further sorted as it is an open field and the amount of information provided by collectors wildly differs (refer to examples 9 and 10).

While I cannot speak for any of the communities whose IEK is stored in the AVH, I do not believe there are any entries that contain highly sensitive information and require immediate action. Having said that, the IEK here belongs to the communities and people from whom it was gleaned, and only they can discern as to whether the information here should be open for public consumption. Whether the collector received permission to disseminate the IEK is not documented in the field notes, but many entries (n=598) include the name of the Indigenous informant. Over half of these were collected by Arpad Kalotas, who was particularly diligent at noting the local name, the language, and his informant.

Identifying traditional ownership of the IEK information is important, not just for ensuring that the information correctly and respectfully acknowledges where the information comes from, but also for any future repatriation efforts of herbarium data.

Table 15: Uses listed in the dataset

USE	NUMBER OF RECORDS
food	340
medicine	157
weapon	26
tool	25
animal food	24
poison	21
ceremony	20
decoration	15
dye	13
grubs	13
firestick	8
drug	6
flavour	6
misc	6
no use	6
soap	6
canoe	5
shelter & shade	5
toy	5
firewood	4
indicator	4
sugarbag	4
tobacco	4
weaving	4
wood	4
water	3
didjeridu	2
paint	2
gum	1
TOTAL	698

Data across herbaria

As the AVH is a collection of datasets from herbaria across Australia, it is worthwhile to have a look at what the contributions from each participating herbarium are. There are many more herbaria that contribute to the AVH than are listed here (for full list see [here](#)), but these are the herbaria which have some sort of IEK currently available publicly (either via the AVH website directly or via the ALA). Furthermore, after contacting some of the herbaria regarding IEK in their collections, it was made clear that there may be more IEK in their collections than they have made publicly available. Both the National Herbarium of Victoria and the Western Australian Herbarium are in the process of tracking down IEK in their collections to move it into non-public fields. Discussions with staff at these

herbaria indicated the need for a definitive guide for managing IEK in Australian natural collections, as currently each herbarium is trying to figure out how to organise, attribute and protect this knowledge on its own. It seems that Australian herbaria (and probably natural collections as a whole) are at the point where a national protocol for managing IEK needs to be developed.

In addition to the twelve herbaria listed here, there are also some IEK records that come from iNaturalist. As the iNaturalist records enter the ALA directly, it is important for the ALA to also adopt any best practice protocols regarding IEK management, so that it is in line with national standards.

Table 16: List of herbaria in the AVH with IEK

HERBARIUM	FUNGI	PLANTAE	TOTAL
Australian National Herbarium		768	768
Australian Tropical Herbarium		11	11
iNaturalist		5	5
James Cook University Herbarium		15	15
N.C.W. Beadle Herbarium		6	6
National Herbarium of New South Wales		342	342
National Herbarium of Victoria	1	2	3
Northern Territory Herbarium	18	1378	1396
Queensland Herbarium		218	218
State Herbarium of South Australia		25	25
Tasmanian Herbarium		5	5
The Janet Cosh Herbarium		2	2
Western Australian Herbarium	7	575	582
TOTAL	26	3352	3378

Species and collector data

There are 532 genera and 1156 species represented in the AVH IEK dataset, the bulk of which are plants. Not all entries contain complete data about taxonomic rank: of the 3379 records, there are 409 entries that only have genus data (i.e. no species epithet included), and a further 13 only provide the family.

Table 17: Genera and Species count in AVH IEK dataset

	GENERA	SPECIES
Plantae	520	1149
Fungi	12	7
TOTAL	532	1156

Just over half the species are only attested once (n=570), and of those with multiple specimens, *Clerodendrum floribundum* 'lolly plant' comes out on top with 22 instances. *Clerodendrum floribundum*, along with another plant, *Senna artemisioides* 'wormwood senna', also have the most linguistic representation, with both having data from nine languages.

The earliest record is from 1770, but the bulk of the records were collected in the 1970s, 80s and 90s, with 1972 seeing the highest number of IEK documentation (n=333).

Figure 13 plots the number of records made of each year. Note that 265 records (of 3379) were missing a date, and so this graph plots the remaining 3114 entries.

The large spikes seen here are from just a few individuals (Table 18), working primarily in the Northern Territory.

Table 18: Top five contributors of IEK

COLLECTOR	YEARS ACTIVE	NO. RECORDS
Kalotas, C. A	1981–1987	480
Reeve, H.	1972–1973	363
Scarlett, N. H.	1972–1986	335
Lawrie, M.	1970–1972	141
Coleman, C.	1989–1994	86

Returning to these collectors' records and notes may help to determine what permissions they had from the communities regarding collecting IEK and the storage of this information. One rather daunting task that may need to be considered by curators is revisiting ethics approvals (or lack thereof) for these entries and contacting communities to organise correct representation of the data.

No. records

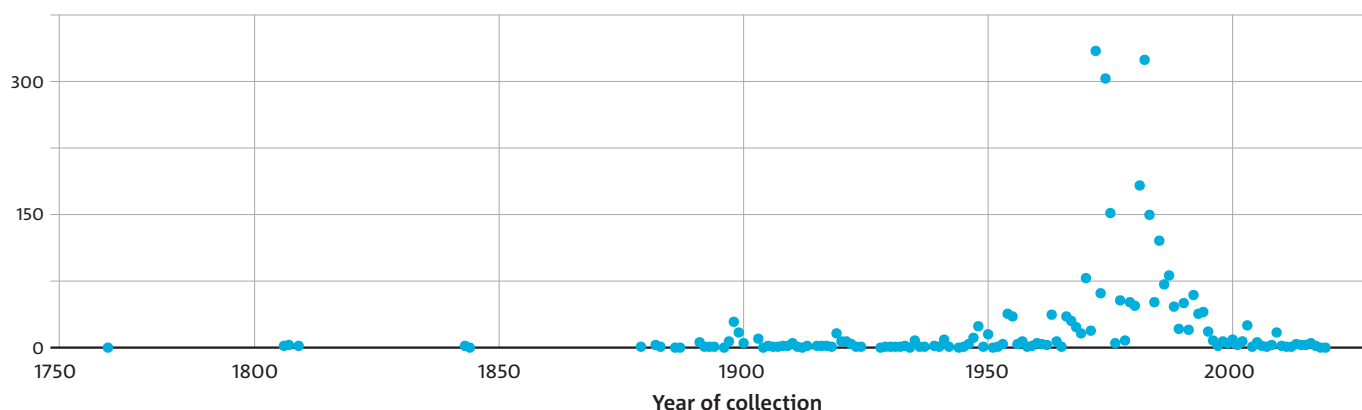


Figure 13: Scatterplot of year of collection for IEK entries in AVH

List of dictionaries and other resources used to infer languages

- 1992. *Pitjantjatjara/Yankunytjatjara to English Dictionary*. IAD Press.
- 2018. *Carl Strehlow's 1909 comparative heritage dictionary an Aranda, German, Loritja and Dieri to English dictionary with introductory essays*. ANU Press. Canberra.
- Alyawarr Dictionary (online). Australian Society for Indigenous Languages. <http://ausil.org.au/Dictionary/Alyawarr/lexicon/index.htm>
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- Western Arrarnta Dictionary (online). Australian Society for Indigenous Languages. <https://ausil.org.au/Dictionary/Western-Arrarnta/lexicon/index.htm>
- *Yolngu Matha Dictionary* (online), CDU. <https://yolngudictionary.cdu.edu.au/>

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