

Corrigendum to: Prioritising animals for Yirralka Ranger management and research collaborations in the Laynhapuy Indigenous Protected Area, northern Australia

Bridget Campbell, Shaina Russell, Gabrielle Brennan, Yirralka Rangers, Bec Condon, Yinimala Gumana, Frances Morphy and Emilie Ens

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The Indigenous translation of the abstract for this paper, as well as the explanation of the translation, was inadvertently missing from the published version of this paper. This should have been included as below:

TRANSLATED ABSTRACT

Context. Bukmak wānānjura dhuwalayukurra ŋorra Yolŋu'wunju dhukarr'yarnnydjunara ŋāthil'yun nhānhara'wu djāma. Dharrwa Yolŋu mala ga wupitjimala ga governments wirrki yukurra djāltirri marŋgi'dhinyarawu ga nhānharawu warrakan'ku ŋunhi marrtji bayŋu'thirri metrics mārr yurru djāka warrakan'ku ŋunhi wirrki Yolŋu'wala mārrŋuru. **Aim.** Ŋanapurru djāma yāku warrakan' mala ŋunhi Ŋalapa'mirri yukurra warwu'yun Indigenous Protected Area, wānānjuru, Miwatjŋuru. Dhiyanjundja djāmayu yurru gung'a'yun ŋathil'yun research djāma nhaltjan ŋanapurru yurru Yirralka wānā djāmamirriyu djāka warrakan'ku. **Methods.** Ŋanapurru ŋāŋ'thun Ŋalapa'mirrinha warrakan'ku lakara'nharawu ŋunhi walala yukurra wirrki warwu'yun ga lakarama nhā warwu malanyinha ŋulinya'mirriyu ŋanapurru group'kurru djāma. Wiripunydia ŋanapurru scientific data ga ŋayan'malanyinha warrakan'ku nhaltjan ŋanapurru yurru djāma ŋathil'yun. **Results.** Ŋalapa'mirriyu nherrāŋ nhāma 30 warrakan' mala Laynhapuy Priority Animal Listlili. Warrakan' mala ŋunhi ŋanapurru wānā nha'mirri wirrkinydia marrtjinyamirri wāyingu, ga rupu, ga djanda. Ŋunhi 30 warrakan' mala ga 43 species ŋunhili 12'tja warrakan' maŋŋ'manhara ŋayan'ŋuranha. Wiripunydia warrakan' mala wirrki ŋanapurru yurru djāka nhakuna waŋ'kurrawu, yurru yaka wirrki warwu'yundja Western scienceŋuru, dhiyanjundja yukurra milkuma dhuwala bāyma dhāwu ga bukmak Yirralka'murru. Ŋanapurru lakarama yukurra nhā Yolŋu'wu waŋarr ga nhā warwu ga milkuma nhā djāmawuy malanyinha Yirralka Rangers ga University researcherskuŋu baseline scientific data warrakan'yu. Dhiyanjundja yurru gung'a'yun ŋanapurrunha nhaltjan ŋanapurru yurru yurama ga djāka ga larruma warrakan'ku yalala. **Conclusions.** Research'thunydia yurru ŋanapurruŋgu gung'a'yunamirri resources djāma Yolŋuwu ga ŋāpakiwu mārr yurru rrambaŋi djāma. Dhiyanjundja manapan yukura Yolŋu ga ŋāpaki muŋkurr mārr ŋanapurru yurru yaka mayali'mirriw'thirri. [Implications section not provided.]


The abstract was translated from English to the Gumatj dialect of Yolŋu matha by Yananymul Munungurr and transcribed by Gabrielle Brennan.

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Prioritising animals for Yirralka Ranger management and research collaborations in the Laynhapuy Indigenous Protected Area, northern Australia

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OPEN ACCESS

ABSTRACT

Context. Amidst growing international calls for inclusive conservation and a backdrop of declining species and cultural diversity, Indigenous-led approaches that offer opportunities for biocultural benefits are of growing interest. Species prioritisation is one area that can be decolonised, shifting from quantitative, large-scale threatened species metrics to pluralistic, place-based approaches that include culturally significant species. **Aim.** This study aimed to establish a list of priority animals of concern to Ḍaḷapaḷmi (senior knowledge holders) in the Laynhapuy Indigenous Protected Area, north-eastern Arnhem Land, Australia. This list could focus the research and management efforts of the Yirralka Rangers and collaborators. **Methods.** Adhering to local governance structures, through six group-elicitation sessions, Ḍaḷapaḷmi were asked to identify animals of concern and describe reasons for concern. Existing occurrence records and threat status of these species were compiled to assess baseline data and guide next steps. **Results.** The Ḍaḷapaḷmi-defined Laynhapuy Priority Animal List contained 30 animals (species/groups), with the highest-ranked animals including Marrtjinyami wāyin (walking animals), Rupu (possums), and Djanda (goannas), all mammals and varanid lizards. The list of 30 animals included 43 species from a Western-science perspective, of which 12 were also listed as threatened through Western conservation frameworks. Some animals were considered high priority locally, such as the waṅ'kurra (northern brown bandicoot, *Isodon macrourus*), although not a concern from a Western-science perspective, demonstrating mismatch between local and larger-scale approaches. To help disentangle whether this mismatch is due to cultural significance and/or localised decline not captured at larger-scale assessments, we provide the animal's publicly known Yolḷu clan connections and reasons for concern alongside existing baseline occurrence data. Recent collaborative surveys have substantially increased data for Laynhapuy Priority Animals, demonstrating the benefits of community engaged wildlife research. **Conclusions.** Multidisciplinary research collaborations can produce Indigenous-led 'working' lists of priority animals to guide culturally attuned on-ground action. Approaches that draw on different cultural knowledge systems require interrogation of how knowledge is created and conveyed to ensure mutual comprehension and practical use. **Implications.** Indigenous-led approaches offer possibilities for enhanced management of species by local groups, with anticipated co-benefits to species and cultural knowledge.

Keywords: Arnhem Land, biocultural conservation, cross-cultural ecology, culturally significant species, Indigenous-led conservation, right-way science, species prioritisation, Yolḷu.

Introduction

This research followed the directive of many Yolḷu Yirralka Senior Rangers, including Banul Munyarryun who stated that we need to 'start to bring the two sciences together,

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Western science and Yolŋu science, so we can have better understanding. Bring both together, have the full story: what's there; how many [animals]; if they're healthy, safe, right; or maybe we're worried about some, maybe expected to see them there but couldn't find them, or maybe they're there.'

Given the global extent of Indigenous-owned and -managed lands and importance for biodiversity conservation (Garnett *et al.* 2018), broader recognition of Indigenous peoples, practices, knowledge and values is needed to balance the dominance of Western science in conservation decision-making. Recognition of Indigenous peoples' rights to and customary responsibilities for managing their ancestral estates has contributed to a rise in convergent environmental and cultural, or biocultural, conservation policies at the global scale (e.g. UNDRIP, IPBES, CBD). However, typically, the criteria used to prioritise and monitor conservation outcomes adopt ecological metrics, rather than tangible and intangible cultural values (Austin *et al.* 2018; Zurba *et al.* 2019; Ens *et al.* 2023). In the case of species conservation, culturally significant species (CSS) and places important to Indigenous peoples could be assessed, not just those of importance to Western conservation prioritisation frameworks (Maffi 2001; Garibaldi and Turner 2004; Goolmeer *et al.* 2022a).

CSS have been defined as 'species of exceptional significance to a culture or a people, and can be identified by their prevalence in language, cultural practices (e.g. ceremonies), traditions, diet, medicines, material items, and histories of a community' (Gore-Birch *et al.* 2020, p. 2). Globally, CSS, especially fauna, are not well documented and are likely to be considered 'Data Deficient' by the International Union for Conservation of Nature (IUCN) (Reyes-García *et al.* 2023). Indigenous leaders and researchers argue that assessments of CSS should follow a place-based approach, led by Indigenous knowledge holders, following local values and cultural governance structures (Coe and Gaoue 2020; Freitas *et al.* 2020; Goolmeer *et al.* 2022a, 2024). Similarly, the biocultural conservation concept emerged in recognition of the convergence of biological and human cultural values that can be simultaneously addressed through inclusive conservation actions, offering a more ethical approach to conservation (Maffi 2001; Sterling *et al.* 2017). This cultural reframing challenges Western species prioritisation approaches to decolonise and acknowledge cultural governance of wildlife management and Indigenous-led fauna science (Goolmeer and van Leeuwen 2023) and, hence, pluralistic values of species, conservation and management (Howitt and Suchet-Pearson 2006). With regard to conservation decision-making, Law *et al.* (2018) argued that 'multiple equity objectives' from non-Western ontologies are rarely considered. The present paper aims to address these discrepancies by exploring which animals Ḍaḷapaḷmi (senior Indigenous rights and knowledge holders) of the Laynhapuy Indigenous Protected Area (IPA) would prioritise for management and research, and why, and how these correspond with external Western conservation frameworks.

Western science places value on the application of unified terminology as a means of producing knowledge that can be globally shared and understood (e.g. binomial taxonomic 'scientific' names). However, Western scientific terminology is not universal. Naming systems can have diverse functions and meanings across cultures. For the Yolŋu Indigenous people of north east Arnhem Land, naming is imbued with relation to Country (Williams 1986; White 2003; Boll 2006). Totemic places, animals and plants have multiple names, and may have ceremonial significance, being sung in manikay (ceremonial song cycles) (Morphy 1991; Toner 2001; Boll 2006). Animals may also be referred to and understood as kin by Indigenous peoples through complex kinship systems that connect the human and more than human world (Boll 2006; Fijn 2014; Goolmeer *et al.* 2024). Likewise, researchers should not assume that Indigenous observations of Country or changes to Country always correspond with the Western scientific worldview (e.g. understandings of biodiversity decline and climate change) (Petheram *et al.* 2010). Rather, a range of reasons for observed changes to Country have been recorded by Indigenous peoples, from the impacts of planetary climate change and globalisation to localised spiritual agency (Petheram *et al.* 2010). Documented strategies of Indigenous people to address contemporary changes often reflect both traditional Indigenous ontology and Western science (see Seton and Bradley 2004; Boll 2006).

Species prioritisation in biodiversity conservation

The prioritisation of species is considered a central pillar of modern conservation decision-making (Game *et al.* 2013) and was introduced to maximise the ecological benefits of conservation actions, given limited project funding and timelines (Wilson *et al.* 2009). In typical Western conservation approaches, species prioritisation has largely been based on species most at risk from extinction. Globally accepted metrics of extinction risk are found in the IUCN Red List of Threatened Species (Rodrigues *et al.* 2006; Keith *et al.* 2015). A species conservation status is typically determined by Western scientific criteria, including the known distribution, reduction in population size and distribution, and sensitivity to threats (Rodrigues *et al.* 2006; Threatened Species Scientific Committee 2015). Evidence for these criteria depends on available data, site access and expert scientific opinion (Rodrigues *et al.* 2006). There have been calls to integrate Indigenous knowledge into the IUCN Red List (Wong 2016; Cross *et al.* 2017) because Indigenous knowledge has been shown to expand species knowledge and inform recovery strategies, especially when quantitative data are limited (Wong 2016). For example, in collaboration with local Indigenous knowledge holders, Russell *et al.* (2023) increased the distribution and abundance data for freshwater turtle species of the South East Arnhem Land IPA in Australia's national biodiversity database, the Atlas of Living Australia, from 12 to 753 records.

Knowledge on threats, habitat and cultural values were also recorded. Without such data, this region may be considered data deficient, impeding potential Western management decisions.

Progress towards CSS prioritisation in Australia

Despite being considered a ‘megadiverse’ continent, Australia holds one of the worst extinction records globally (McDonald *et al.* 2015; Ward *et al.* 2019). Given the extent of Australia’s Indigenous estate (~57% of the land surface) and IPAs (~49% of the National Reserve System), the potential benefits of applying the CSS concept to encourage Indigenous-led fauna management and research are substantial (Goolmeer *et al.* 2024). Australian conservation efforts are broadly guided by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and conservation funding is often preferentially given to species considered by Western frameworks as endangered or part of certain taxonomic groups (e.g. birds, mammals and amphibians) (Possingham *et al.* 2002; Watson *et al.* 2010). Recently, the EPBC Act and state-level threatened species legislation have been scrutinised as being ineffective, limited in the representativeness of threatened biodiversity and unable to halt or prevent further biodiversity declines (Watson *et al.* 2010; McDonald *et al.* 2015; Ward *et al.* 2019).

An independent review of the EPBC Act by Samuel (2021) argued that the Act failed to meet international directives for Indigenous inclusion and leadership in conservation decision-making. However, there is growing recognition of the importance of engaging with Australian Indigenous peoples to co-develop solutions to protect threatened and culturally valued species and places (Baker *et al.* 1992; Ens *et al.* 2015; Paltridge and Skroblin 2018; Goolmeer *et al.* 2022a). At a national level, the federal government recently developed ‘First Nation’ targets within the Threatened Species Action Plan (2022–2023) that prioritises working with the right people to include their ‘knowledges in conservation assessments, processes and planning to guide recovery actions, research and monitoring activities’ (Target 15; DCCEEW 2022). As part of the Threatened Species Action Plan (2022–2023), a list of 110 priority species was determined. This list did include an ‘importance to people’ principle to help prioritise CSS; however, the list was based on species considered important for other factors, such as extinction risk (DCCEEW 2022). We suggest there is greater potential for the co-production of species knowledge and priority setting, especially within the IPA program, where Indigenous rangers are the primary decision-makers and responsible for implementation of such decisions.

In Australia, there are some examples of CSS prioritisation in fauna management and monitoring (Cochrane *et al.* 2009; Fitzsimons *et al.* 2012; McKemey *et al.* 2019; Campbell *et al.* 2022; Skroblin *et al.* 2022). In Kakadu National Park, consultations with Bininj/Munggy peoples were undertaken

to develop a threatened species priority list aligned with local priorities (Winderlich and O’Dea 2014). Species were ranked according to the level of concern by Bininj/Munggy, alongside reasons (e.g. inappropriate fire regime, effects of invasive pest species) and observed changes. In the Western Desert, two-way monitoring of Mankarr (greater bilby, *Macrotis lagotis*), a threatened and culturally significant species for the Martu people, was co-developed in response to concern around ongoing decline (Skroblin *et al.* 2022). These examples demonstrate recent concerted efforts to decolonise the prioritisation and monitoring of CSS; however, we acknowledge that such approaches are not widespread and further work is required to empower Indigenous knowledge holders and decision-makers.

Building on emerging CSS discourse in Australia, the present research aimed to better understand the animals that Daḷapaḷmi (Yolḷu knowledge holders) of the Laynhapuy IPA would identify as priority for on-ground management and research collaborations by the Yolḷu Yirralka Rangers. The research was a collaboration between the Yirralka Rangers and university researchers and was conducted in association with the Laynhapuy IPA Ward Mala (homeland leaders) and Yolḷu Daḷapaḷmi. Yolḷu Daḷapaḷmi are senior knowledge holders, among the Wāḷa Wāḷaḷu (‘place-holders’ or Traditional Owners; members of a patrilineal clan) and Djuḷgayi (caretakers; children of the women of a clan who have responsibility to care for their mother’s Country). This initiative followed five years of cross-cultural fauna research (2018–2022) by these groups, including 14 collaborative fauna surveys with over 100 participants (Ens, Yirralka Rangers, Kitchener, Campbell and Russell, unpubl. data), and Yolḷu knowledge mapping of six culturally significant species (Campbell 2020; Campbell *et al.* 2022). Throughout this work, Yolḷu Daḷapaḷmi expressed concerns for culturally important and threatened fauna and questioned what strategies could be applied to support their persistence for future generations.

The research approach included the following:

1. consultations with Yolḷu Daḷapaḷmi to develop a list of Laynhapuy priority animals for the Laynhapuy IPA;
2. recording Yolḷu reasons for animal prioritisation; and from (1) and (2)
3. investigating the similarities and differences between Yolḷu and Western species priority lists, including underlying values and concerns; and
4. collating existing baseline data for the priority animals to direct future monitoring and management decisions.

The outcomes of this research were intended to inform the Yirralka Rangers’ management efforts and research collaborations across the Laynhapuy IPA. The scope of this project centred around vertebrate terrestrial animals. Future efforts could expand this work to better capture other animals, such as birds, invertebrates, marine animals and plants.

Materials and methods

Study region: Laynhapuy Indigenous Protected Area

Located in north-eastern Arnhem Land in the Northern Territory of Australia, the Laynhapuy IPA is a region of immense local, national and international conservation value (Yirralka Rangers 2017). The IPA provides habitat for 47 species of vertebrate fauna and internationally significant critical habitat for migratory birds (Yirralka Rangers 2017). As part of the Australian monsoonal tropics, the Laynhapuy IPA makes up one of the largest intact savanna systems on Earth (Woinarski *et al.* 2007), and spans an area internationally recognised as one of the last remaining regions free from large-scale anthropogenic change (Watson 2016). However, factors continue to threaten ecosystem health and biodiversity values, namely the impacts of accelerating sea level rise, and introduced species such as water buffalo (*Bubalus bubalis*), feral pigs (*Sus scrofa*), feral cats (*Felis catus*) and cane toads (*Rhinella marina*) (Yirralka Rangers 2017). Alongside the recognised biodiversity value of this region, north east Arnhem Land is also considered a significant stronghold of Indigenous Australian traditional cultures and languages (Marmion *et al.* 2014) and a hotspot of Indigenous biocultural knowledge documentation (Ens *et al.* 2015).

North east Arnhem Land is Aboriginal Land (under the Commonwealth's *Aboriginal Land Rights (Northern Territory) Act 1976*) and has been stewarded by the Yolŋu Indigenous peoples since time immemorial. The Yolŋu form a well-defined cultural bloc, differing from surrounding groups both in terms of language and social organisation. The Yolŋu universe is divided into two moieties (halves) named Dhuwa and Yirritja. Not only people but fauna, flora, land and sea Country, and weather phenomena such as winds and clouds have a moiety identity. Rom, often translated as Law, but covering a wider field than the English translation implies, is the foundation of the Yolŋu world. Rom sets out the right way to live and entrusts the land, sea, and everything in them to the care of Yolŋu, who are, through the performance of manikay (song cycles) in ceremony, rirrakay wājawu ('voice of place'). The Yolŋu social universe is organised around gurruṯu (relations between kin). Like moiety, kinship is a universal organising principle. In relation to Country, the most significant people are first the Wāḷa Wāṯaṯu ('place-holders' or 'Traditional Owners'). The Country-holding unit is a named group of people, often called a 'clan' who trace their descent patrilineally to an apical ancestor several generations back. Also significant are the children of the women of the clan who are known collectively as Djungayī. Yolŋu translate this role as 'caretaker' or sometimes 'manager'; it is their responsibility to assist their mother's clan to look after their Country well, and the Wāḷa Wāṯaṯu will always consult senior Djungayī on matters relating to Country.

In the 1970s, Yolŋu leaders began the 'Homelands Movement' that saw many Yolŋu move from mission towns

to live on their traditional clan estates. Motivations for this movement were founded in Rom and the responsibilities of Wāḷa Wāṯaṯu and Djungayī to look after Country. The Laynhapuy Homelands Association (later the Laynhapuy Homelands Aboriginal Corporation, LHAC) was established in 1982 to support these homeland communities (LHAC 2017). The old people's vision for the LHAC was 'To determine our own future, to manage our own affairs, to become self-sufficient so that the homeland mala (clans) can continue to live in peace and harmony' (LHAC 2017). The Yolŋu leaders gave the LHAC responsibility to implement this vision.

In 2003, the LHAC established the Yirralka Ranger land and sea resource management program in response to Wāḷa Wāṯaṯu desire to manage their Country and deal with threats to cultural and environmental values. The Laynhapuy IPA was declared in 2006, with an expansion being imminent, and now covers 14,728 km² (Fig. 1). Currently, there are Yirralka Rangers working out of 14 of the Laynhapuy homelands.

Laynhapuy IPA governance system

In determining policy and priorities, the Yirralka Rangers recognise a higher responsibility to the Wāḷa Wāṯaṯu and Djungayī. A new Yolŋu governance structure was introduced to the IPA in 2021 with the goal of empowering the Yolŋu leadership to make management and operational decisions on Country. The Ward Mala governing body for the Djalkiripuyŋu (Blue Mud Bay), Miyarrkapuyŋu (Arnhem Bay) and Laynhapuyŋu (Gulf Coast) were formed through discussions with over 45 Ḍaḷapaḷmi from across the Laynhapuy homelands (Fig. 1). The LHAC endorses the decisions of the Ward Mala and ensures organisational matters are properly considered. LHAC Board and Ward Mala membership is overlapping. Supporting the LHAC operations, the Yirralka Rangers deliver collaborative governance of the IPA. The Laynhapuy IPA Advisory Committee supports Yirralka's operations by providing advice and technical support.

The Yirralka Rangers have consulted with Ḍaḷapaḷmi from all the Yolŋu clan groups to develop the next Laynhapuy IPA Plan of Management. The IPA Plan has strong focus on prioritising Yolŋu Rom and Yolŋu ways of caring for their Country. The Rangers also look to co-design partnerships that promote Yolŋu rights and interests, ensuring reciprocity. To support these partnerships, the Yirralka Rangers have produced a 'research protocol' to ensure the right people and processes are followed and that Yolŋu are leading with their partners by their side.

Prioritising animals for conservation

Consultations to identify Laynhapuy priority animals were made in accordance with Yolŋu Yirralka Ranger governance and decision-making structures. During initial consultations, university researchers attended Head Ranger and Ward Mala meetings where Ḍaḷapaḷmi nominated priority animals

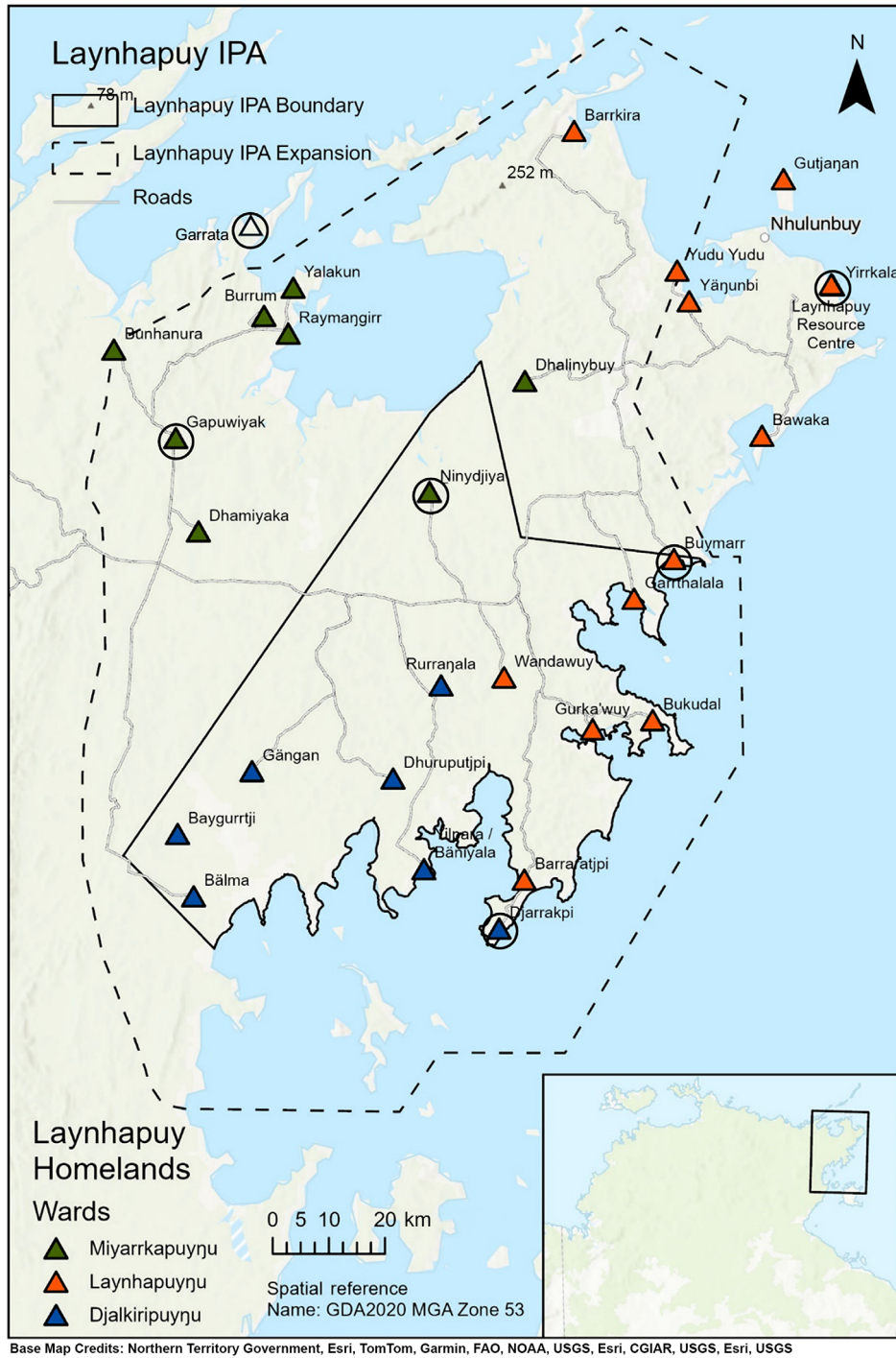


Fig. 1. Map of the Laynhapuy IPA boundary and tentative expansion. Laynhapuy homelands are coloured by respective local governance ward. Circles around the homeland symbols indicate the locations of elicitation sessions and/or ranger and Ward Mala meetings.

(Table 1, Fig. 2a). Specifically, after discussing the project, *Dalapałmi* were asked which animals they were worried about and why (Table 2). Any Yolŋu-recognised animal classifications and/or species mentioned during the elicitation

sessions were recorded by researchers. During these sessions *Dalapałmi* were also asked to identify locations where they were interested in looking for these animals, to direct collaborative camera-trapping and fauna survey research.

Table 1. List of elicitation sessions where D̩alapałmi and rangers were asked to identify priority animals.

Item	Knowledge-elicitation event	Location	Number of D̩alapałmi
Governance meetings	Yirralka Rangers head ranger meeting (April 2022)	B̩aniyala	12
	Laynhapuyju Ward Mala meeting (May 2022)	Birany Birany	11
	Miyarkapuju Ward Mala meeting (June 2022)	Dh̩alinybuy	8
Survey interviews	Garrata cross-cultural fauna survey (May 2022)	Garrata	8
	Buymarr cross-cultural fauna survey (June 2022)	Buymarr	7
	Djarrakpi cross-cultural fauna survey (October 2022)	Djarrakpi	6
	Total	6	52 ^A

^AThe total number of knowledge holders does not consider attendance of the same individuals across multiple meetings.



Fig. 2. Recording the Laynhapuy priority animals at (a) the initial Head Ranger meeting (4 April 2022), and during an (b) interview with Gapuwiyak D̩alapałmi led by the Yirralka Rangers and university researchers (credit: Emilie Ens).

Table 2. Questions used in the elicitation sessions to identify Yolju priority animals.

	Yolju Matha	English
1	Nh̩aku w̩ayingu nhe yukurra warwuyundja? Ga nh̩aku warray?	What animals are you worried about? Why?
2	Nh̩a w̩ayin important ga nh̩aku warray?	Which animals are important? Why?
2a	Nh̩a w̩ayin ŋunhiyi manikaymirri, dh̩awumirri, ga rommirri? Ga yolku b̩apurruwu?	Which of these animals are in stories, songs and ceremony? Which clans?
2b	Nh̩a w̩ayin lukanhamirrinjdja?	Which of these animals do you eat?

Translations were made by Nyemburr Munuŋgurr and Yananyumul Munuŋgurr, with assistance from Frances Morphy.

Survey interviews

Prior to three on-Country fauna surveys, elicitation sessions were conducted with D̩alapałmi from each survey location (Fig. 2b). D̩alapałmi were asked to nominate priority animals by discussing which animals they were worried about and why (Table 2). Written prior informed consent was sought for interviews in accordance with Macquarie University Human Research Ethics committee approval (Ref: 5201800178). The Yirralka Rangers nominated D̩alapałmi for interviews by peer selection and ensured that local Yolju cultural protocols were followed throughout the interview process. Interviews were conducted at the interviewee’s place of

residence or on-Country and ran for 35–75 min. Interviews were often led by the Yirralka Rangers, and were conducted in Yolju Matha and English, with the Yirralka Rangers translating *in situ*. The interviews were recorded either by audio or video (depending on permissions), and the researchers compiled a list of animals mentioned during the interviews. For the full methods and interview questions for this project see Campbell, Yirralka Rangers, Morphy and Ens (unpubl. data). At the end of each interview, researchers and rangers transcribed the recorded interviews. The Indigenous knowledge featured in this paper is the property of Yolju D̩alapałmi who gave written and/or oral prior informed consent for knowledge to be recorded and published.

During interviews, discussion of terminology was necessary to clarify the meaning of certain key concepts. Namely, clarification of ‘animal’ was needed, because the concepts in Yolŋu Matha that most closely translate as ‘animal’ (‘wäyin’ and ‘warrakan’) traditionally refer only to animals that are eaten, and/or the meat of these animals. This was navigated by listing a range of different animal groups (e.g. garkman (frogs)) or specific animals that are included in the Western scientific understanding of the term ‘animal.’ This excluded invertebrate fauna, because the project scope focused on vertebrates. Discussion of the concept of an animal was not always necessary and some Dajapalmi were familiar with the concept, namely those with Western land management experience. As there was no direct translation for the words ‘culturally significant’ or ‘important’, it was recommended to leave the English word ‘important’ in the Yolŋu Matha interview questions (Table 2, Question 2). However, we did introduce two follow-up questions to elaborate on the meaning of this, specifically asking about the clan connections and ceremonial and nutritional value of the animals (Table 2, Questions 2a, 2b).

Ranking of Laynhapuy priority animals

Priority animals recorded during elicitation sessions were given a score of 1 for each session they were mentioned in (including if they were mentioned several times during a session). The priority animal scores were tallied to generate an importance rank (Tables 3, 4, 5 and 6). Because Western scientific species and Yolŋu animal classifications are not always commensurable, some scores could not be calculated at the species level. For example, small native rodents are categorised (and discussed) by Dajapalmi as nyiknyik, and all sea turtle species, although separately named, all fall under the group name of miyapunu. If the animal group name rather than unique species name was nominated by Dajapalmi, all species within the animal group were given a score of 1. Both Western scientific and Yolŋu ‘animal group’ classifications are provided in the tables. Yolŋu animal classifications identified in the sessions were highlighted orange in the table and are what we referred to as Laynhapuy priority animals in the results. Yolŋu animal groups are from data supplied by the Yirralka Rangers and Macquarie University (unpubl. data) and Rudder (1977, 1999). The Yirralka Rangers were consulted to verify correct terminology and content of the priority animal list.

The ranked priority animals were visually displayed on a poster (Supplementary Fig. S1), which also included the current conservation status for species from the Northern Territory *Territory Parks and Wildlife Act 1976* or *EPBC Act 1999*. The poster was presented at the Head Yirralka Ranger meeting, April 2023. During this meeting, the process of collating the list and calculating ranks was explained and discussed. Following time to consider this list after the meeting, the Yirralka Rangers endorsed the list, confirming

that it represented priority animals for Yolŋu that could be targeted in a Laynhapuy IPA fauna strategy.

Laynhapuy priority animals: baseline data

The following two sets of baseline data were collated for the Laynhapuy priority animals from: (1) the Atlas of Living Australia (www.ala.org.au) (1935–2023); and (2) the eight-year collaboration between the Yirralka Rangers (YR) and Macquarie University (MQ) researchers. The Atlas of Living Australia data were checked and cleaned to remove duplicate entries (same latitude, longitude, date and time). Old data, that pre-dated electronic, satellite-enabled GPS devices, and were hence displayed in the ocean, were included in mainland estimates. Points located on islands were excluded because islands across northern Australia often constitute a refuge for many species (e.g. Woinarski *et al.* 2011) and reflect different conservation efforts, such as translocations and intensive monitoring.

The fauna data of the YR-MQ research team came from collaborative fauna surveys (2018–2023) and a camera trap monitoring program (2022–2023). The fourteen fauna surveys involved live-fauna trapping (Elliott, cage and pitfall traps), spotlighting and opportunistic sightings across three habitat sites. Camera-trap monitoring involved a five-camera array (50 m apart) across 86 sites and cameras were left out for five weeks. For the present analysis, species records for the camera monitoring were noted as presence/absence per site.

Results

Laynhapuy priority animals

Through the six elicitation sessions, Yolŋu Dajapalmi identified 30 Laynhapuy priority animals, including 26 animals representing nominal species and four animals that encompass multiple species according to Western classifications (Tables 3, 4, 5 and 6). These animals extend across 13 broader Yolŋu animal groups and span 43 nominal species in total (Tables 3, 4, 5 and 6). The highest-ranked animals (of a total rank of six, representing the six elicitation sessions) were found across the Yolŋu animal groups of Marrtjinyami wäyin (walking animals), Rupu (possums), and Djanda (goannas). These animals included wan’kurra (northern brown bandicoot, rank = 6), rupu/marrju (northern brushtail possum, rank = 4), djanda (yellow spotted monitor, rank = 4) and biyay’ (sand goanna, rank = 4). Animals that were mentioned across half of the elicitation sessions (rank = 3) included wäraŋ (savanna glider), min’tjirtjirr (mangrove monitor) and wan’kawu (water goanna). All other animals were ranked one to two, including animals from Yolŋu animal groups Nyiknyik (native rodents and dasyurids), Wetŋi ga dhum’tum (kangaroos and wallabies), Bäpi (snakes), Gal’yunami wäyin (crawling

Table 3. List of Laynhapuy priority mammals with Yolŋu and Western scientific classification groups, names and values.

Western classification group	Yolŋu classification groups	Yolŋu Yäku (name)	Common name	Scientific name	Moiety	Associated bāpurru	Rank	Conservation status	CWR	110 NPS	Reasons for worry	Eaten?	ALA records	YR-MQ project	
Mammals	Marrtjinyami wäyin (walking animals)	Waŋ'kurra	Northern brown bandicoot	<i>Isoodon macrourus</i>	Y	Guma , Gupa, Maḍa, Maŋg, Rith	6	LC (IUCN)	✓		NSA	✓	6	24	
		Barkuma'	Northern quoll	<i>Dasyurus hallucatus</i>	Y	Maŋg, Rith , Maḍa, Dhaḷ, Wang	2	CE (NT)	✓	✓	NSA		3	1	
		Djirrmaŋa'	Short-beaked echidna	<i>Tachyglossus aculeatus</i>	Y	Ḍaym, Ḍäṭi	2	LC (IUCN)	✓		NSA	✓	4	30	
	Nyiknyik (native rodents and dasyurids)	Dhurryyamba	Dhurryyamba	Water rat	<i>Hydromys chrysogaster</i>	Y	Wang , Gupa, Maŋg, Rith	1	LC (IUCN)	✓		NSA		1	8
			Manbul	Black-footed tree-rat	<i>Mesembriomys gouldii gouldii</i>	Y	Wang , Gupa, Maŋg, Rith	1	E (NAT/NT)	✓		NSA		3	10
		Nyiknyik		Common planigale	<i>Planigale maculata</i>	Y	Wang, Maḍa	1	LC (IUCN)			NSA		0	4
				Common rock rat	<i>Zyzomys argurus</i>	Y	Wang, Maḍa		LC (IUCN)	✓		NSA		2	9
				Delicate mouse	<i>Pseudomys delicatulus</i>	Y	Wang, Maḍa		LC (IUCN)			NSA		3	11
				Dusky rat	<i>Rattus colletti</i>	Y	Wang, Maḍa		LC (IUCN)	✓		NSA		2	3
				Grassland melomys	<i>Melomys burtoni</i>	Y	Wang, Maḍa		LC (IUCN)	✓		NSA		23	56
				Red-cheeked dunnart	<i>Sminthopsis virginiae</i>	Y	Wang, Maḍa		LC (IUCN)	✓		NSA		6	4
				Pale field-rat	<i>Rattus tunneyi</i>	Y	Wang, Maḍa		V (NT)	✓		NSA		0	8
				Sandstone pseudantechinus	<i>Pseudantechinus bilarni</i>	Y	Wang, Maḍa		V (NAT)			NSA		0	1
		Brush-tailed rabbit rat	<i>Conilurus penicillatus</i>	Y	Wang, Maḍa		V (NAT/NT)	✓		NSA		6	0		
	Rupu (possums)	Rupu/Marrŋu	Northern brushtail possum	<i>Trichosurus vulpecula arnhemensis</i>	Y	Maŋg, Rith , Maḍa, Dhaḷ, Wang	4	E (NT)	✓	✓	NSA, IBF	✓	2	8	
		Wäraŋ	Savanna glider	<i>Petaurus ariel</i>	D	Djap, Dhuḍ	3	NL	✓		NSA		3	5	
Weṭi ga dhum'thum (kangaroos and wallabies)	Gataḷa	Eastern short-eared rock wallaby	<i>Petrogale wilkinsi</i>	D	Gupa, Dhaḷ	1	LC (IUCN)	✓		NSA	✓	3	6		
	Garrtjambal	Antilopine wallaroo	<i>Osphranter antilopinus</i>	Y, D	Guma , Dhaḷ, Gupa, Rith	1	LC (IUCN)			NRR	✓	6	12		
												Mammals total	73	200	

Yolŋu animal classification nominated by Ḍaḷapaḷmi during elicitation sessions as being of concern or priority are highlighted in orange. Other classifications were added subsequently and checked by the Yirralka Rangers. Animals were ranked from one to six, based on the number of elicitation sessions they were identified in.

Yolŋu moiety (Y, Yirritja; D, Dhuwa; U, unknown); Yolŋu bāpurru associated with animals (Birr, Birrkili; Ḍäṭi, Ḍäṭiwuy; Dhaḷ, Dhaḷwaŋu; Dhuḍ, Dhuḍi Djapu; Djap, Djambarruyju (represents a set of clans including Dhurili, Guyula, Wutjara), Djap, Djapu; Djar, Djarrwark; Gälp, Gälpu; Golu, Golumala; Guma, Gumatj; Gupa, Gupapuyju (represents a set of clans including Birrkili, Daygurrurr, Guyamirrili, Wubulkarra), Guya, Guyamirrili; Maḍa, Maḍarrpa; Maŋg, Maŋgalili; Marr, Marraju; Marra, Marrakulu; Ḍaym, Ḍaymil; Rirr, Rirratjiju; Rith, Ritharrju; Wang, Wangurri; Warr, Warramirri; Yarr, Yarrwiḍi), bolded bāpurru represent Wajarr; Ḍaapami priority ranking across six elicitation sessions (2022–2023); Western conservation status (NL, not listed; LC, Least Concern; NT, Near Threatened; V, Vulnerable; E, Endangered; CE, Critically Endangered) across various listing levels (NT, Northern Territory; NAT, National; IUCN, International Union for Conservation of Nature); critical weight-range (CWR) mammal status; 110 National Priority Species (NPS) status; Ḍaapami reasons for worry (NSA, not seen anymore; NRR, no reason recorded; CTHM, changes to hunting method; DIH, decline in harvest; IBF, affected by fire); nutritional-value status; ALA fauna records (1935–2023) and fauna records (2018–2023) of the collaborative project between the Yirralka Rangers (YR) and Macquarie University (MQ) researchers (YR-MQ).

Table 4. List of Laynhapuy priority reptiles with Yolŋu and Western scientific classification groups, names and values.

Western classification group	Yolŋu classification groups	Yolŋu yäku (name)	Common name	Scientific name	Moiety	Associated bāpurru	Rank	Conservation status	110 NPS	Reasons for worry	Eaten?	ALA records	YR-MQ project	
Reptiles	Djanda (goannas)	Djanda	Yellow-spotted monitor	<i>Varanus panoptes</i>	D	Rirr	4	V (NT)		NSA, DIH	✓	0	2	
		Biyay'	Sand goanna	<i>Varanus gouldii</i>	Y	Rith, Dhaḷ, Maḡa, Guma, Wang	4	LC (IUCN)		NSA	✓	0	2	
		Min'tjirrtjirr	Mangrove monitor	<i>Varanus indicus</i>	D	Dəym, Dəṭi	3	LC (IUCN)		NSA, DIH	✓	0	2	
		Wan'kawu	Water goanna	<i>Varanus mertensi</i>	D	Marra, Marr, Golu, Rirr, Djam	3	V (NT)		NSA, DIH	✓	1	5	
	Bāpi (snakes)	Dārpa	Northern brown snake	<i>Pseudonaja nuchalis</i>	D	Djam, Rirr	1	NL		NRR			0	3
		Garanaṅga'	Common (green) tree snake	<i>Dendrelaphis punctulatus</i>	U	None listed	1	LC (IUCN)		NRR			4	3
		Gunuju'	Black-headed python	<i>Aspidites melanocephalus</i>	Y	None listed	1	LC (IUCN)		NRR			1	1
		Djaykuṅ'	Arafura file snake	<i>Acrochordus arafurae</i>	D	Gālp, Djar	1	LC (IUCN)		NRR	✓		1	0
	Gal'yunami wāyin (crawling animals; lizards)	Dhamiiju'	Northern blue-tongued lizard	<i>Tiliqua scincoides intermedia</i>	D	Gālp	1	CE (NAT)		NSA	✓		0	9
		Munhananiṅ'	Marbled velvet gecko	<i>Oedura marmorata</i>	U	None listed	1	LC (IUCN)		NSA	✓		2	1
	Miyapunu (sea turtles)	Dhalwatpu	Green turtle	<i>Chelonia mydas</i>	D	Djam , Djap, Dhuḍ, Rirr	2	NT (NT)	✓	CTHM	✓		99	2
		Guwarrtji	Hawksbill turtle	<i>Eretmochelys imbricata</i>	Y	Warr , Yarr, Guma, Birr, Gupa		V (NT)		CTHM	✓		454	0
		Muḡuthu	Olive Ridley turtle	<i>Lepidochelys olivacea</i>	Y	None listed		V (NT)	✓	CTHM	✓		12	0
		Gariwa	Flatback turtle	<i>Natator depressus</i>	D	None listed		V (NAT)		CTHM	✓		56	0
	Minhala (long-necked turtles)	Minhala	Northern snake-necked turtle	<i>Chelodina rugosa</i>	Y	Dhal , Wang	2	NT (IUCN)		NSA, DIH	✓		1	0
Dukawu (short-necked turtles)	Gurruṅi (big), Maḡaltj (small)	Yellow bellied snapping turtle	<i>Elseya flaviventralis</i>	D	None listed	1	NL		NSA, DIH	✓		1	0	
		Northern yellow-faced turtle	<i>Emydura tanybaraga</i>	D	None listed		NL			✓		0	0	
											Reptiles Total	632	30	

Yolŋu animal classification nominated by Dalaḷami during elicitation sessions as being of concern or priority are highlighted in orange. Other classifications were added subsequently and checked by the Yirrkala Rangers. Animals were ranked from one to six, based on the number of elicitation sessions they were identified in.

Yolŋu moiety (Y, Yirritja; D, Dhuwa; U, unknown); Yolŋu bāpurru associated with animals (Birr, Birrkili; Dəṭi, Dəṭiwuy; Dhaḷ, Dhaḷwaṅju; Dhuḍ, Dhuḍi Djapu; Djam, Djambarrupuyju (represents a set of clans including Dhurili, Guyula, Wutjara); Djap, Djapu; Djar, Djarrwark; Gālp, Gālpu; Golu, Golumala; Guma, Gumatj; Gupa, Gupapuyju (represents a set of clans including Birrkili, Daygurrurr, Guyamirrilili, Wubulkarra); Guya, Guyamirrilili; Maḡa, Maḡarrpa; Maṅg, Maṅgalili; Marr, Marraṅju; Marra, Marrakulu; Dəym, Dəymil; Rirr, Rirratjijju; Rith, Ritharrju; Wang, Wangurri; Warr, Warramirri; Yarr, Yarrwiḍi), bolded bāpurru represent Waṅarr; Daaḷami priority ranking across six elicitation sessions (2022–2023); Western conservation status (NL, not listed; LC, Least Concern; NT, Near Threatened; V, Vulnerable; E, Endangered; CE, Critically Endangered) across various listing levels (NT, Northern Territory; NAT, National; IUCN, International Union for Conservation of Nature); 110 National Priority Species (NPS) status; Daaḷami reasons for worry (NSA, not seen anymore; NRR, no reason recorded; CTHM, changes to hunting method; DIH, decline in harvest; IBF, affected by fire); nutritional-value status; ALA fauna records (1935–2023) and YR-MQ project fauna records (2018–2023).

Table 5. List of Laynhapuy priority birds with Yolŋu and Western scientific classification groups, names and values.

Western classification group	Yolŋu classification group	Yolŋu yäku (name)	Common name	Scientific name	Moiety	Associated bäpurru	Rank	Conservation status	110 NPS	Reasons for worry	Eaten?	ALA records	YR-MQ project
Birds	Buṯṯhunami wäyin (flying animals; birds)	Djirikitj	Brown quail	<i>Coturnix ypsilophora</i>	Y	Maḍa, Guma, Gupa	2	LC (IUCN)		IBF		0	2
			Red-backed button quail	<i>Turnix maculosus</i>	Y	Maḍa, Guma, Gupa		LC (IUCN)		IBF		0	1
		Buwaṯa	Australian bustard	<i>Ardeotis australis</i>	D	Rirr, Djam, Ḍäṯi, Ḍaym	1	LC (IUCN)			✓	15	0
		Biḡiwidi	Magpie lark	<i>Grallina cyanoleuca</i>	Y	Guma, Wang, Dhaḷ, Maḍa, Rith	1	LC (IUCN)		NRR		33	2
		Muḷunda	White-breasted woodswallow	<i>Artamus leucorhynchus</i>	U	None listed	1	LC (IUCN)		NRR		29	0
	Buṯṯhunamiriw wäyin (non-flying birds)	Maḷwiya	Emu	<i>Dromaius novaehollandiae</i>	Y	Gupa, Majj, Rith, Dhaḷ, Maḍa, Guma	1	NT (NT)		NSA	✓	8	2
											Birds Total	85	7

Yolŋu animal classification nominated by Ḍaḷapaḷmi during elicitation sessions as being of concern or priority are highlighted in orange. Other classifications were added subsequently and checked by the Yirralka Rangers. Animals were ranked from one to six, based on the number of elicitation sessions they were identified in.

Yolŋu moiety (Y, Yirritja; D, Dhuwa; U, unknown); Yolŋu bäpurru associated with animals (Birr, Birrkili; Ḍäṯi, Ḍäṯiwuy; Dhaḷ, Dhaḷwajju; Dhud, Dhudi Djapu; Djam, Djambarrupuyju (represents a set of clans including Dhurili, Guyula, Wutjara); Djap, Djapu; Djar, Djarrwark; Gälp, Gälpu; Golu, Golumala; Guma, Gumatj; Gupa, Gupapuyju (represents a set of clans including Birrkili, Daygurrurr, Guyamirrilili, Wubulkarra); Guya, Guyamirrilil; Maḍa, Maḍaripa; Majj, Majjalili; Marr, Marraju; Marra, Marrakulu; Ḍaym, Ḍaymil; Rirr, Rirratijju; Rith, Ritharrju; Wang, Wangurri; Warr, Warramirri; Yarr, Yarrwidj), bolded bäpurru represent Wajarr; Ḍaapaḷmi priority ranking across six elicitation sessions (2022–2023); Western conservation status (NL, not listed; LC, Least Concern; NT, Near Threatened; V, Vulnerable; E, Endangered; CE, Critically Endangered) across various listing levels (NT, Northern Territory; NAT, National; IUCN, International Union for Conservation of Nature); 110 National Priority Species (NPS) status; Ḍaapami reasons for worry (NSA, not seen anymore; NRR, no reason recorded; CTHM, changes to hunting method; DIH, decline in harvest; IBF, affected by fire); nutritional-value status; ALA fauna records (1935–2023) and YR-MQ project fauna records (2018–2023).

Table 6. List of Laynhapuy priority fishes with Yolŋu and Western scientific classification groups, names and values.

Western classification group	Yolŋu classification groups	Yolŋu yäku (name)	Common name	Scientific name	Moiety	Associated bapurru	Rank	Conservation status	I10 NPS	Reasons for worry	Eaten?	ALA records	YR-MQ project
Fish	Guya (Fishes)	Duykal'	Giant trevally	<i>Caranx ignobilis</i>	Y	Maŋg, Wang, Mađa, Gupa	1	LC (IUCN)		CTHM	✓	0	0
		Yambirrkū'	Blue tuskfish	<i>Choerodon cyanodus</i>	Y	None listed	1	LC (IUCN)		CTHM	✓	1	1
											Fish total	1	1
										PS total	791	238	

Yolŋu animal classification nominated by Daŋapałmi during elicitation sessions as being of concern or priority are highlighted in orange. Other classifications were added subsequently and checked by the Yirralka Rangers. Animals were ranked from one to six, based on the number of elicitation sessions they were identified in. Yolŋu moiety (Y, Yirritja; D, Dhuwa; U, unknown); Yolŋu bapurru associated with animals (Birr, Birrkili; Däti, Dätiwuy; Dhał, Dhałwaŋu; Dhuđ, Dhuđi Djapu; Djambarrpuyŋu (represents a set of clans including Dhurili, Guyula, Wutjara); Djap, Djapu; Djar, Djarrwark; Gälp, Gälpu; Golu, Golumala; Guma, Gumatj; Gupa, Gupapuyŋu (represents a set of clans including Birrkili, Daygurrurr, Guyamirrilili, Wubulkarra); Guya, Guyamirrilili; Mađa, Mađarrpa; Maŋg, Maŋgalili; Marr, Marrajŋu; Marra, Marrakulu; Daym, Daymil; Rirr, Rirratjŋu; Rith, Ritharrŋu; Wang, Wangurri; Warr, Warramirri; Yarr, Yarrwiđi), bolded bapurru represent Waŋarr; Daapami priority ranking across six elicitation sessions (2022–2023); Western conservation status (NL, not listed; LC, Least Concern; NT, Near Threatened; V, Vulnerable; E, Endangered; CE, Critically Endangered) across various listing levels (NT, Northern Territory; NAT, National; IUCN, International Union for Conservation of Nature); I10 National Priority Species (NPS) status; Daapami reasons for worry (NSA, not seen anymore; NRR, no reason recorded; CTHM, changes to hunting method; DIH, decline in harvest; IBF, affected by fire); nutritional-value status; ALA fauna records (1935–2023) and YR-MQ project fauna records (2018–2023).

animals; lizards (excluding goannas), Miyapunu (sea turtles), Minhala (long-necked turtles) and Dukawu (short-necked turtles) (Tables 3, 4, 5 and 6).

Laynhapuy priority animals: Yolŋu values

Across all Laynhapuy priority animals, 15 were Yirritja, 10 were Dhuwa, three had unknown moiety designations and two had both (Tables 3, 4, 5 and 6). Twenty-four animals were identified with bapurru (clan) associations (including Waŋarr ancestor beings, or totemic species), with a total of 20 bapurru (both Dhuwa and Yirritja clans) nominated from across the Laynhapuy IPA. The highest-ranked animals (ranked 4–6) all have known moiety designations and clan connections and are considered of nutritional value to Yolŋu.

Daŋapałmi drew on traditional Yolŋu ontology/epistemology and contemporary understandings of Western biodiversity conservation and global change to discuss reasons for concern about animals and why they were not seeing them as often/anymore. It is important to note that in traditional Yolŋu ontology, in Waŋarr (totemic creation times), animals were shape-shifters, who could move between human and animal form, and given the size of the marks their actions left in the landscape they were powerful, gigantic beings. People are thought to embody the Waŋarr of their clan. In the example below, a landmark considered to be the wiŋitj (olive python) is referred to as Marcus Maymuru’s mother because his mother is from the clan for which wiŋitj is a major Waŋarr:

That dream, that hill. That’s wiŋitj. Nhuŋu nãŋđi [your mother]. (Translated by Yalapuru Gumana for Nanikiya Marcus Maymuru.)

All animals still potentially have a Waŋarr aspect today and can intervene in human lives. Certain birds, for example, are harbingers of death or illness. Animals are considered to play a necessary role in ‘managing’ the land (in their own way), as Yolŋu do. In Yolŋu ontology animals therefore have consciousness and agency. They are considered to be aware of what they are doing and how they are affecting Country.

As Gathapura Munuŋgurr elaborated:

And plus the land himself, it’s important for the land to [have] animals. Because the animals are connected to the land. Because the land gives the natural resource to help them keep alive, so they can manage their land themselves and for the Yolŋu too. Because animals are also maintaining like Yolŋu.

Yet animals are also food, and much of the huge store of knowledge that Yolŋu hold about flora and fauna is directly related to their successful hunting and gathering economy. But although observed shifts in biodiversity trends (e.g. abundance, distribution) are often the basis for concern about animals, these are not understood simply in terms of presence, absence and observable, quantifiable threats as in western conservation frameworks.

When asked why the priority animals were important, Daŋapałmi provided an array of responses. The majority of responses fell into one or both of the following categories: (1) they had an ancestral and ceremonial connection with them; (2) they were of nutritional value. Almost all priority animals (n = 24) share an ancestral and ceremonial connection with Yolŋu expressed through manikay (songlines) and

buṅgul (dance/ceremony). Certain manikay and buṅgulmi animals can also be considered Waṅarr (totemic beings) and dhuyu (connected to sacred ceremony).

As Munurruṅ Bobby Wunuṅmurra translated for Marrarrawuy Margaret Waṅambi:

She wants to see it [waṅ'kurra] again because of the ceremonial connection with it. So, it's important, she wish she could see it again and [know] how to look after it . . . It would be good to, you know, the next time you see that, you sing.

Priority animals valued by Yolḷu as food (n = 19) and/or for their medicinal properties, included many of the marrtjina wäyin (walking animals/mammals), weṭi ga dhum'thum (kangaroos and wallabies), maḷwiya (emu), djanda (goannas), miyapunu (marine turtles), minhala (freshwater turtles) and guya (fish).

As Muwarra Davis Marrawuṅgu and Julie Yunupijū discussed:

We are looking for this [Djanda (goannas)] now to eat. We've got none here. Bäyḷu [none].

And Butḷiyaṅanybuy Thomas Marrkula discussed with his father Guthitjipuy Clancy Marrkula, after Clancy described gaṭala (eastern short-eared rock wallaby):

Ga [and] gaṭala rumbalku [really] old man?...That gaṭala, little kangaroo, I never seen it. Yo, because maybe long time they used to be seen or eaten mak [maybe].

Most Daḷapaḷmi were 'worried' about more than one animal. Although reasons for worry were not recorded for all Laynhapuy priority animals, the reasons fell into the following four main categories: 'not seen anymore', 'affected by fire', 'decline in harvest' and 'changes to traditional hunting method' (Tables 3, 4, 5 and 6). The most prevalent reason for concern (n = 18) was that animals were 'not seen anymore' on Country, followed by those that were not seen when specifically hunting, resulting in a 'decline in harvest' (n = 6 animals).

As Butḷiyaṅanybuy Thomas Marrkula translated for Jimmy Marrkula:

Barkuma', waṅ'kurra and what else, biyay', djanda they [are] all gone. Yo [yes]. Worrying about them because they haven't seen them that's why.

Yolḷu cited invasive species as the main reason for not seeing some animals much anymore, especially cane toads, which poisoned animals such as djanda (goannas), waṅ'kurra (northern brown bandicoot), barkuma' (northern quoll) and nyiknyik (native rodents and small marsupials).

As Banul Munyarryun translated for Mr T Bidiṅal:

We want to see all that, those mammals, and reptiles, we want to see them back on the land . . . once that cane toad come in, you can't see that [anymore].

Damage to habitats caused by feral gatapaṅa (water buffalo) and bikipiki (pigs) (specifically near wetlands) was also suggested by Yolḷu as a reason for not seeing some animals. And, in some instances, Yolḷu indicated that gatapaṅa and bikipiki were species they were 'worried about' because of the damage they cause (because of this status as a threat, they were not included in the priority list). Other threats included hot fires and 'affected by fire' was listed as a reason for worry for two animals (rupu (possums) and djirikitj (quails)) and climate change, including increasing temperatures and saltwater intrusion caused by sea-level rise (affecting freshwater ecosystems).

As Ganbilpil PJ White said:

Minhala [longneck freshwater turtles] are starting to die out. In guḷun [billabongs] there used to be räkay [water chestnut], wakwak [waterlilies] in clean, fresh water in billabongs. Now it's gone. The saltwater table is rising, the habitat is changing, with global warming.

Some Daḷapaḷmi indicated that they were worried about certain animals because of disrespect for and 'change to [traditional] hunting methods', namely for miyapunu (marine turtles), and guya (fish) (n = 3 animals).

As Gathapura Munuṅgurr described:

We are worrying about also turtle. People are taking lots of turtle, big numbers, and they are not hunting by boat, just going on Toyota Landcruiser and taking [them off the beach].

Laynhapuy priority animals: Western values and baseline data

Of all Laynhapuy priority animals (43 species), 10 are listed as 'Threatened' species at state, national or international levels, two are listed as 'Critically Endangered', two as 'Endangered', and four as 'Vulnerable' (spanning nine western recognised species in total) (Tables 3, 4, 5 and 6). Eighteen animals were considered of Least Concern (including 24 species) and three Near Threatened. Three Laynhapuy priority animals are not currently listed in conservation legislation, and include wäraṅ (savanna glider), dārrpa (northern brown snake), ṅukawu (yellow bellied snapping turtle and northern yellow-faced turtle). The Laynhapuy Priority Animal list also contains three (4%) of the 69 terrestrial fauna of the national 110 Priority Species. Notably, barkuma' (northern quoll), rupu (northern brushtail possum), and miyapunu (marine turtles) (specifically: dhalwaṭpu (green turtle) and birrṅarr (olive ridley turtle)) feature in the Laynhapuy,

threatened-species, and 110 priority-species lists. The majority of mammals (nine animals, ~14 species) identified by Yolŋu as priority, are also critical weight-range (CWR) species.

In total, 1029 baseline data records were collated for the 43 Laynhapuy priority animals across the Laynhapuy IPA (including Stage 2) (Tables 3, 4, 5 and 6), with at least one record for each priority animal (except ŋuykal', giant trevally). For the period 1935–2023, 791 records were found in the Atlas of Living Australia (accessed 28 February 2024). The YR-MQ collaborative fauna research made 238 new records from 2018 to 2023, substantially increasing the number of occurrence records for Laynhapuy priority species. Specifically, the YR-MQ project doubled the number of records for Nyiknyik (native rodents and marsupials), Rupu (possums) and Weŋi ga dhum'thum (wallabies and kangaroos) groups, and quadrupled records for the Marrtjinyami wäyin (walking animals; here 'mammals') group. The YR-MQ project detected all terrestrial reptile priority animals, increasing records for the Gal'yunami wäyin (crawling animals) group seven-fold, and for Djanda (goannas) 10-fold. Occurrence points were recorded at the species, rather than Yolŋu-identified animal level. There was strong bias in records of some species. For example, there was a large number of miyapunu (marine turtles) records and very few records minhala and ŋukawu (freshwater longneck and shortneck turtles), despite their being similarly ranked. Occurrence data exist for all species except the northern snapping turtle, and giant trevally.

Discussion

I think there is a question for all of us. I think we can't manage the environment, because of climate change.... We can't solve all of nature. Researchers are here to help us, and we can help them too. (Yinimala Gumana, Yirralka Rangers Co-Manager, 4 April 2023)

The Laynhapuy Priority Animal List (Supplementary File S1) represents a 'working' group of important animals that can inform locally meaningful management and research collaborations in the Laynhapuy IPA. Production and promotion of this Daŋapaŋmi priority animal list addresses growing bottom-up and top-down calls for practical and meaningful inclusion of Indigenous values and interests in conservation decision-making, policies and programs (IPBES 2019; Wintle *et al.* 2019; Samuel 2021; Goolmeer *et al.* 2022b).

Capturing pluralistic worldviews

The Laynhapuy Priority Animal List (Tables 3, 4, 5 and 6) explored alignment of Yolŋu and Western values, necessitating attention to often divergent Yolŋu and Western scientific taxonomic terminologies. Pluralistic worldviews, epistemologies and ontologies demand that equitable cross-cultural

approaches adopt a multiple evidence-based approach and avoid subsuming one into another (Tengö *et al.* 2014; Law *et al.* 2018; Ens *et al.* 2023). To promote Yolŋu values, the Priority List included the Yolŋu kinship (gurrutu), moiety and bāpurru (clans) associated with each animal. Clans that sing or dance these animals were often discussed when Daŋapaŋmi were asked why they were important. Publication of clan–animal connections directs future projects to acquire appropriate permissions for work, especially for major Wajarr (totemic) animals. We also noted which species were nutritionally valuable (eaten) as a key aspiration for Daŋapaŋmi was to not only see but to hunt and pass on knowledge of how to hunt and eat these animals.

The ranking system indicated a general consensus across participating Daŋapaŋmi. We acknowledge that not all Daŋapaŋmi across the Laynhapuy IPA were consulted to produce this published list; however, we followed Yolŋu governance structures and consulted Daŋapaŋmi of the three Wards (Figs 1 and 2) as recommended by Yirralka Ranger co-researchers. Further, this list is not intended to be a static entity. Rather, the Laynhapuy Priority Animal List is a resource that the Yirralka Rangers can adapt over time, as recommended by Coe and Gaoue (2020) and Bundjalung leaders in Goolmeer *et al.* (2024). Experimentation with other ranking methods could be explored in the future to incorporate the nuances of Yolŋu priorities.

In response to the directive of the Yirralka Head Rangers, captured by the words of Senior Yirralka Ranger Banul Munyarrun presented at the front of this paper, the Laynhapuy Priority List also includes animal's Western conservation status. Unlike previous attempts to bring Western scientific threatened species and Indigenous values together (e.g. DCCEEW 2022), we began by privileging Yolŋu priorities, and then added Western science metrics to broaden the knowledge base. Additionally, we indicated which species were on the national '110 Priority Species' list (DCCEEW 2022) and were CWR mammals (35 g–5.5 kg), highlighting those most at risk from extinction (Woinarski 2015). Notably, higher ranking from Yolŋu Daŋapaŋmi did not always correspond with Western threatened-species status. For example, the waŋ'kurra (northern brown bandicoot) was the highest-ranked Laynhapuy priority animal and is considered of Least Concern by Western science. This could reflect the cultural significance of the waŋ'kurra as an important Wajarr (totemic being) and food source and/or that local knowledge of declines are not captured by Western conservation metrics (Campbell *et al.* 2022). This shows the benefit of including local or regional knowledge to identify local or regionally important species.

The importance of scale

Scale is considered an important point of difference between Indigenous and Western knowledge systems (Wohling 2009). A global list of CSS identified 48 species in the Oceania region, including Australia (Reyes-García *et al.* 2022). None of the

Laynhapuy priority animals was listed for the Oceania region, and only two were listed as ‘global’ CSS (wurrumbili, leatherback turtle; gärun, loggerhead turtle) (Reyes-García *et al.* 2022). The discrepancy between the global and local CSS here is stark and highlights the disconnect between large- and small-scale assessments and importance of on-ground Indigenous-led nomination of priority animals (Coe and Gaoue 2020; Goolmeer *et al.* 2024). Furthermore, respecting Indigenous people’s agency to decide which animals are a priority to them, rather than the use of a ‘yes/no’ metric of cultural significance can open up space for ontological pluralism and opportunity to empower local decision-making and livelihoods (Naughton-Treves *et al.* 2005; Hill *et al.* 2020), congruous with international directives for inclusive conservation (IPBES 2019; CBD 2021).

Baseline data on Laynhapuy priority animals

Assessment of the Laynhapuy priority-animal baseline data highlighted the paucity of animal research in this region compared with other parts of northern Australia such as Kakadu National Park (Woinarski *et al.* 2007, 2011). The lack of Western data does not correlate with absence but highlights an opportunity for further research by the Yirralka Rangers through collaborative surveys. The YR-MQ animal research over five years significantly increased the recorded distribution and presence of highly ranked priority animals, especially the mammals and varanid lizards. Increasing the species occurrence records for this region not only directs local management efforts but can attract competitive conservation funding that often targets threatened species and relies on observation records.

Interestingly, the ALA data were collected over 88 years, whereas the collaborative YR-MQ surveys were conducted over five years. The comparative records in Tables 3, 4, 5 and 6 illustrate that through culturally meaningful and inclusive approaches, data gaps can be addressed on remote Aboriginal-owned and -managed lands, building on evidence from other studies, such as Ens *et al.* (2016). Furthermore, by focussing on culturally significant species, research and management not only addresses Western species conservation pursuits (quantification and distribution mapping) but also invests in cultural knowledge maintenance and empowerment in the conservation space. Identification of known locations, or lack thereof, of highly ranked Laynhapuy priority animals, such as wan’kurra, provides practical direction for further research and management action.

The YR-MQ research focussed on terrestrial surveys and mainly targeted mammals and reptiles on the basis of initial concern for these groups. The bird, turtle and fish records were opportunistic and/or collected during hunting activities as part of the cross-cultural survey method. Further ethnographic research to record Dajapalmi ‘memory knowledge’ of past observations, similar to Russell *et al.* (2023) and Campbell *et al.* (2022), could add records for ‘Data

Deficient’ Laynhapuy priority animals to detect whether in fact they were always in low numbers, declining in this region, or are still present and just have not been recorded yet.

Lost in translation?

For many of the priority animals, Dajapalmi stated that they were ‘bäyñu nhäma’ (not seeing) the animals anymore, or not as much as people once did. However, this question was ambiguous for some people and required qualification. For example, some Yolŋu were ‘worried’ about certain animals as cultural obligations were not being followed, such as correct hunting methods, or they were worried as a particular animal was invasive, or because an animal was poisonous or venomous. Similarly, when asking which species were ‘important’, some Dajapalmi asked what this meant, as there is no direct translation of the word important in Yolŋu Matha. There is also no direct translation for ‘animal,’ and the words ‘warrakan’ and ‘wäyin’ which were used as translations refers to edible animals only (Boll 2006) and so Dajapalmi and the research team often had to negotiate meanings of terms during interviews to reach a mutual understanding. It is important to note that the discussion about what organisms qualified as animals may have been influenced by the interests of the YR-MQ research group in vertebrate terrestrial fauna. Hence, no invertebrate fauna were mentioned and only 8 of 30 aquatic or marine species were nominated as a concern by Dajapalmi. These difficult translations and potential bias warrant caution for future research to ensure sound knowledge of local language, communication style and terms. Secondary qualifying statements are often essential when working in cross-cultural bilingual contexts to check understandings, and collaboration with expert linguists is strongly advised.

Further, ontological and epistemological differences between cultures can result in communication disconnect and gaps in understanding. In this study, it is likely that Yolŋu spiritual dimensions of understanding and concern for Country and animals were not fully captured. For example, when the Laynhapuy Priority Animal List poster was fed back to the Head Yirralka Rangers by the researchers, they spoke about the animals being ‘clever’ and hiding from the research team and hypothesised that failure to observe animals could be connected to fulfilment (or not) of ceremonial obligations. Such comments imply that the animals may actually be abundant and they were exhibiting a kind of ‘cultural’ agency that would not be attributed to them within a Western framework. This reinforces the need for continued discussion and refinement of the list and questions to ensure that they are accurate, relevant and appropriate.

Taxonomic differences

Differences in Yolŋu and Western priority-animal classifications also created challenges in synthesis of the priority animal list. Yolŋu sometimes have no name for what Western

science designates as a species; conversely, in some cases there are multiple names for different members of what would be considered a single species under Western frameworks (Dickson 2015; Si 2020). Examples where Yolŋu differentiate males from females but there is no overarching Yolŋu name include the antilopine wallaroo and northern brushtail possum. Freshwater turtles are named differentially according to their size or life-stage (whether or not they are aestivating). Some priority animals were identified using an animal-group term that does not correspond to Western notions of species, but to a group of species, such as the Miyapunu and Nyiknyik groups. The term Miyapunu encompasses several turtle species (and sometimes also dugong), all of which also have Yolŋu names. Miyapunu anatomy is also named in detail and there are laws about how to cut and eat them according to Rom. Nyiknyik is a general term often used for several species of rodents and dasyurids, some of which do have specific Yolŋu names; however, increasingly, people do not know these and use the more well-known group name. In this study, Yolŋu did not know unique names for the small nyiknyik that Western science splits into species.

The Yolŋu group names for morphologically similar taxa, such as nyiknyik or djanda (large goannas), did at times add uncertainty to discussions. Daŋapaŋmi expressed concern that the younger generations were learning only the general names for some animal groups, for example, referring to all large goannas as djanda, or all rodents and dasyurids as nyiknyik. The loss or shift in salience of traditional animal names has also been noted for other language groups in Arnhem Land (e.g. Dickson 2015), even where intergenerational language transmission is strong (e.g. Si 2020). Changes to lifestyles and hunting practices, as well as species decline, were implicated in the loss of specialised taxonomic terminology (Si 2020), whereas totemism, songlines and social practice ('related to abundance and physical proximity of species') were considered factors associated with maintained salience of taxonomic names (Dickson 2015).

As mentioned in the introduction, certain animals may also have ceremonial names that are taught only to the right people according to Yolŋu Rom (Morphy 1991; Boll 2006). The Yolŋu animal names featured in the Laynhapuy Priority Animal List are public knowledge names only. In the wake of changing lifestyles and species decline, manikay (songlines) may serve as a means of maintaining specialised terminology relating to animals (alongside other phenomena). However, the information in manikay becomes increasingly abstract and esoteric unless it is reinforced by experience in place that supports intergenerational transmission, as described by Dhaŋwaŋu Daŋapaŋmi in Boll (2006). Such nuances of Indigenous language are at risk of being lost due to the forces of globalisation and technological expansion (Maffi 2001). Deliberate actions to maintain cultural diversity are essential, especially in propitious niches such as the thriving Indigenous Ranger and Caring for Country programs (Moorcroft 2016) and biocultural conservation initiatives

more generally (Maffi and Woodley 2012; Sterling *et al.* 2017; Reyes-García *et al.* 2022, 2023).

Continued application of the Daŋapaŋmi prioritisation approach by the Yirralka Rangers may assist the maintenance of Yolŋu taxonomic terminology and CSS salience in younger generations, enabling active biocultural conservation. As in other Indigenous societies, Yolŋu knowledge is embodied and performed, and terminology is passed on through experience rather than classroom instruction (Morphy 1991; Christie 2007). As Yolŋu Daŋapaŋmi in this project discussed, this knowledge has been largely passed on through hunting (discussed also by Dhaŋwaŋu Daŋapaŋmi in Boll (2006)). Similarly, support for 'on-Country community gatherings linked to cultural practice' was identified by the Bundjalung people to positively benefit conservation of CSS (Goolmeer *et al.* 2024) and by Yolŋu for adaptations to climate-driven environmental and social changes Petheram *et al.* (2010).

Conclusions

Localised species prioritisation efforts can guide on-ground animal management and cross-cultural research collaborations. Prioritisation allows for more effective use of resources, especially in remote sparsely populated areas such as the location of this case study. This case study followed local Yolŋu governance structures and cultural protocol to generate a Daŋapaŋmi-led animal priority list, complemented with Western science values. The 'working' list concept supports an adaptive management approach, which aligns with Indigenous stewardship of Country (Berkes *et al.* 2000) and can continue to provide IPA decision-makers with a better understanding of what assets Daŋapaŋmi want to protect.

As Goolmeer *et al.* (2024, 1628) argued, 'Indigenous peoples are ready to sit at decision-making tables' to inform management of Country. This case study has demonstrated that local Indigenous governance structures and organisations such as ranger groups are capable of asserting their own priorities, (rather than having them defined by a third party) and can also be interested in engaging with Western science metrics and methods in collaborative research. As the number of Australian Indigenous Protected Areas continues to increase, respectful, collaborative work that builds bridges between Indigenous and Western priorities is needed to inform equitable and locally relevant Australian biodiversity conservation. As Yirralka Rangers Co-Manager Yinimala Gumana expressed at the Head Ranger meeting (4 April 2022):

We need to work together, learn together and walk together.

Supplementary material

Supplementary material is available [online](#).

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Data availability. Data may be provided upon request depending on permissions from the research team and Yolŋu ḎaḎapaḎmi.

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