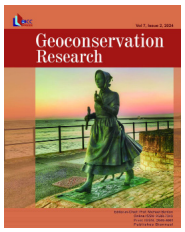

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More than Museums: Care for Natural and Cultural Heritage in Australia

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Abstract

Fossils and First Nations artifacts are both physical remains that demonstrate the deep history of the Earth and its inhabitants. Modern museums have become the places where both of these kinds of natural and cultural heritage are often stored. Yet, many museums carry baggage of institutional distrust, rooted in damaging colonial practices that rely on extractive approaches to research and collection. These practices have encouraged the separation of paleontological and cultural collections and knowledge, and have often excluded First Nations voices from their exhibitions and research practices, Here, we explore the role of museums and their relationship with paleontological objects and sites in Australia and their relationship with First Nations peoples and heritage. We analyze the results of the 'Found a Fossil' survey, and describe three case studies; paleontological and cultural cross-over with dinosaur tracks in the West Kimberley region of Western Australia, the digital Museum of Stone Tools initiative, and the Rola[Stone] documentary film project, both based on Anaiwan Country in New South Wales, Australia. Acknowledging the innate duality of objects and places promotes elevated complexity in the way they are understood, studied, managed, legislated and curated. It is essential that First Nations stories, places, and objects be centered with fossils and geological materials to simultaneously tell the story of life on Earth, and in Australia, the story of the oldest living cultures in the world.

Keywords: Paleontology; Archaeology; Museums; Heritage Conservation; Australia; First Nations; Fossils; Artifacts

Introduction

Everything is Country. To Aboriginal people, fossils are artifacts. That is our culture. The fossil has its own spirit. We don't see or distinguish between our artifacts and a fossil. Our artifacts come from Mother Earth; a fossil comes from Mother Earth. I come from the Earth. I walk the Earth. I die, I go back to the Earth. Everything positive comes from the Earth. Everything negative comes from the Earth. Earth is the end and break of our life, our existence.

The Earth can continue without us. We can't con-

tinue without the Earth.

– Steve Ahoy, Anaiwan Elder, Cultural Knowledge Holder

Ask any paleontologist if they have had a member of the general public confuse their field of study with archaeology, and vice versa, and you will find that this is very common. Despite the differences between these disciplines, both are perceived as being focused on retrieving 'lost ancient treasures' from the Earth. This confusion of disciplines by the public has also impacted the conservation of these objects and sites.

Paleontology is the study of the physical remains of past life, potentially of considerable age, whereas archaeology focuses on the physical and intangible evidence of human behavior. The archaeological record began with the first evidence of hominin behavior, about 3.2 million years ago (Harmand *et al*. 2015). Fossils of ancient hominins are analyzed by paleoanthropologists, the associated tools are studied by archaeologists, and the associated animal bones are studied by vertebrate paleontologists and/or zooarcheologists.

In most academic institutions, paleontology departments are considered part of the Earth and life sciences, while, in Australia, archaeology is often (but not always) placed within the humanities, despite its overt reliance on scientific methods in modern research/excavations. These areas of overlap reflect the Western focus on categorization and teleological concepts of time, but the hard boundary placed between them is somewhat artificial.

Australia was colonized by 47,000 BP (O'Connell *et al*. 2018)—perhaps as early as 65,000 BP (Clarkson *et al*. 2017)—and these First Peoples encountered a suite of diverse megafauna species as they spread across the continent. By about 30,000 BP, most species of Australian megafauna were extinct. When cultural artifacts and ancestral burials are discovered in Australia, they are managed by archaeologists/anthropologists in collaboration with First Nations Traditional Owners, following protocols mandated by cultural heritage legislation, but when the remains of extinct animals such as megafauna are found, paleontologists excavate the site, guided by quite different legislation. This separation of paleontology and archaeology can be limiting; both need to be more deeply understood and appreciated and have richer cultural and academic value when viewed together – drawing on cultural, scientific, traditional and western knowledge systems and ways of thinking to learn about the past in a holistic process.

Geology, ecology, paleontology, and archaeology are all the same thing to me – they all overlap. They're all the study of Mother Earth.

– Steve Ahoy, Anaiwan Elder, Cultural Knowledge Holder

This disparity can also clash with the perception of First Nations communities who typically consider cultural artifacts and fossils as part of Country. Therefore, paleontological (and by extension, geological) sites and fossils are connected to Country and are culturally important. It is relatively common in Australia for a member of the public to stumble upon a fossil or a First Nations archaeological site or object, but knowing what to do next may be confusing because of unclear legislation and misconceptions, and distrust of institutions and organizations (Hurst *et al*. 2023). Stone artifacts have increased preservation potential and so are more resistant to decay over hundreds or thousands of years (relative to wooden/plant- or animal-based artifacts), and so are objects modern people more readily come across. However, knowing the difference between fossils, stone artifacts, and other rocks may be outside of the knowledge of a farmer, bushwalker, or miner who may not have studied these fields. Indeed, fossils and artifacts are evidence of the continent's deep-time past; they are part of a continuing sto-

ry, not two different stories. However, the public probably has little incentive to understand the nuances in legislation that protect Aboriginal cultural heritage material versus paleontological material (Hurst *et al*. 2023).

Museums are uniquely situated to negotiate between the activities of the public and the aspirations behind the legislation managing cultural heritage and fossils. While we acknowledge that museums are colonial institutions, and many First Nations peoples would rather see their cultural material returned and kept on Country, museums are currently the largest existing repositories for both natural and cultural heritage objects (even if these objects were sometimes acquired through questionable and unethical means). Modern museums are tasked with communicating the importance of these archives in their collections, and, by extension, the importance of unrecovered archives that still reside in the Australian landscape. Yet, staffing and funding restraints often restrict these activities to those that occur within museum walls. As such, in response, many grassroots initiatives, driven by motivated individuals or community groups have taken up this mantle of the protection and communication of heritage in Australia.

Here, we explore heritage protection and communication in Australia at the intersection between paleontology and archaeology within museums and across regional centers and include three case studies: paleontological and cultural knowledge on the 'Dinosaur Coast' in the West Kimberley, the digital Museum of Stone Tools initiative, and the Rola[Stone] documentary film project. We discuss how the approaches of paleontology and archaeology can assist in a better understanding of First Nations cultural knowledge, western scientific research, public understanding, and the grand history of life on this planet.

Human-Fossil Relationships

While fossils are defined as being the remains of life from a past geological age, artifacts are defined by their relationship with and modification by humans. Artifacts can be of different materials ranging from wood, stone, plants, bone, shells, animal products, etc., and include a diverse array of objects, from weapons and tools, baskets, clothing, jewelry, and ceremonial and burial items. Their elevated preservation potential means that stone artifacts are often the objects that modern people come across.

Many cultures use the paleontological and archaeological records to help define their foundational beliefs and creation stories, and individuals within those cultures relate to foundation stories via objects (Csikszentmihalyi & Rochberg-Halton 1981; Bradley 2002; Wheeler & Bechler 2021). Humans construct aspects of beliefs, stories, and identities by referring to physical evidence of the past (Heersmink 2018; 2022; 2023), and the objects used for this are often artifacts from the archaeological record (e.g., Urwin 2019) and, sometimes, fossils (Mayor 2011, 2013).

The archaeological record indicates that behaviorally modern *Homo sapiens* collected, transported, and used fossils for many purposes across the world. In the Upper Paleolithic in Europe, people collected fossil marine shells, sea urchins, rudist bivalve mollusks, coral, sponges, ammonites, and belemnites, among others (Oakley 1975; 1985; Moncel *et al*. 2012). These were sometimes abandoned without modification but were frequently perforated or grooved for suspension as jewelry or sewing onto clothing. Amber and jet or lignite (fossilized organic matter) were carved into beads and figurines during the Upper Paleolithic (Moncel *et al*. 2012), and an extensive trade network for Baltic amber was in place by the Neolithic across Europe (Mazurowski 1984; Gimbutas 1985; Czebreszuk 2003). Pendants and carvings of Baltic

amber were frequently interred in graves (e.g., Núñez& Franzén 2011; Larsson 2017), highlighting its importance. An extensive review of prehistoric sites in Iberia documented persistent use of fossils dating from the Upper Paleolithic through the Bronze Age (Cortés-Sánchez *et al*. 2020); nearly 500 fossils from archaeological contexts were identified, including large mammals, shark teeth, gastropods, bivalves, scaphopods, crinoids, and fish. A section of large rudist mollusks fossilized in the limestone of a cave wall was decorated with red ochre dots, and slabs with fish and bivalve fossils were used to line the walls of megalithic graves, although most fossils were used as markers of social identity by wearing them as pendants or beads (White 1993; Kuhn 2014; Cortés-Sánchez *et al*. 2020).

Fossil shark teeth, stingray spines, and slabs with fish fossils were placed in subfloor temple offerings and within Mayan tombs. These slabs of fish fossils were painted with blue and red pigment, and use-wear analysis suggests that the edges of the shark teeth and spines were used for cutting. The fossils preserved in the slabs were emphasized by removing the surrounding matrix (Alvarado-Ortega *et al*. 2018). Iconography on incense burners from Mayan Palenque represent large shark teeth near their mouths, and bivalves appear as earmuffs, interpreted by Cuevas-García and Alvarado-Ortega (2012) as deliberate images of fossils (see also Newman 2016). In a Pre-Columbian site in Panama, *Otodus megalodon* teeth were painted red and black and interred in a grave along with other ceremonial materials (de Borhegyi 1961). In North America, fossil shark teeth were traded extensively along the northeastern Atlantic Coast and the Ohio River valley and interred in ritual mounds and burials. Large numbers of fossil shark teeth were traded out of the Chesapeake region and the Carolinas as part of the Hopewell Interaction Sphere, ca. 1500-2000 BP (Betts *et al*. 2012); nearly 200 fossil teeth have

Figure 1. Examples of both fossils and artifacts that have been made into pendants/talismans, demonstrating the similar use of the objects throughout human history. A) Pendant made from a fossil shark's tooth—From Fayum Kom K (4200-5000BC), Egypt. Accession number: LDUCE-UC2909. University College London (2017). Image: CC by CC BY-NC-SA 3.0 DEED; B) Tooth pendant set in gold, Etruscan, 4th Century BC, Italy. Metropolitan Museums of Art, Accession Number: 95.15.288; C) Recycled stone adze from Laos with modern wrapping for suspension. The adze was made and used in the Neolithic but recycled in recent times for use as a talisman (Curry 2020; Moore 2020a). D) Cigarette package from the 1920s detailing how neolithic arrowheads were re-used as pendants. Imperial Tobacco Company (n.d.); E) Large Neolithic flint arrowhead, mounted in silver, with suspension ring. Aquila, Abruzzi, Italy. From Balfour (1929b), Pl. II, no. 19.

been found in Hopewell archaeological contexts in Ohio (Murphy 1975). Some fossil teeth were modified by retouching and perforating for use as pendants, and unmodified red ochre-coated megalodon teeth are found singly and in caches with contemporary teeth of great white and mako sharks (Ritchie 1965; Murphy 1975; Carr & Case 2005; Betts *et al*. 2012). Large shark teeth were recovered by archaeologists in a ceremonial mound at Cahokia (Elliott & Whitenack 2013). Fossil shark

teeth were also collected by Neolithic people in Oman (Charpentier *et al*. 2020), Iron Age people in the southern Levant (Tütken *et al*. 2020), and peoples in Neolithic and Dynastic Egypt (Oakley 1975: 17).

Elements of the archaeological record can also function as 'memory aids' in the construction, maintenance, and re-negotiation of a culture's history and legitimacy. This is most obviously manifest in behaviors centered around monuments and buildings in many colonial cultures (Bradley 2002), but perhaps more often involves the use of cultural artifacts (e.g., Colwell-Chanthaphonh & Ferguson 2006). For instance, people of Oroko Bay, New Guinea, observe the nature and distribution of buried pottery sherds that are linked to culturally significant soil horizons, to reconstruct the actions of ancestors (Urwin 2019). In Europe both fossils and stone artifacts were referred to as 'thunderstones' and were used as talismans to ward off evil influences, prevent lightning strikes, and ensure successful and bountiful milk production, among many other properties (Balfour 1929a, b; Carelli 1997; Johanson 2009; Houlbrook 2019; McNamara 2020). The link between stone tools and thunderstones is widespread, occurring on most continents (Seonbok 2002; Brumm 2018). While stories and beliefs related to the creation or origination of stone artifacts varied from origin stories of fossils, stone artifacts and fossils themselves were often used in identical ways (Fig. 1). Indeed, the inclusion of an echinoid fossil and a broken Neolithic stone axe in an Iron Age pot in Britain may have been meant to invoke the talismanic properties of both simultaneously (McNamara 2007). This is also suggested by the discovery of stone axes and fossils together 'in a heap' at a Romano-Celtic temple site (Oakley 1985). Stone artifacts, like fossils, were mounted or suspended as talismanic items in Medieval Europe (Balfour 1929b; Faraone 2014), a pattern which began thousands of years earlier and continues to the modern day (cf. Colwell-Chanthaphonh & Ferguson 2006). Stone tools and fossils were also used in similar ways for medicinal purposes. In Ghana, stone 'god' axes from archaeological sites were collected and scraped to produce a medicinal powder (Burton & Cameron 1883)—much like 'dragon' fossils in Asia (Oakley 1975, McCormick & Parascandola 1981)—and stone axes and fossils in Southeast Asia and Indonesia are still used for medicine today (Brumm 2018). Ancient mummies from Egypt were powdered and consumed to cure disease, an activity persisting into the 20th Century (Gorini 2005), and the handling of fossils and artifacts is a modern method for improving health outcomes for patients (Chatterjee *et al*. 2009; Ander *et al*. 2013; Solway *et al*. 2015) or as aids for memory therapy in the elderly or dementia patients (Simpson *et al*. 2004; Thøgersen *et al*. 2022).

Despite the similarities between the treatment of fossils and artifacts, fossils are used as icons that invoke natural history and artifacts made by prior humans were icons that invoked cultural history, although the stories are often conflated. The convergence of similar strategies for integrating them into peoples' lived experiences attests to the way objects found on the earth serve to 'ground' cultural narratives in local landscapes and daily activities.

First Nations peoples in Australia use both fossils and stone artifacts to affirm their connection to Country. First Peoples arrived on the landmass now called Australia ca. 47–65,000 years ago (Clarkson *et al*. 2017; O'Connell *et al*. 2018) and these first human inhabitants overlapped with at least eight species of now-extinct megafauna for perhaps up to 17,000 years (Westaway *et al*. 2017; Broughton & Weitzel 2018; Zeller & Göttert 2021). While the physical remains of extinct megafauna are invariably considered fossils and so the purview of western-trained paleontologists

in Australia, they were living animals for early First Nations peoples. As the temporal cross-over of megafauna and First Nations peoples spanned thousands of years, First Nations peoples likely knew that fossilized bones represented large, extinct, versions of living species. Some rock art depictions are said to be images of now-extinct species (Taçon & Webb 2017), although none of these motifs is dated and they can be parsimoniously explained as images of still-living animal species (Bednarik 2017). Archaeological evidence for this period of overlap occurs at Cuddie Springs in New South Wales, where megafaunal remains have been discovered alongside First Nations objects/sites. While direct evidence of interaction or hunting has not been confirmed, the taphonomy and site formation processes indicate that the area has not been disturbed (Fillios *et al*. 2010; Field *et al*. 2013). Additional megafaunal and cultural sites are being reanalyzed or excavated, adding to the evidence of this overlap (Westaway *et al*. 2017; David *et al*. 2021; Johnson *et al*. 2021; McNiven & David 2023), including cultural deposits at Warratyi rock shelter in South Australia that includes both Diprotodon bone and Genyornis eggshell (Hamm *et al*. 2016).

First Nations peoples' Traditional Knowledge incorporates these extinct animals into many aspects of their cultures (Akerman 2009; Cane 2013). For instance, the Uallaroi People at Cuddie Springs explain that the fossils were the remnants of meals of the mythical figure mulyan, an eagle who had a nest near the site (Anderson & Fletcher 1934). Megafauna bones from the Lake Eyre basin are known to the region's Arabana Traditional Custodians as kadimakara, an extinct form of animal that once lived in the verdant roof of the world (Australian Government, Department of Climate Change, Energy, Environment and Water 2023), and megafaunal bones in the Ikara-Flinders Ranges are referred to by Adnyamathanha people as yamuti, giant extinct animals that found it difficult to raise their heads (Tunbridge 1991). Stone tools from prehistory are similarly related to foundation stories by later people; for instance, Djaru and Kitja flintknappers in the Kimberley region of Western Australia assigned earlier types of spearpoints to panangga (bird-people), who lived there before the arrival of the present-day custodians (Tindale 1985; Moore 2015). These examples show how First Nations peoples in Australia may use fossils and artifacts in a similar way as other cultures around the world. While the cultural beliefs, connections to Country, and relationships to these objects are likely as diverse and unique as First Nations cultures themselves—fossils and artifacts are similarly used as a means of relating physical objects in the environment to both everyday life and the cultural narratives that define their cosmology.

Given these universal practices, it is not surprising that many people encountering fossils and artifacts in Australia today feel as if they have encountered something important. The discovery of First Nations artifacts—usually stone tools—poses a difficult issue, as these ubiquitous objects are iconic reminders to non-Indigenous people of the deliberate and often violent dispossession of the ancestors of First Nations peoples who live in their communities today. Many non-Indigenous people react to First Nations artifacts with a lack of interest or even fear, others often feel a strong need to act responsibly in relation to these objects, both fossils and artifacts, and they seek guidance from cultural institutions to do so. While museums are often contacted for advice given their role as key institutions in Western cultures (Coombes 1988), there is also a level of distrust in contacting museums (especially state museums) as they are perceived as political tools of the government (cf. Elgenius 2014). As a result, First Nations 'keeping places' are playing an increasingly important role in the custodianship of cultural objects (discussed more below). The process of returning artifacts

directly to keeping places tracks the progress of ongoing reconciliation with First Nations peoples, as conventionally these artifacts were deposited in museums or universities. While this is a modern example of using artifacts from landscapes in the ongoing negotiation and creation of cultural narratives, it can also be seen as First Nations peoples having more rights and agency over their own cultural heritage and its display (or removal) in museums.

The Role of Museums

The historical linkages between materiality and knowledge are well established (Simpson 2022). Museums, as currently construed, are, like universities, knowledge-based European institutions that have carried a western scientific 'enlightenment epistemology' to all corners of the world during the expansion of European empires in the later part of the previous millennium, often through invasion and dispossession. Museums are places for the interpretation of collections of both natural and cultural history, and therefore become a conduit of information between these objects, the people they originally belonged to, the institution they are housed, and the communities for whom the collection is ostensibly designed to serve. Despite the possibility that earlier variants of the museum encompass multiple epistemologies (Simpson 2022), the singular enlightenment epistemology was particularly exclusive of others in colonial-settler societies. This inherent sense of cultural superiority marginalized and excluded other, largely indigenous, Ways of Knowing the world. In fact, some scholars see the singular enlightenment epistemology as the only true form of the museum (e.g., Van Praët 2019). This placed museums and universities at the center of colonial power and knowledge and therefore colonial epistemic predominance. Despite this, some authors have noted that even from within the colonial museum system, agencies associated with the materiality of the objects themselves can still challenge the dominant epistemic paradigms (e.g. Thomas 1997; Innes 2021; Harrington & Creighton 2024).

In 1946, when the International Council of Museums (ICOM) was founded, museums included "all collections, open to the public, of artistic, technical, scientific, historical or archaeological material" (Lehmannová 2020). In 2022, this was updated and the ICOM now defines a museum as "a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing" (ICOM 2022).

Distrust in Museums

In my experience, I have never seen a museum freely engage with our community and say 'hey, we've got your stuff, do you want it back?'. It's always us having to go through the authorities to come down onto museums to force the return of our cultural heritage.

- Steve Ahoy, Anaiwan Elder, Cultural Knowledge Holder

For museums in many countries, the communities to whom objects originally belonged no longer exist as a group that can be consulted (Schuenemann *et al*. 2017; Vågene *et al*. 2018). This makes the museological process of decontextualization from the original setting and recontextualization into the museum irreversible. However, in Australia, First Nations peoples retain their ongoing connections to their stories, traditions, and knowledge, which have been passed down for millennia. This connection between Country and culture was interrupted by the British invasion in 1788, with the impact of this trauma continuing today (Robinson

& Paten 2008; McCalman & Smith 2016; Menzies 2019; Lipscombe *et al*. 2020; Green 2022).

While the renewed ICOM definition of museums emphasizes their social and ethical responsibilities in relation to research and involvement of communities, there has been a long history of extractive exploitation of First Nations peoples and their cultural heritage. The removal and stealing of ancestral burials or Old People to other countries for museum display, or, more often, to trade with other museums, and the use of these remains for racist incentives (to attempt to prove evolutionary differences and race theory for example) has led to ongoing trauma, and, rightly, the distrust by many First Nations peoples of museums, as well as other institutions of colonial authority, such as governments and universities (Fforde 1997; Turnbull 2015; Sculthorpe 2023). These colonial practices continue today often in more subtle ways, with museums and other institutions proclaiming their dedication to repatriation yet retaining collections and databases that are not openly accessible, or requiring strong advocacy from First Nations communities to petition for the return of these remains or objects (Green & Gordon 2010; Pickering 2015; Turnbull 2020). The issue of the return of cultural heritage is made more complex by the fact that 1) many museums may not want to return the heritage items or ancestral remains in their collections; and 2) they do not always know what is in their collections, with the unethical acquisition or theft of many objects and Old People resulting in few historical records of the provenance of collections.

Institutional Distrust in Australia—Findings from the Found a Fossil Survey

In 2022, the Found a Fossil (FAF) project (run by SH) released an Australia-wide survey asking the public questions about what they would do if they ever discovered a fossil or First Nations artifact (Hurst *et al*. 2023). Over 1300 people responded from all over the country, showcasing enthusiasm to learn about and engage with Australian cultural and natural heritage. However, the results showed that many people were unsure of proper actions or appropriate people to talk to in their interactions with heritage and their search for information.

When asked via the FAF survey, 'Who would you report a [fossil] or [First Nations artifact] to?', museums were the most popular answer for fossils (35% of respondents), and the second most popular answer for artifacts (22%), after telling their local Indigenous community (38%). When asked, 'What would stop you from contacting someone about a [fossil] or [First Nations artifact] find?' a major answer for both heritage types was that people did not know whom to contact (22% for fossils, 28% for artifacts). While there is no legal requirement to report fossils, that most people selected museums as a source of information for fossils is positive, as it suggests that despite a history of distrust, people view museums as sources of expertise that can guide them on correct handling and assist with identification and research in relation to their finds. That people selected museums for First Nations cultural objects, despite the history of distrust associated with these institutions, may reflect efforts to change community perceptions about museums and their relationship with First Nations communities and collections (for example, the updated ICOM museum definition mentioned above). That many people simply do not know what to do means that more can be done to improve communication with the public, and therefore improve the protection of heritage.

Participants in the FAF survey were also asked if they agreed or disagreed that current state laws adequately protect fossils/fossil sites or Aboriginal and Torres Strait Islander artifacts and sites (Fig. 2). The number of respondents that agreed laws were adequate were in a minority, with only 23% selecting this option for both fossils and arti-

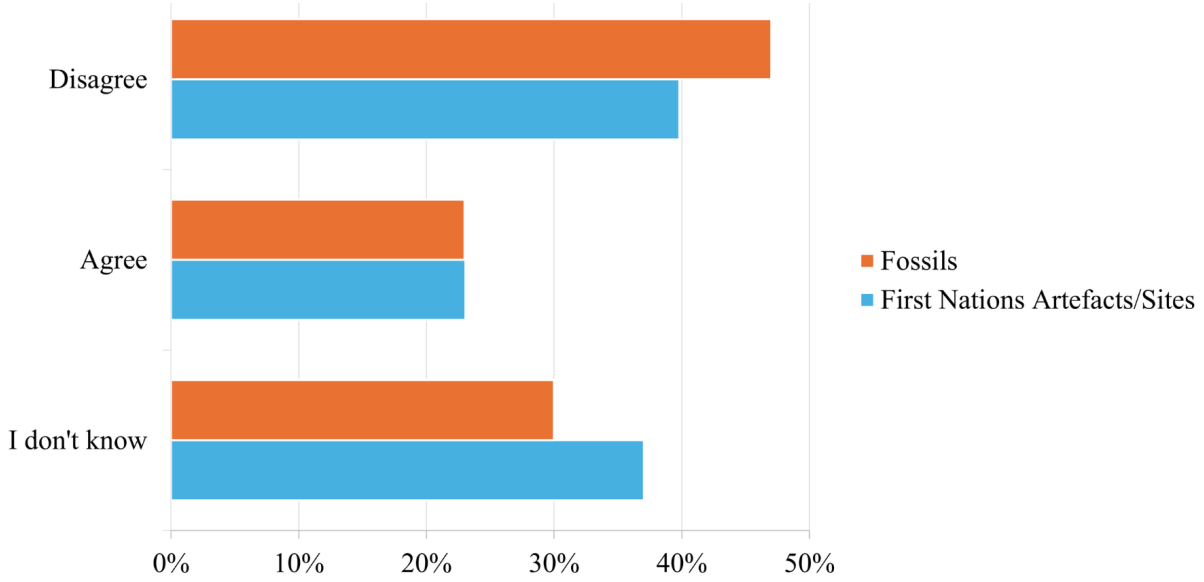

Figure 2. Proportions of agree/disagree/I don't know responses to the statement '*I feel confident that any existing laws in my state adequately protect [First Nations artifacts/sites] OR [fossils/fossil sites]'*. Results are from the Found a Fossil survey detailed in Hurst et al. (2023).

facts. A considerable percentage of 'I don't know' responses (37% of people for artifacts, 47% for fossils) again reveals the lack of awareness within the Australian community of heritage legislation, most likely from poor or non-existent communication of this information to the public, both by government, and museums.

Found a Fossil is now an online resource that provides clear and accessible information aimed at the public, explaining what to do if they discover a fossil or an Aboriginal or Torres Strait Islander artifact or site in Australia (Fig. 3) (Hurst *et al.* 2023; Found a Fossil 2024). Containing state-by-state legislation that is updated as laws change, links to museums that provide object identification services, as well as resources for finding relevant Traditional Owner contacts in different areas, Found a Fossil is helping to promote reporting, address misinformation, and is the first website of its kind to provide this information in a centralized and accessible way.

Legislation and Government

Across Australia, all objects and sites of Aboriginal cultural heritage are protected under legislation that varies across each state or territory. And, while communication about reporting may vary, states and territories generally have departments dedicated to these responsibilities. Legislation protecting fossils in Australia also varies considerably in its protection across state and territory borders (if it exists at all) but is often vague in its details of requirements to report, who to report to, and who actually 'owns' or is responsible for the fossils. Importantly, these laws vary depending on the land type where the material has been found (e.g. farmland, Crown land, National Parks, state/local heritage sites, Native Title land). In New South Wales (NSW), Aboriginal cultural heritage is protected under the National Parks and Wildlife Act 1974. This Act states that a person who is aware of the location of Aboriginal objects must notify the Secretary (or relevant heritage department), so they can be added to a heritage database, and that any damage to Aboriginal objects or sites may lead to financial penalties.

Under the National Parks and Wildlife Act 1974, fossils are only mentioned alongside a long list of other Earth and environmental materials. In NSW, fossils are not granted any protections of their

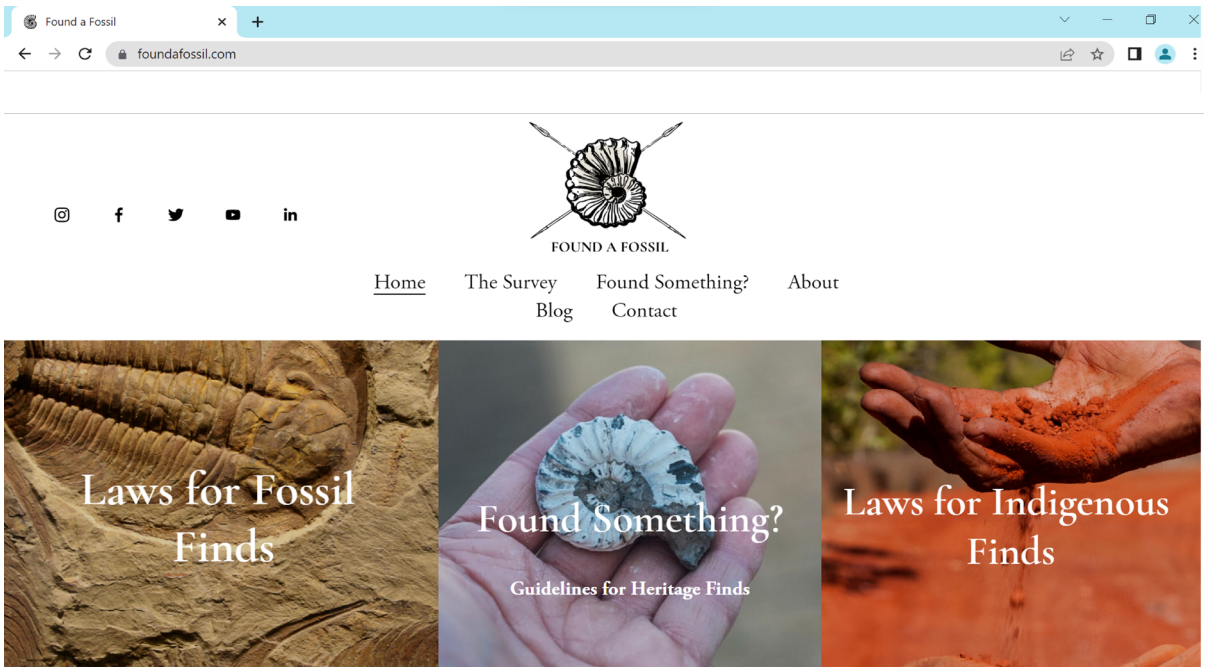

Figure 3. The Found a Fossil website allows for easy navigation for multiple types of heritage finds, with detailed legislative information, identification resources, and reporting requirements for every state and territory in Australia. Image provided by Sally Hurst (2024) (see Hurst et al. 2023).

own, and they are only protected since they are associated with areas within national parks. The consequence of this is that if a person discovers a new, scientifically significant fossil site on their property there is no legal requirement to report it so that it can be researched. In contrast, Queensland (QLD) law specifies that a fossicking license is required to collect fossil material and that vertebrate fossils in particular cannot be collected. However, the information provided by the QLD government does not include instructions about what to do or who to contact if fossil material is found. When sites and objects of paleontological and cultural value intersect, e.g., if a fossil is found as part of an Aboriginal stone tool, there is no legislative guidance in any state or territory about how to treat the sites and objects. However, because Aboriginal cultural heritage laws are more protective and have a (somewhat) clearer framework they tend to "trump" any fossil legislation. Unfortunately, the definition of what Aboriginal cultural heritage is still typically associated with objects made by people, rather than an intrinsic aspect of Country in a much more holistic sense.

Most Australian state and territory legislation requires people to report First Nations artifacts and heritage to the relevant state or territory heritage department, and these departments are then obliged to liaise with local First Nations communities and organize authentication, site or object management, or repatriation. One of the key findings from the FAF survey was that >90% of respondents said they would not report an Aboriginal artifact to their state heritage body, most likely because they were unaware that these departments existed, or that reporting was a requirement (Hurst *et al*. 2023). Unfortunately, these departments often suffer from a lack of funding and staffing (admittedly, a common problem for museums also), meaning that even if inquiries regarding First Nations heritage discoveries or site management are made, they frequently go unanswered (Baker & Cantillon 2020; Banfield & Hamilton 2022). Subsequent lack of action increases the sense of distrust in (and contempt for) these institutions and procedures (Hobbs & Spennemann 2020; du Cros 2024).

Top-down and state-controlled heritage processes are perceived as lacking care or personal con-

nection to the local heritage about which they are making decisions (Perkin 2010; Brown 2016; Liebelt 2020). This has contributed to distrust in state governments not only by First Nations peoples, but the wider Australian community, with many believing that governments are more likely to pursue their own agendas, policies, and curated stories, rather than pursing truth-telling initiatives or other wishes or interests of the Australian community (Aplin 2009; Waterton 2018; Dellios 2019; Evans *et al*. 2020). This distrust in governments was expressed frequently in the qualitative responses of the Found a Fossil survey (Table 1).

Actions of industry and the perceived lack of consideration of Indigenous voices by the government have exacerbated the level of distrust in these institutions by Aboriginal communities and many others (Wensing 2020; Harris 2024). Two recent examples are the destruction of Juukan Gorge in Western Australia—a known and significant First Nations archaeological site over 45, 000 years old—by mining giant Rio Tinto to access higher-grade iron ore; and the 2023 referendum that resulted in a majority 'no' vote to the establishment of a First Nations Voice in Parliament of Australia. Lack of community consultation (or consultation that is in name only, rather than action) and, at times, limited opportunities for First Nations peoples to engage with and manage their own heritage and Country have been taken as evidence of a lack of political will to prioritize First Nations perspectives and control of their own heritage (Parliament of Australia 2021; du Cros 2022; Cole 2022; Estcourt 2022). Government control of heritage has also led to the control and dissemination of nationalistic narratives, perpetuating destructive colonialist ideals, and maintaining disparate power dynamics between government bodies and First Nations communities in Australia (Sakata & Prideaux 2013; Bennion& Kelly-Mundine 2021;

Table 1. Allegations were repeatedly raised by survey participants in qualitative free-text questions in the Found a Fossil survey.

Issue	Comments
Distrust in Museums	"Once items disappear into the coffers of state museums they are rarely seen again." [ID: 49].
	"Artifacts have a habit of being taken by academics and not returned." (ID: 1281)
	"Because I still wouldn't TRUST the museum/ government officials to treat it with respect [AND I am a historian and have worked in museums/ historic houses]." (ID: 1220) (in response to Q – 'Why wouldn't you report a fossil/ artifact find?')
	"If I were to report it, it would be taken and hidden away in a museum never to be seen again along with thousands of others." (ID: 497)
Distrust in Government	"Protecting artifacts in particular is genuinely bloody difficult. Small finds are often found by individuals in places where nobody is watching."
	"Large things such as caves, middens, etc. are wiped out by companies chasing profits, endorsed by governments happy to turn a blind eye to the money it gives them. Then faux outrage when the bastardry is exposed, then, back to work, nothing to see here, literally." (ID: 526)
	"Academics try to lock up fossils and sovereign peoples' artifacts, for their own research, the current approaches by government, museums and universities does nothing to support the preservation, or respectfully acknowledge artifacts." (ID: 97)

Costello 2021; Raja *et al*. 2021). All state museums in Australia are government-run and funded, compounding distrust in these institutions and complicating relationships between stakeholders (van Barneveld & Chiu 2018).

Landholders, Fossils and First Nations Sites and Objects

Australia's landmass is approximately 7.6 million square kilometers, almost half of which is dedicated to recent agricultural use (approx. 3.69 million square kilometers) (National Farmers' Federation 2017; Australian Bureau of Statistics 2023). This means that farmers/pastoralists/graziers and others employed in agricultural industries are a key group of people likely to discover natural heritage objects, as well as First Nations artifacts or sites. Independent surveys by Liebelt (2016) and Toone (2016) revealed that farmers reported a range of emotions when discovering First Nations artifacts on their land, including fear, indifference, guilt, or aversion. However, this was also at times paired with curiosity, joy, pride, or responsibility.

A fossil find is frequently seen as an exciting discovery to be shared with the community and the wider public. For example, in 2022, a farmer worked with the Australian Museum to explore an area on their property near Gulgong, NSW, that has been touted as one of Australia's best-preserved fossil sites (named McGrath's Flat in honor of the farmer) (McCurry *et al*. 2022; ABC News 2022). Other examples include farmers and property owners who have made important discoveries and have not only been involved in subsequent research but have had new species named after them (e.g., the dinosaurs *Muttaburrasaurus langdoni* after grazier Doug Langdon, *Rhoetosaurus brownei* after station manager Arthur Browne; *Fostoria dhimbangunmal* after miner Robert Foster; *Savannasaurus elliottorum* named the Elliott family of Winton) (Longman 1926; Bartholomai & Molnar 1981; Poropat *et al*. 2016; Bell *et al*. 2019). On Kangaroo Island, South Australia the famous Emu Bay fossil lagerstätte is named Buck Quarry, after Paul Buck, the farmer who owns the property where the site is located (Jago & Cooper 2011).

Similarly, farmers also discover First Nations objects and artifacts on their land. However, in contrast to fossil finds, the relationship of farmers with artifacts can be markedly different. Studies have reported that farmers can harbor guilt and shame in the context of finding First Nations artifacts, perhaps related to the knowledge that they are directly benefitting from the displacement of First Nations peoples from the land they reside on and manage for profit (Allpress *et al*. 2010; Maddison 2011). This results in an unwillingness to report objects or sites, and a reluctance to engage in heritage conversations (Liebelt 2020).

The most prevalent barrier to the involvement of farmers in heritage conservation is, ironically, concern about land claims associated with First Nations finds (McKenzie 2018; Hurst *et al*. 2023). For decades, many landholders in Australia feared that the discovery of First Nations objects on their land might be grounds for that land being taken away, or at the very least, a means to restrict their activities and access (First Peoples - State Relations 2021). This has been a major concern since the introduction of the Native Title Act 1993, where inadequate communication of this legislation, or a lack of engagement by the public to properly understand it, led to the belief that private land could be claimed back by Aboriginal or Torres Strait Islander communities (Hobbs & Spennemann 2020). This is incorrect, with only vacant Crown land and some limited other land types available for claim (NSW Aboriginal Land Council 2017).

While the 1998 Amendment of the Native Title Act helped to clarify this issue, the deep-seated distrust by landholders, First Nations communities

and other members of the Australian public in the federal and state governments and their perceived ability to change laws for their own benefits and agendas remains, and many farmers still believe that their land could be taken (Hurst *et al*. 2023; Toone 2016; Liebelt 2020). The lack of incentives for farmers to report heritage material paired with this fear of loss of control of their land, means that many finds are going unreported (Hurst *et al*. 2023). Failure of the Australian federal and state and territory governments to work towards correcting this misinformation further demonstrates the continuing poor communication of legislation to the public (Bennett 2016; Toone 2016; Liebelt 2020; Simmons *et al*. 2020).

The Role of Regional Collections and Museums

While government-funded state museums in Australia carry the bulk of the institutional distrust under discussion, regional, local, and community-based collections and museums also play a role in protecting heritage materials and communicating their importance to the public. For fossils, regional centers exist in the form of places like the Age of Fishes Museum in Canowindra (NSW), Naracoorte Caves Wonambi Fossil Centre (South Australia), the Eromanga Natural History Museum and the Australian Age of Dinosaurs Museum (both in Queensland), which were founded by landholders who noticed dinosaur bones on the land they manage. The Australian Opal Centre (AOC) in Lightning Ridge, NSW, has formed partnerships with local miners so that they can donate their opalized fossil finds as part of the Cultural Gifts Program (Commonwealth of Australia 2013), an initiative that offers tax incentives to encourage people to donate cultural items to public art galleries, museums, libraries and archives in Australia, enabling the AOC to protect significant finds. While some of these regional centers operate as tourist attractions (rather than not-for-profit research collections and educational displays), they still contribute significantly to raising awareness of local heritage, providing a localized hub to keep collections close to the context of their discovery, and sharing stories of the local people involved in their discovery or excavation.

Cultural centers and Keeping Places are regional collections for Aboriginal and Torres Strait Islander cultural heritage. These centers were created by Aboriginal and Torres Strait Islander peoples after seeing the need for a place that could hold ancestral remains or sacred and cultural objects, after they had been removed or stolen from Country. This allowed Old People to be respectfully reburied on Country, and objects to be displayed and interpreted through a First Nations lens, rather than a colonial one.

While some of these centers have formed beneficial partnerships with museums, governments and universities, they remain First Nations-run and managed, united by their ability to tell self-determined stories. The Armidale Aboriginal Cultural Centre and Keeping Place is an example of this. The center's proximity to the University of New England, and early connections to the university have allowed for the two-way flow of knowledge and teaching opportunities, enabling students to connect with and learn about the significant Anaiwan cultural heritage of the area. Potentially not as concerned with having static collections that remain behind glass, the collection is used for tactile education, where the objects are held and used to exemplify cultural knowledge, stories, and technology that has been passed down and is now being shared with new audiences and generations. With a focus on living Aboriginal culture, these collections also allow Elders and Knowledge Holders to engage audiences with not only the physical objects but also marry them with their intangible heritage within the wider cultural landscape.

These local approaches to heritage protection and interpretation have helped not only to engender trust with local people but have potentially contributed to growing trust in museums and institutions more broadly as they work to forge respectful partnerships that benefit both parties. Prioritizing First Nations perspectives, as well as First Nations-led research, community programs, and other initiatives not only positively contributes to heritage conservation, but has great potential to initiate knowledge transfer between First Nations and non-Indigenous peoples (Artelle *et al*. 2019). Successful Australian projects with First Nations leadership, co-design and co-management, that integrate scientific/Western and First Nations knowledge and practices include the Dinosaur Coast Management Group which includes Traditional Knowledge Holders and other members of the Indigenous community, professional paleontologists and local fossil enthusiasts to protect and manage dinosaur tracks in Western Australia (discussed more in Case Study 1); the Barunga Community Archaeology Field School in the Northern Territory, where students from Flinders University are taught Aboriginal archaeology by Traditional Owners in the field, rather than in the classroom (Smith 2020); the co-management of the Wet Tropics World Heritage Area in Queensland (Cullen-Unsworth *et al*. 2012); and the co-development of fire management practices that integrates western sciences with First Nations cultural knowledge (McKemey *et al*. 2022).

The inclusion of First Nations knowledge, perspectives, and management practices is of vital importance for future research and conservation of all heritage in Australia. First Nations artifacts, cultural sites, and fossil sites are all part of Country that have a continuing connection to the ancestors, Dreaming, identity, history, and future. First Nations views, practices and expertise around caring for Country need to be more widely leveraged to preserve both the western perspective of cultural and natural heritage, and the wider environments in which these objects and sites reside (Kingsley *et al*. 2013; McConnell *et al*. 2021; Tutchener *et al*. 2021; McKemey *et al*. 2022). Critically, these approaches remain essential, even when considered at a global scale.

UNESCO: Global Natural and Cultural Heritage Conservation

Since its inception in 1972, the United Nations Education, Science and Cultural Organization (UNESCO) World Heritage List has aimed to protect sites around the globe that have 'outstanding universal values to humanity' (UNESCO 2024a). Initially, sites nominated for this list were designated as either natural or cultural sites, but 'mixed' sites with both natural and cultural value were included soon after.

Most state legislation in Australia requires consultation with local First Nations communities regarding cultural sites. The United Nations Declaration of the Rights of Indigenous People (UNDRIP) (2007) states that 'Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage'. Despite this, First Nations stakeholders frequently have little actual power in these types of decision-making processes because there is no legal requirement that their suggestions be implemented (Soderland & Lilley 2015; Costello 2021). Hence, UNESCO created the Operational Guidelines of the World Heritage Convention which, in line with UNDRIP, 'recognizes the role of indigenous peoples in identifying, managing, protecting and presenting World Heritage', and encourages the inclusion of First Nations peoples in all parts of the nomination process and management of World Heritage sites (UNESCO 2023; UNESCO 2024b). This means that contemporary World Heritage nominations are less likely to be accepted if local Indigenous communities are not involved in the process.

In Australia, 20 heritage sites have made the World Heritage List; 12 are natural sites, four are cultural sites, and four are mixed sites (Uluru, Kakadu, Willandra Lakes, and the Tasmanian Wilderness) (UNESCO 2024c). The Budj Bim Cultural Landscape in Victoria is the only site in Australia to have been granted a World Heritage listing based on First Nations cultural heritage values alone (National Museum of Australia 2022). Australia's first additions to the World Heritage List in 1981 were the mixed sites, and all four detail co-management plans with the local First Nations peoples to care for the sites. In 2021, the Ikara-Flinders Ranges in South Australia (SA) was added to the UNESCO Tentative Heritage List (Fig. 4). While this 'serial' site has been nominated as a natural site for its exceptional geology and fossils, many of the locations listed in the nomination are within national parks, private land, or are co-managed by the South Australian Government and the First Nations peoples of South Australia (Government of South Australia 2024). The SA Government and the World Heritage nomination team gained consent from Traditional Owners to submit the nomination, and are actively working with First Nations stakeholders, integrating cultural knowledge of these areas with paleontological, geological and geomorphological information in the application. The changing values in the nomination process can show how global and Western institutions can help to lead the way in First Nations consultation and heritage management.

How can Museums do it Better?

We want people to work with us, instead of us being forced to work with them. Building transparent, educational partnerships is the only way we can guarantee the free two-way flow of information. We need the partnership with museums for our culture to survive.

– Steve Ahoy, Anaiwan Elder, Cultural Knowledge Holder

While efforts to address distrust in museums by

Figure 4. The Ikara-Flinders Ranges, recently admitted to the Tentative World Heritage List. Image provided by Sally Hurst (2021) (taken by author).

different members of the broader community, including First Nations peoples are ongoing, the FAF survey showed the beginnings of positive change. Respondents were asked what sources of information they were most likely to trust in relation to fossil and First Nations cultural heritage finds: 90% of respondents agreed that they would trust information provided by museums (compared to 74% for government websites, and 11% for social media) (Hurst *et al*. 2023). This trust in museums is supported by a recent study by Evans *et al*. (2020) that showed that over 70% of Australians would put their 'political' trust and confidence in information disseminated by museums. This was much higher than information provided by, for example, federal governments (54%) and social media (only 20%).

Despite the dark history of museums and their involvement in colonial practices widely documented in recent academic and popular literature (e.g., Hicks 2020; Vawda 2019; Turner 2020; Frost 2019; Hudson and Woodcock 2022), there is evidence of change (Tythacott & Arvanitis 2014). Despite some criticism of the slow pace and lack of critical engagement (e.g., Besterman 2014) and critiques concerning their ulterior intentions (McAuliffe 2021; Hicks 2023; Oforiatta-Ayim 2023) there are moves by museums and professional museum associations to become more transparent, trusted and accessible sources of information for the public (Soares *et al*. 2018; Scholten *et al*. 2021; Simpson *et al*. 2023). Efforts to create community engagement programs and build positive perceptions and relationships between the public and scientists demonstrate that some museums around the world are trying to make a concerted effort to address the unethical behaviors of their past and move into an inclusive and transparent future (Sullivan *et al*. 2003; Eid & Forstrom 2021).

One such initiative to rectify past errors is the recent (December 2023) revising of the Native American Graves Protection and Repatriation Act 1990 in the USA, requiring museums to gain consent from Native American tribes before displaying or performing research on their cultural objects (Department of the Interior, United States of America 2024). The new revisions, which came into effect in January 2024, also aim to facilitate the timely repatriation of Native American human remains and funerary objects—something that was originally required in the Act but had no deadline, so museums faced few repercussions for dragging this process out (Jacobs & Small 2024). Museums now have five years to prepare all Native American human remains they store for repatriation. Across all American institutions, this is estimated to represent more than 96, 000 Native American individuals (National Parks Service 2023).

This legislative change acknowledges both the unethical acquisition of parts of their collections, as well as their responsibility as modern museums to gain free, prior, and informed consent from Native American communities, and recognizes that the onus should be on museums to push for change and improve engagement. These processes mean that museums will defer to Native American traditional knowledge holders, providing avenues for two-way dialogue, and overall increasing trust in museums and their processes (Department of the Interior, United States of America 2024). The opportunities for displaying two knowledge systems side-by-side can be of huge benefit not only to museums and their audiences (see The Ecomuseum section, below), but to First Nations communities as well, as they can control their own heritage and its exhibition. While this legislation focuses on those burial objects within the museum, the active inclusion of multiple voices and knowledge systems informed by First Nations communities could be adopted at other heritage sites, including fossil and geo-sites. This change in legislation could motivate the introduction of similar laws, deadlines, and processes in other museums around

the world.

On a more local scale, partnerships between First Nations-run cultural centers and universities, museums and other institutions provide an avenue for First Nations peoples to have an authoritative voice concerning the curation, interpretation, and display of their own cultural heritage. Partnerships between the Armidale Aboriginal Cultural Centre and Keeping Place and the University of New England, for example, have allowed local Anaiwan Knowledge Holders to have a voice in the room – providing a two-way system of knowledge transfer, rather than only a single, colonial voice retelling a history that was not its own.

While there is still work to be done, the creation of innovative and inclusive citizen science programs, volunteering opportunities, and supporting existing grassroots projects like those mentioned below, means that museums will continue to play a central role in future communication, protection, and celebrations of heritage (Clary & Wandersee 2014; Cvitanovic *et al*. 2015).

The Ecomuseum

While museums can strive to be more inclusive and transparent, there are also challenges to be confronted when breaking free from a singular Enlightenment epistemology and applying museum technology and programming to multiple epistemologies. This can be facilitated where the museum concept and authority have been democratically initiated rather than institutionally imposed. One such approach is the concept of the ecomuseum, emerging from Europe in the 1970s, originally constituted as an alternative to Enlightenment museology and employing co-design principles involving public authority and community aspiration (Rivière 1985).

More significantly, the ecomuseum lies beyond the walls of the enlightenment museum and embodies a cultural understanding and dimension of the landscape (Rota 2022). This means that concepts of nature are culturally situated (Borrelli & Davis 2012). As noted by Badiali & Piacente (2012), this is more than a juxtaposition of place and more like an integration of 'ambits'. The ecomuseum concept therefore has the capability of embracing more than one knowledge system or epistemology. The ability to embrace multiple knowledge systems is the ultimate test of inclusivity for the museum concept.

There are many ways in which the museum can attempt to capture multiple epistemologies within its operations. This can be done through education programs (e.g. Schultz 2022), exhibition planning, virtual reality, and research protocols (Conrad 2023), but perhaps the ecomuseum is the most obvious manifestation given the need for multiple stakeholders in its initiation.

The UNESCO Geopark concept underpins the creation of sustainably managed geological places for geoheritage protection, education, research, tourism and creation of jobs, and even health and well-being programs (Turner 2006). Others have identified the different potential of geoheritage when interpreted in situ (within the landscape) and *ex-situ*, (within the walls of the museum) (e.g. van Geert 2022). However, given the oral and performative modes and traditions of knowledge generation and transmission that take place on Country (Muecke & Eadie 2020), the ecomuseum in Australia can be a fortuitous and obvious blend of Indigenous knowledge and Western scientific understanding of landscape. This provides a unique cultural framework for understanding the environment.

More than Museums

Traditionally, museums are physical places for the protection of heritage objects. However, as expected, for state museums in Australia, protection is restricted to objects physically housed

Figure 5. Goolarabooloo Maja (Law Boss) Richard Hunter alongside tracks in the Walmadany area of the Dampier Peninsula, Western Australia, subsequently named in his honour as *Walmadanyichnus hunter* (Hunter's mark of Walmadany). Image provided by Steve Salisbury (2024) (see Salisbury et al. 2017).

within the museum, while sites that remain in the landscape are perceived as outside the responsibilities of the museum. Many museums have strict budgets which restrict staffing, time and resources allocated to the protection of (and communication about) sites and objects. Hence, other institutions, initiatives, projects, and organizations have filled gaps left by museums, government and legislation to protect and communicate natural and cultural heritage.

Several recent projects, including the FAF survey, have showcased the value of community-led initiatives to promote change in the context of cultural and natural heritage protection in Australia. Community-led initiatives benefit from proximity, intimate knowledge, and personal connection to places, objects, and histories which is more likely to result in increased investment in the protection and celebration of local heritage, and foster increased community trust, control, and leadership in heritage management (Sakata& Prideaux 2013; Higgins& Douglas 2020). A local approach to heritage protection, with open discourse promoting the sharing of local pieces of knowledge—both from Western perspectives and from First Nations perspectives—can create a greater sense of trust between stakeholders as they find common ground (Greer 2010; Strickland-Munro & Moore 2013; Isidiho & Sabran 2016; McGinnis *et al.* 2020). Next, we explore three case studies highlighting such grass-roots initiatives.

Case Study 1: Dinosaur Tracks in the Broome Sandstone of Western Australia

In the West Kimberley region of Western Australia, the peoples of the West Coast Saltwater Sun Down Law and Cultural Group, traditionally known as Goolarabooloo, and today encompassing peoples of the Nyulnyulan language group (Bardi, Jawi, Nimanburr, Nyulnyul, Jabirrjabirr,

Ngumbarl, Jukun, Yawuru, Nyikina and Warrwa, as well Karajarri), have a strong cultural connection to dinosaur tracks and other fossils (Fig. 5). For these peoples, dinosaur tracks, and in particular those with three toe impressions, along with many plant fossils that occur alongside them in the Lower Cretaceous Broome Sandstone, are an integral part of The Northern Tradition of a Song Cycle (also referred to as a 'Songline' or 'Dreaming Path') that traces the journey of a being known as Marala, or Emu Man. Marala is the 'Lawgiver' who encoded into Country with ways of behaving and wellbeing, both for people towards each other and towards the landscape of which they are a part (Salisbury *et al*. 2017). There are traditional songs about Marala, and cultural sites along the coast with names that relate to the tracks, such as Maralagun ('place of the Emu Man') at Cable Beach, all of which highlight the deep time connection the peoples of this area have to these fossils. In this sense, the tracks are regarded as part of Country, meaning they are seen as an integral aspect of the landscape, both in a physical sense and in a spiritual one. No single track is more important than any other, and because these tracks occur in the intertidal zone, they constantly appear and disappear as a result of erosion and shifting sand. In this way, newly emerged tracks are seen as part of the way in which Country (and the Dreaming, referred to within the Nyulnyulan languages as Burgarrigarra) reveals itself as part of the Song Cycle and Law. Many other geological features along the coastline are also integral to the Song Cycle (Salisbury *et al*. 2017; Salisbury& Romilio 2019).

Non-indigenous people became aware of dinosaur tracks in the Broome Sandstone during the first half of the 20th century (e.g., Bates 1929; Anonymous 1946; Hill 1973), and they entered the scientific literature in 1952 (Glauert 1952). The first detailed scientific description was published by Colbert & Merrilees (1967), who named the tracks *Megalosauropus broomensis*.

Scientific research continued in the late 1980s and early 1990s (Long 1990, 1992; Thulborn *et al*., 1994), but during this time the relationship between western-trained paleontologists and Traditional Custodians became tense. Despite having been asked to seek the permission of local Law Bosses before visiting certain areas, the paleontologists ignored such requests, removing tracks without consent and desecrating the sites in the process (see Salisbury *et al*. 2017, Appendix 2 for a full account of events during this period). Further events followed in the mid-1990s, which only exacerbated the situation (see Salisbury *et al*. 2017 for details). Tensions increased again in 2008, when an area 50 km to the north of Broome referred to as James Price Point (traditionally known as Walmadany) was selected by the Western Australian Government as the preferred location for a $35 billion liquid natural gas (LNG) processing precinct, with the site selection endorsed by the Western Australian Museum (Siversson 2010). Collaboration between the area's Traditional Custodians, paleontologists, and members of the broader Broome community, along with environmental, political, and business groups eventually saw plans for the LNG precinct abandoned by the WA Government and its joint venture partners in 2013. In the process, the coastline of the Dampier Peninsula, from Bardi-Jawi Country in the north to Yawuru Country in the south, was also added to the West Kimberley National Heritage Area (Place ID 106063, Commonwealth of Australia, 2011) on account of its fossilized tracks. The research collaboration between paleontologists and Traditional Custodians led to the publication of the 2016 Memoir of the Society of Vertebrate Paleontology (Salisbury *et al*. 2017). Ironically, James Price Point, famously referred to in September 2009 by the then WA Premier Colin Barnett as "an unremarkable beach" was shown to preserve the most diverse dinosaur track fauna in the world – this

stretch of coastline became known as part of 'The Dinosaur Coast'.

In 2015, a collective comprising Knowledge Holders and other members of the indigenous community, professional, western-trained paleontologists and local dinosaur track enthusiasts formed the Dinosaur Coast Management Group (DCMG 2024). The DCMG is a not-for-profit organization and registered charity, whose goal is to protect and promote the dinosaur tracks of the Dampier Peninsula and to educate the public about their cultural and scientific importance. Its Broome-based volunteers do their best to manage and protect the dinosaur track sites through public education materials, school field excursions, school visits and events, and by providing feedback to local government about proposed developments that may damage them. They also work closely with paleontologists to continue research into the tracks, all the while working in partnership with their Traditional Custodians.

In 2021, the DCMG obtained funding from the Australian Government to develop the Dinosaur Coast National Heritage Management Plan (DCNHMP) for the Broome Sandstone located in the intertidal zone around Broome. The DCMG recruited and chaired a project steering group comprising representatives of the land managers and key stakeholders, including relevant government departments, The University of Queensland, the Shire of Broome, Kimberley ports Authority, Yawuru Prescribed Body Corporate and Goolarabooloo Millibinyarri Indigenous Corporation.

The main purpose of the DCNHMP is to inform the public about the significance of the Dinosaur Coast and to protect it from impacts associated with increased visitation and/or coastal development. The plan also creates opportunities for people in Broome, through educational activities and guided tours, all aimed and enhancing the experience of visitors.

While it has often been tempting for non-indigenous people (including western-trained paleontologists) to claim to have 'discovered' various dinosaur tracks and other fossils along the coastline of the Dampier Peninsula over the years, it is clear that knowledge of them goes back many thousands of years and has likely evolved with changes in the landscape. Partly because of the cultural significance attached to the tracks and the knowledge that goes with them, and because much of this knowledge has been passed down orally or through dance and song, it is tempting for western scientists to ignore it or look past it in some way as 'secondary' or 'complementary' to information that appears in published scientific literature. It has only been through the demonstration of respect and trust that non-indigenous people have been given insight into the depth of knowledge that exists around the dinosaur tracks in the Kimberley, ultimately with benefits for both groups (see Muecke & Roe 2021).

Case Study 2: Museum of Stone Tools

The Museum of Stone Tools (MoST) (https://stonetoolsmuseum.com/), hosted at the University of New England in Australia, and directed by MWM, is an online resource of stone artifacts from around the world and all periods of prehistory (Fig. 6). The MoST is open-access and can be viewed by anyone with an electronic device and an internet connection, and was designed as a platform to promote knowledge about stone artifacts to students and interested members of the public. The MoST is populated with 3D models made by photogrammetric and laser-scanning techniques applied to artifacts housed in various types of collections; the MoST itself does not curate stone artifacts. Launched in May 2023, within nine months it accrued 95,000 unique views and 464,000 page views. Website metadata shows that the MoST is used by universities across the world, as anticipated, but also by secondary schools, par-

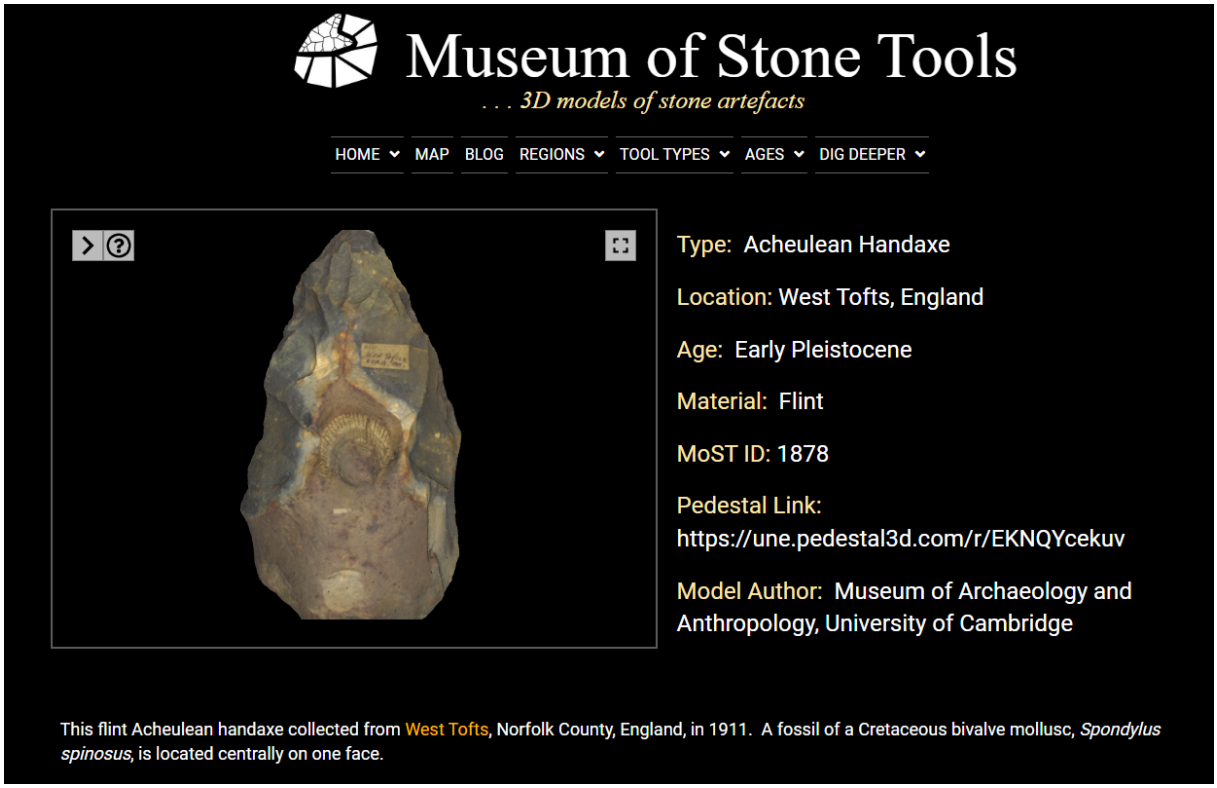

Figure 6. Museum of Stone Tools interface, showing the open-access archive of 3D artifact scans from around the world. Image Provided by Mark Moore (2020b)

ticularly in Australia and the USA, and international media outlets. Anecdotal feedback indicates that the models are used by heritage consultants in Australia for staff training and cultural inductions on job sites, and also by First Nations groups engaged in managing their own heritage.

The MoST has an email address and people from around the world have reached out for assistance in identifying and managing individual stone artifacts. These people are not antiquity collectors; rather, they have accidentally found the artifacts on the landscape, or have come across them in family estates. They generally feel that the items in their possession are significant, and they request that the MoST verify their intuition. Many of these artifacts—particularly those from estates—are 'orphan' objects, in the sense that information about the places where they were collected has been lost. An unexpected role for the MoST then has been to facilitate explicit wishes that, in cases where the appropriate First Nations group for repatriation is unknown, an object can still be used for education by uploading a 3D scan of it into the Museum, thus realizing the artifact's 'value' to some extent. Other 'grass roots' roles for the Museum have been to upload 3D models of artifacts returned to Country by First Nations groups, and to leverage the platform for an archaeologist in Ukraine to publicize the impacts of war on their cultural heritage, including stone artifact assemblages. These various roles are difficult for large state or national museums to accommodate or are explicitly prevented by museum policies, but they demonstrate how small-scale initiatives like the Museum of Stone Tools—facilitated by modern digital platforms—can articulate the aspirations of individuals to interpret and manage found objects in their own ways.

Case Study 3: Rola[Stone] Film Project

The Rola[Stone] documentary began as a small, low-budget initiative driven by MB in the Geosci-

ence Discipline at the University of New England (UNE), Armidale, located on Anaiwan Country in the New South Wales Northern Tablelands. The ~30 min film brought together geoscience and Anaiwan cultural knowledge and Dreaming stories about geological features in the local landscape. "Rola" is the Anaiwan word for "stone" (Fig. 7).

Films are an excellent way to promote enthusiasm for complex topics, and because films engage people "visually, aurally, viscerally and emotionally" they have a powerful capacity to capture audiences' attention and promote behavioral change (Berlin 2016). The Rola[Stone] documentary was a response to the Juukan Gorge disaster (mentioned above) and aimed to leverage these benefits of film, connect deeply with audiences and articulate the inseparable connection between geology, landscape and culture in Australia. As Anaiwan elder Les Ahoy says in the film, "Geology is important to us in that it creates the physical connection through our Dreaming to [a] place". While emphasizing the contributions of Anaiwan Elders to the film, Rola[Stone] delivers geoscience and cultural knowledge in parallel—without one qualifying the other—clearly showing the audience that objects and places can have more than one meaning, and can be understood in multiple ways.

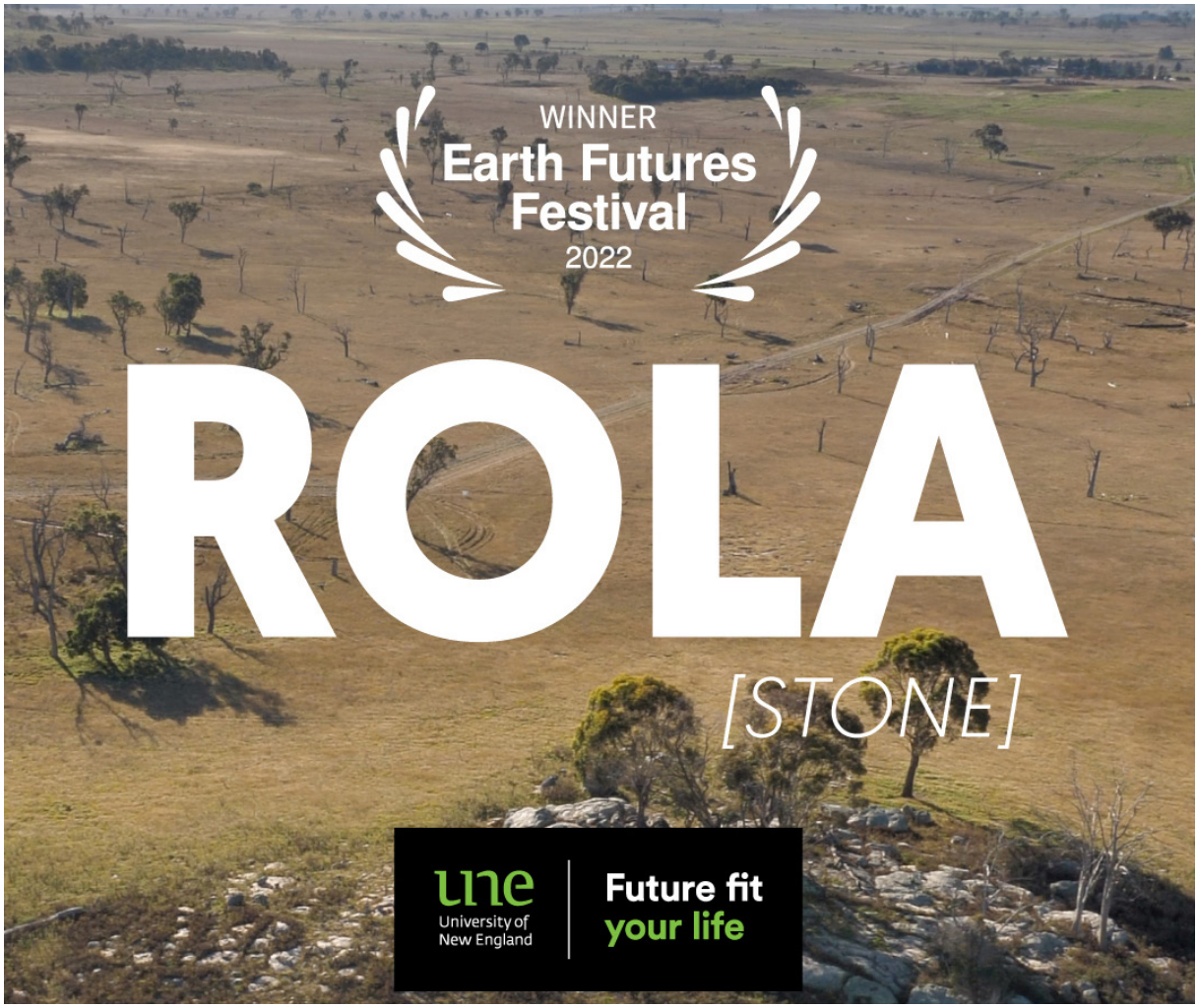

Figure 7. Poster for Rola[Stone], a short film exploring the geological and First Nations stories attached to sites in Anaiwan Country, NSW. Image provided by Marissa Betts (2022).

For university-level geoscience students in Aus-

tralia, the relationship between geology, landscape and culture is rarely taught. Yet, geoscience graduates will face complex—and high-stakes—economic and social challenges in meeting the increasing global demand for critical minerals essential for sustainable energy technologies. Such materials are the products of mining, which has an enormous impact on Aboriginal communities throughout Australia, as well as the natural landscapes, flora and fauna that are central to many Aboriginal and Torres Strait Islander cultures. Rola[Stone] is now embedded in the UNE geoscience curriculum and teaches students important values that they will take with them into their careers, and that should inform decision-making when they are faced with these fundamental challenges.

For the broader community (particularly the local community in Armidale) Rola[Stone] was an insight into two ways of understanding familiar, and probably frequently overlooked aspects of the local landscape. The Dreaming stories from Les Ahoy and Anaiwan artifacts knowledge from Steve Ahoy were the central components of the film and imparted a unique, rich and often emotional experience that audiences connected strongly with. In addition, the geoscientific information in the film is delivered in simple, easy-to-understand ways. Audience members have given positive feedback such as, *"the marrying of the geological landscape and Aboriginal Dreamtime stories was such an inspiration and one I hadn't connected myself before seeing this"*.

Rola[Stone] was an award winner at the international Earth Futures Film Festival in 2022 and had a world premiere at the UNESCO Headquarters in Paris. The Australian premiere in Armidale, NSW sold out and was then screened at the local cinema for several months. The film is now freely available on YouTube and is rapidly being adopted as a tertiary-level teaching tool across Australia and is also currently being developed into a high-school classroom activity.

Two-Way Benefits

The main similarities of these three case studies is that they benefit members of Indigenous communities as well as the research teams/institutions involved. These benefits include increasing cultural awareness, understanding and respect of Aboriginal and Torres Straight cultural heritage by academics, and having a space to share self-determined stories for Aboriginal and Torres Strait Islander peoples. Further, the collaboration can start conversations that can lead to co-designed projects, as well as share knowledge, resources, training, and funding in the pursuit of raising awareness of heritage and its protection, and further demonstrates the complementary nature of embedding multiple ways of knowing into these multi-cultural, -dimensional, and -disciplinary projects. A focus on education is also a central pillar of these case studies - either through academic publications that acknowledge Traditional Knowledge and experience alongside scientific interpretations, or through digital formats: films, and 3D scans that bring Traditional Knowledge to new audiences and generations, as dictated by Aboriginal and Torres Strait Islander peoples.

These projects arose from differing needs and gaps that were realized by individuals or small community groups, by people chose to address the gaps from a grassroots level, rather than through a larger institution with top-down approaches. Many of the relationships and partnerships in these cases began with one or two people and grew organically and often in unanticipated ways. These projects demonstrate not only the ability for multiple ways of knowledge to be displayed alongside one another but how the diversity of perspectives can complement each other, rather than clash.

Conclusion

The role of museums as the storage places and caretakers of heritage has evolved considerably over time, with new emphasis on the ethical and societal role these institutions play in communities around the world. While part of their role concerns the protection and communication of heritage, challenges remain over the care of objects both inside and outside the museum walls. These challenges are often a consequence of the distrust held by many people for these institutions that arise from confusing and poorly communicated legislation, ineffective governmental processes, and damaging colonial histories and continuing intergenerational trauma. However, there are examples where museums are doing it differently; where institutions are becoming transparent and accessible and are building deeper trust and engagement with the community. There are also ways to re-think Western Enlightenment museology that center the cultural understanding of landscape and nature. The concept of the Ecomuseum, for example, embraces more than one knowledge system or epistemology.

The emergence of grass-roots initiatives in the gaps left by larger institutions in terms of heritage protection and engagement demonstrate pathways for future conservation, that can easily complement museums or be supported by them. The Found a Fossil project, and the three Australian case studies described exemplify this approach: the paleontological-cultural cross-over on the Dinosaur Coast in the West Kimberley; the virtual Museum of Stone Tools; and the Rola[Stone] documentary film project. These initiatives show the willingness of individuals and local groups to engage in heritage discourses and demonstrate the effectiveness of community-scale work in the context of cultural geoheritage in Australia. These often individual-driven projects show the capacity of such approaches for communicating parallel knowledge systems in ways that serve to benefit all, fostering meaningful dialogue and mutual understanding.

I was raised Catholic, but I'm Aboriginal and I'm in Aboriginal culture now so I don't believe in one god. What would it mean if I walked into a Catholic church and grabbed a golden candlestick off of the altar because I only wanted to investigate it for the gold properties in it? Does that take away the fact that that's a religious object, that's a culturally significant object to the church and to European culture? Does that downplay it? No. That significance has to be acknowledged.

The human perspective has to be respected. We [First Nations peoples] are the first human perspective. We have to be acknowledged along with the artefact, even if it is a fossil. Even if you are just focusing on the rock or the fossil, you still have to respect and acknowledge the spiritual and cultural side.

– Steve Ahoy, Anaiwan Elder, Cultural Knowledge Holder

Rather than occupying non-overlapping epistemologies, paleontological and geological materials have a deep, interconnected relationship with cultural heritage. In Australia for example, this relationship is ongoing as part of the inseparable connection between First Nations peoples and Country. Acknowledging the innate duality of objects and places promotes elevated complexity in the ways they are understood, studied, managed, legislated and curated. It is essential that First Nations stories, places, and objects are centered with fossils and geological materials to simultaneously tell the story of life on Earth, and in Australia, one of the oldest living cultures in the world. These natural and cultural objects and sites form a collective history spanning millions of years, and generations of knowledge. That certainly seems like a history worth protecting.

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Ethics Approval

The Found a Fossil research survey was approved by the Macquarie University Human Research Ethics Committee (HREC reference number: 10181).

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Sally Hurst devised the main conceptual ideas for this work and led the research and writing of the manuscript. Mark W. Moore led the research and writing of the Human-Fossil Relationships sections, as well as the Museum of Stone Tools case study. Andrew Simpson was responsible for co-writing the Role of Museums section with Sally Hurst and wrote The Ecomuseum section. Steven W. Salisbury devised the Broome dinosaur tracks case study. Steven Ahoy acted as the First Nations Indigenous consultant on this project and provided direct quotes of his lived experience that have been included in each section. Cheryl Kitchener was responsible for the conceptualization of the information related to Keeping Places and was involved in the discussion of the relationship between museums and Aboriginal communities in NSW. Marissa Betts contributed to the conceptualization of ideas and led the structuring and editing of the manuscript, as well as the written section on the Rola(Stone) case study. All authors were critical in providing feedback and edits to the final manuscript.

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