

Synthesis of Australian cross-cultural ecology featuring a decade of annual Indigenous ecological knowledge symposia at the Ecological Society of Australia conferences

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Summary Indigenous Australians are Australia's first ecologists and stewards of land, sea and freshwater Country. Indigenous biocultural knowledge, as coded in story, song, art, dance and other cultural practices, has accumulated and been refined through thousands of generations of Indigenous tribal groups who have distinct cultural responsibilities for their ancestral estates. European colonisation of Australia had and is still having severe impacts on Indigenous cultural practice, knowledge, people and Country. In contemporary ecology and environmental management, re-recognition of the unique values of Indigenous biocultural knowledge and practice is occurring and increasingly being deployed alongside Western approaches in what has been described as cross-cultural, two-way or right-way work. This article describes the development of cross-cultural ecology and environmental approaches in Australia. We then provide an overview of 10 years of conference presentations associated with the annual Indigenous Ecological Knowledge symposia of the Ecological Society of Australia (ESA). From 2010 to 2020, 173 people participated in the symposia from around Australia and Aotearoa (New Zealand), of which 62% were Indigenous Australians and 3% Maori. Most participants were from Indigenous Ranger groups followed by University staff, with a roughly even split of men and women. A total of 100 presentations were given and a word frequency analysis of the presentation titles revealed the dominant words (themes) were: Indigenous, management, Country, fire, working, knowledge and cultural. The increasing Indigenous participation in the ESA conferences was coincident with increasing Indigenous-led projects across Australia, although we recognise that much more work needs to be done to increase Indigenous participation and control in Australian ecology and environmental management to move from cross-cultural to Indigenous-led approaches.

Key words: *both-eyes seeing, decolonising methodologies, Indigenous biocultural knowledge, right-way science, Traditional Ecological Knowledge, two-way science.*

Re-recognition of Australian Indigenous Biocultural Knowledge

Over 500 diverse Indigenous language groups maintain ancestral connections to tribal lands that collectively span what is now known as Australia (Goolmeer *et al.* 2022). For millennia, thousands of generations of Indigenous family groups have traversed, lived on, observed and manipulated or 'worked' the ecosystems of their tribal estates for food, resources, medicines, access and cultural purposes using a range of intensive and extensive environmental 'management' practices (Fletcher *et al.* 2021). We use the terms 'work' and 'environmental management' here as Western concepts invoking

notions of deliberate actions and environmental conservation and manipulation, respectively. However, we recognise that these terms are not always conducive to Indigenous ontologies of environmental stewardship that in contemporary society have been re-badged as forms of work and environmental management (Howitt & Suchet-Pearson 2006; McRae-Williams & Gerritson 2010). Intensive Indigenous environmental management or stewardship practices include small scale and larger scale practices that are deeply rooted in spiritual and kinship systems, linked to survival strategies. Small-scale practices include the following: singing and dancing to maintain species populations, cultural knowledge and practice (Bradley 2010; Robin *et al.* 2022); harvesting and re-

planting of food plants such as the *Murnong* (Yam Daisy, *Microseris scapigera*) (Gott 1983); clearing around bush fruit tree patches to prevent fire (Vigilante 2004; Lindsay *et al.* 2022); and manipulation of landscapes to capture, nurture and breed animal species such as through fish traps (Maclean *et al.* 2012; Rose *et al.* 2016). Extensive or large-scale Indigenous 'environmental management' or stewardship occurred and still occurs through for example burning, often for specific reasons and at specific times, such as to 'clean' Country, for communication, cultural purposes or facilitate harvesting of resources (Bowman 1998; Yibarbuk *et al.* 2001; Pascoe 2014; Steffensen 2020; Blackwood *et al.* 2022; McKemey *et al.* 2022). The capitalised term Country is a

term commonly used by contemporary Indigenous people that encapsulates the spiritual, physical, cosmological, biotic and abiotic components of the environment and associated cultural connections (for more in-depth discussion of Country, see Smyth 1994; Bradley 2000; Daiyi *et al.* 2002; Rose 2002; Burarrwanga *et al.* 2013).

Indigenous Australians are Australia's first ecologists who meticulously observed and studied the many interconnected and spiritual aspects of Country including flora and fauna; soils, rocks, hydrology and air of aquatic, terrestrial and marine systems; short- and long-term climate change and cycles; and the stars, sun and moon.

For Indigenous peoples, study and knowledge of the environment are woven through interconnections with cultural, kinship, historical and spiritual events (Rose 1988, Smyth 1994; Rose 1996, 2000; Rose 2002; Hemming *et al.* 2007). As a result, globally, Indigenous ecological knowledge is increasingly referred to as biocultural knowledge (Maffi & Woodley 2010; Hill *et al.* 2011a; Roberts *et al.* 2011; Ens *et al.* 2015; Gavin *et al.* 2015), acknowledging the deep culturally driven attachment, understanding and interactions that Indigenous peoples have with their environments.

Indigenous biocultural knowledge is traditionally passed down through generations via intangible (story, song, dance, ceremony) and tangible (drawings and carvings) forms, following cultural Lore, rights and responsibilities (Goolmeer *et al.* 2022). These modes of knowledge transmission are often referred to as 'art' by Euro-Western communities and hence were classified as creative pursuits, open to interpretation and often not considered as having a factual basis. Many people of European descent perceive Indigenous biocultural knowledge as 'myth', 'legends', non-factual and/or artistic expressions (for example, see Sutton 1988). However, Indigenous peoples assert that cultural knowledge transmission contains facts and encodes Indigenous cultures, ways of life, scientific knowledge, past observations and moral standards (for example see Newsome 1980; Pascoe 2014).

There is increasing evidence in the academic literature corroborating Indigenous stories as containing important scientific facts or evidence of past events (Bohensky & Maru 2011). For example, Rossetto *et al.* (2017) aligned genetic evidence with the Nguthungulli songline to demonstrate the prehistoric human-mediated range expansion of the Bean Tree (*Castanospermum australe*) in eastern Australia. Similarly, if early botanists had understood that Indigenous stories and song could reveal biocultural knowledge about past human dispersal of plant, they may not have described *Livistona rigida* of the Mataranka region, Northern Territory, as distinct from *Livistona mariae* of Palm Valley near Alice Springs. Recent genetic research suggests they are the same species (Bowman *et al.* 2015). Nunn and Reid (2016) also reviewed Indigenous stories of sea level rise around Australia and noted the accuracy of many Indigenous stories of past sea level rise. Although we acknowledge that not all past stories contain facts about past observations, there are many examples where they do. Furthermore, contemporary Indigenous knowledge of environments, that variably draws on inherited knowledge and recent observations, is increasingly being recognised as valuable to sustainable environmental management practice, not only in Australia, but worldwide (e.g. Roche 2005; Shaw *et al.* 2010). Correspondingly, Indigenous biocultural knowledge has been increasingly recognised at the annual Ecological Society of Australia conferences, especially since 2010 when Indigenous Ecological Knowledge symposia become a deliberate annual event. This special issue of *Ecological Management & Restoration* celebrates the 10th Anniversary of the annual Indigenous Ecological Knowledge symposia and associated Indigenous Travel Grant scheme which was intentionally established by the Ecological Society of Australia to increase the involvement of Indigenous people, knowledge and Country in Australia's premier ecology conferences, and hence decolonise Australian ecology.

Development of Cross-Cultural Ecological Research and Management in Australia

The benefits of combining Indigenous and Western ecological understanding and methods has resulted in the emergence of the two-way or cross-cultural ecology concept in Australia (Ens 2012; and papers in this special issue), akin to the 'two-eyed seeing' concept in Canada (Bartlett *et al.* 2012) and cross-cultural approaches in New Zealand (Stephenson & Moller 2009; Hardy *et al.* 2015). The mechanisms and benefits of cross-cultural approaches to managing Australia's environments emerged in government discourse from the late 1970s, following Aboriginal land rights legislation, and resulted in the establishment of Australia's first Aboriginal-owned and jointly managed National Park, Kakadu, in 1978, followed by Gurig (1981), Uluru (1985) and Nitmiluk (1989) National Parks and others since (de Lacy 1994; Ross *et al.* 2009). In the late 1980s, documented government discourse about Indigenous roles in conservation grew (Smyth *et al.* 1985; Griffin & Allan 1986; Kean *et al.* 1988; Young 1991) as did scientific papers on cross-cultural approaches to ecology (Bradley 1989; Lewis 1989; Baker *et al.* 1990; Walsh 1990). These collaborations between Indigenous and non-Indigenous people followed two centuries of research *on* rather than *with* Australia's Indigenous peoples, knowledge and Country. The importance of early Australian research by anthropologists, ethnobiologists and linguists cannot be dismissed, as in some places, this knowledge has been instrumental to the revitalisation of traditional Indigenous cultural practices and languages following decimation by European colonisation (Marmion *et al.* 2014). However, unintentionally, the observation of Indigenous peoples as 'other' and often as subjects of study rather than a collaborative, Indigenous empowerment approach, is likely to have contributed to the centuries of disconnect between Indigenous and Western scientific knowledge systems.

Following the establishment of co-managed National Parks and employment of Indigenous people as National Parks Rangers, there was pressure from Indigenous communities for greater control and inclusion of Indigenous knowledge systems in conservation (Yunupingu 1997; Szabo & Smyth 2003; Ross *et al.* 2009). This pressure, combined with international mandates for decolonisation and increased Indigenous inclusion in conservation (such as the UN Environment Program and Declaration on the Rights of Indigenous Peoples), resulted in the establishment of the Indigenous Protected Area (IPA) and Indigenous Ranger (Working on Country) programs of the Australian Government in 1997 and 2007, respectively. These programs enabled more Indigenous control and participation in Australia's conservation agenda, although there are ongoing tensions between use of, values and prioritisation of Indigenous knowledge systems and those of Western science (Davies *et al.* 2013; Morphy 2017). IPA and Ranger funding models were and largely still are aligned with Western conservation priorities around threat abatement, including activities such as fire suppression, invasive species control and threatened species management. While these activities are important to Indigenous communities, the management planning and execution processes were initially controlled by non-Indigenous stakeholders and disempowered Indigenous ways of knowing and doing. Innovative governance processes that privilege Indigenous over Western ways have evolved, such as through the Healthy Country Planning initiative (e.g. Moorcroft *et al.* 2012) and other co-design frameworks, that place Indigenous people and Country at the centre of planning and management processes (Austin *et al.* 2019; Hill *et al.* 2021). On the ground, practical application of cross-cultural knowledge in IPAs has been increasing, notably around fire and species management (Ens *et al.* 2015) and has been variably described as two-way, both-ways, right-way, biocultural or ecocultural approaches. In this paper, we will use the term cross-cultural or biocultural to refer to the possibility that more than

two cultural traditions or ways are being deployed that typically incorporate mixes of ecological and cultural epistemologies. Although the application of cross-cultural approaches was becoming more prevalent on the ground in natural resource management, fuelled by the IPA and Indigenous Ranger programs, cross-cultural ecology and science did not feature strongly in university curricula or the ecological literature until recently. Calls to decolonise ecology and science have come from within Australia (Muller 2003; Langton 2003; Rose 2004) and abroad (Smith 1999, 2012).

Decolonising Ecology through the ESA Indigenous Ecological Knowledge Symposia 2010–2020

In an effort to decolonise ecology and bring Indigenous people, knowledge and collaborations into Australia's leading ecology society, an annual Indigenous Ecological Knowledge symposium was established by the ESA. The first in this series of Indigenous symposia was instigated by author Emilie Ens, who was a post-doctoral ecologist at ANU's Centre for Aboriginal Economic Policy Research, following exposure to two-way or both-way approaches to natural resource management in Arnhem Land (Ens 2012). We acknowledge that symposia and presentations featuring Indigenous ecology occurred at earlier ESA conferences including a symposium in 2008 led by Rosemary Hill. After the 2010 symposium, approximately 100 symposium participants and attendees met and agreed to initiate annual Indigenous symposia at the ESA conferences and establish an ESA Indigenous Working Group, including eastern Arrernte and Warramungu man Wayne Barbour (Barbour & Schlesinger 2012) who became the chairperson of the working group from 2011 to 2013. Bundjalung man Oliver Costello was co-chairperson from 2011 to 2013 (Costello & Cameron 2022). Christine Schlesinger was chairperson in 2014 and Mbabaram ethnobotanist Gerry Turpin was the subsequent chairperson of the Indigenous Working Group for 6 years from 2016 until 2021 (Turpin

& Cameron, 2022). Following the momentum of the 2010 symposia, a special issue of journal *Ecological Management and Restoration* on Indigenous land and Sea Management in Remote Australia (2012) was devoted to promotion of the presentations and served as an important foundation for future cross-cultural ecology, as highlighted throughout this second special issue nearly 10 years on.

Concurrent with the annual symposia, and we believe was integral to the success, was annual Indigenous land management field trips and establishment of an annual Indigenous Travel Grant scheme. Over the following decade, the Indigenous Travel fund was nourished with support primarily from The Nature Conservancy (Australia), the Sidney Myer Fund and Territory NRM with one-off support from organisations local to the conference locations. In 2019, Bush Heritage supported the annual ESA conference 'right-way science' award of \$5000 that acknowledged the best Indigenous focussed presentation that most respectfully highlighted Indigenous knowledge and promoted Indigenous inclusion. Inaugural winners of this prize in 2019 were the Yugul Mangi Rangers and Michelle McKemey. In 2020, there were two winners: The Banbai Rangers and Michelle McKemey; and Bernadette Duncan and Nat Raisbeck-Brown (McKemey *et al.* 2022).

Here, we provide a review of the decade of ESA Indigenous Ecological Knowledge symposia which provides a snapshot of cross-cultural ecological pursuits across Australia and New Zealand. From 2010–2020, 173 people presented in the ESA Indigenous symposia (Table 1, for full participant list, see Appendix 1), often with a 'full house' audience. There was roughly an equal gender split (52% women, 48% men) and mostly Aboriginal presenters (62%), followed by non-Indigenous (35%) and Maori (3%) (Figure 1a). Most presenters were Indigenous Rangers, followed by University researchers and state/Territory government and non-government organisation staff (Figure 1b). Presenters came from urban to remote parts of Australia, showing that cross-cultural ecological research and management were operating across the

Table 1. Summary of ESA conference location and Indigenous symposium participation

Year	Location	Participants
2010	Canberra, ACT	13
2011	Hobart, Tas	20
2012	Melbourne, Vic	27
2013	Auckland, New Zealand (EcoTas)	15
2014	Alice Springs, NT	12
2015	Adelaide, SA	22
2016	Fremantle, WA	9
2017	Hunter Valley, NSW (EcoTas)	16
2018	Brisbane, Qld	10
2019	Launceston, TAS	23
2020	Online (was Wollongong, NSW)	6

continent, although there were notable gaps from the 4-border region (NSW, Qld, SA, NT) (Figure 2). The two trans-Tasman Australia-New Zealand Ecological Society conferences also promoted cross-cultural and Maori ecology from Aotearoa (New Zealand) (Awatere *et al.* 2017; Spinks 2018; Smith 2020).

A word-cloud of presentations titles given over the decade of ESA's Indigenous Ecological Knowledge symposia, generated using NVivo qualitative data analysis software, is presented in Figure 3. The word frequency analysis was restricted to the 100 most used words in the presentation titles, excluding stop words, and pooling exact matches, stemmed words (eg talk, talking) and synonyms. Dominant words (themes) (shown in large red font) included: Indigenous, cultural, management, Country, fire, working and knowledge. Less frequently used words (sub-themes) are shown in black and font size reflects frequency of use: the larger words were used more than smaller words. The secondary words (sub-themes) in large black font highlighted work activities such as planning, monitoring and research, and core work elements of cross-cultural, linking, people and resources.

The Multiple Benefits of Cross-Cultural Ecological Research and Management

Indigenous-led and cross-cultural ecological research and management can have

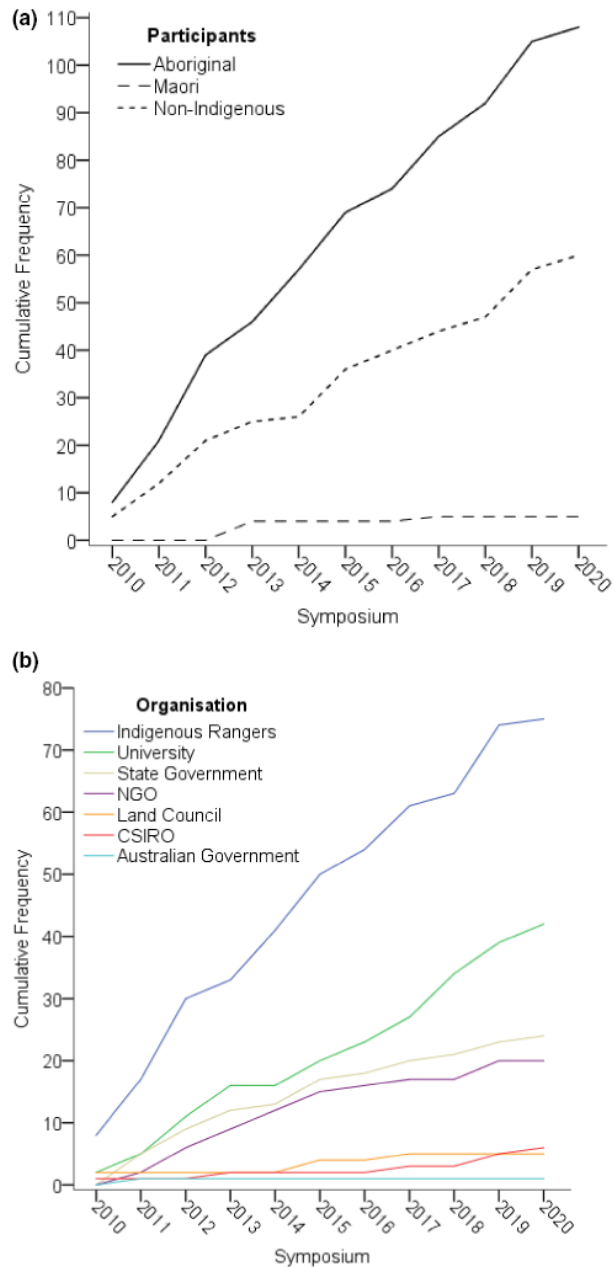


Figure 1. ESA Indigenous symposium participant heritage (a) and Organisational affiliation (b).

environmental, social and economic benefits if done well (see papers in this issue), although practitioners must be aware of power imbalances and the politics of knowledge integration (Nadasdy 1999; Hill *et al.* 2012). Barbour and Schlesinger (2012) eloquently wrote about the need to keep "black hands on the steering wheel" to ensure that Indigenous people benefit, not just Western science and scientists. In this special issue, Cameron

(2022) described how Indigenous people have seven senses that allow heightened understanding and deeper connections with Country and kin. Cooke *et al.* (2022) noted that Country is more than the biophysical components of the environment but also refers to the spiritual connections and kinship responsibilities that dominate Indigenous people's lives and epistemology, and hence, ethical research on Country must follow a suite

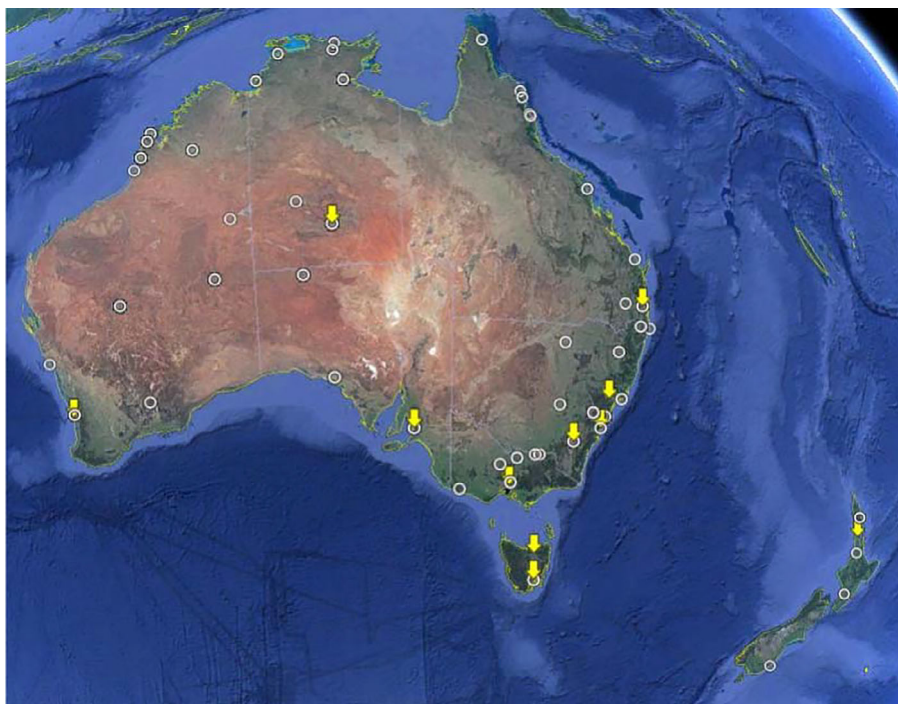


Figure 2. Map of ESA Indigenous Symposium project locations (2010-2020) (white circles) and conference locations (yellow arrows) across Australia and New Zealand.

special issue detailing work in the six IPAs: Walalkarra (Robin *et al.* 2022), Bardi Jawi (Lindsay *et al.* 2022), Yawuru (Lindsay *et al.* 2022; Wysong *et al.* 2022), Karajarri (Blackwood *et al.* 2022), South East Arnhem Land (Daniels *et al.* 2022, McKemey *et al.* 2022) and Wattlebridge (McKemey *et al.* 2022). IPAs are managed by Indigenous Rangers and communities who hold customary responsibility for Country and widely deploy their knowledge to manage threats and maintain ecological and cultural assets (for example see Preuss & Dixon 2012; Robin *et al.* 2022). Featured throughout the symposia was Indigenous knowledge of Country, fire, seasons, long-term change, weather, species interactions and habitats, that was drawn on by Rangers to manage the ecological and cultural values of Protected Areas (for example, see Bangalang *et al.* 2022; Robin *et al.* 2022; McKemey *et al.* 2022). Western scientific and management techniques are also often deployed, such as modern burning tools, pesticides, computers, mapping, modelling and other technologies (Ansell & Koenig 2011; Hoffmann *et al.* 2012; Preuss & Dixon 2012; Blackwood *et al.* 2022; Wysong *et al.* 2022; Daniels *et al.* 2022; Lindsay *et al.* 2022; Skroblin *et al.* 2022). In contemporary times, often a mix of Indigenous and Western knowledge and techniques are used in conservation as cultures have come into contact and rangers look for the most efficient ways to manage Country. Indigenous rangers, managers and communities make decisions about which knowledge and tools are best to use at any given time to manage Country, giving rise to a fluid mix of cross-cultural knowledge and approaches.

A dominant theme in traditional Indigenous caring for Country and contemporary Australian cross-cultural ecology is fire management. In this special issue, Blackwood *et al.* (2022) used historical aerial photography and satellite imagery of parts of the Karajarri IPA to investigate the differences in contemporary burning patterns compared to historical (1940s) burning patterns. They found that modern burns were larger and more frequent than burning in the 1940s. McKemey *et al.* (2022) created local Indigenous seasonal



Figure 3. Word-cloud of ESA symposium presentation titles from 2010 to 2020.

a biocultural protocols. Gore-Birch *et al.* (2022) and Goolmeer *et al.* (2022) advocated for Indigenous-led research and increased Indigenous recognition, decision-making and accountability in Australia’s key piece of environmental

legislation, the *Environment Protection and Biodiversity Conservation Act* (1999).

Throughout the ESA symposia, cross-cultural ecology and management of IPAs were showcased including papers in this

fire calendars with the Banbai (New South Wales) and the Yugul Mangi (Northern Territory) Rangers that were used to guide traditional burning techniques based on cultural indicators. Lindsay *et al.* (2022) worked with local communities on the Dampier Peninsula in Western Australia to keep fire out of ecological and culturally important monsoon vine thicket communities. Cultural burning featured strongly throughout the symposium, especially from the Firesticks group in eastern Australia (Costello & Cameron 2022), savanna burning programs across the north (Richards *et al.* 2012; Ansell & Evans 2019) and from desert groups (Preuss & Dixon 2012).

Another dominant theme emerging throughout the symposia was cross-cultural fauna ecology where Indigenous knowledge of species habitats and behaviour was combined with scientific monitoring and modelling approaches to better understand the current home ranges and threats. Cross-cultural research featuring culturally significant species in this special issue includes the following: *Man-karr* (Greater Bilby; *Macrotis lagotis*) (Skroblin *et al.* 2022), *Kukra* (Short-beaked Echidna, *Tachyglossus aculeatus*) (McKemey *et al.* 2022) and the Spectacled Hare-wallaby (*Lagorchestes conspicillatus*) (Wysong *et al.* 2022). Other standout presentations in the decade of the Indigenous symposia included enhanced Indigenous research on lizards in the Kimberley (Ward-Fear *et al.* 2019), *Warru* reintroduction in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands (Muhic *et al.* 2012) and Indigenous knowledge and tracking skills for monitoring and managing feral cats in the Kiwirrkurra IPA (Paltridge *et al.* 2020). Although the benefits of Indigenous knowledge in managing threatened and invasive species were a highlight of the symposia, The Indigenous Reference Group of the Threatened Species Recovery Hub advocated for greater inclusion of Indigenous Knowledge and people in species research and increased Indigenous leadership (see Gore-Birch *et al.* 2022).

Indigenous knowledge of and concern for freshwater places also emerged as a significant theme across the decade of Indigenous symposia. In this special issue,

the cultural importance of freshwater places and culturally relevant management was highlighted by Robin *et al.* (2022), Bangalang *et al.* (2022) and Daniels *et al.* (2022). Throughout the symposium, similar themes were presented by the Nyul Nyul Rangers (Pyke *et al.* 2018), Ngukurr Yangbala Rangers (Russell *et al.* 2020) and the ESA Indigenous Keynote Speaker in 2018, Dr Brad Moggridge, who spoke about the need to integrate Indigenous cultural values into water planning (Moggridge *et al.* 2019).

Cross-cultural ecology and conservation can also be used to shift power towards Indigenous peoples and influence social and environmental justice and governance issues. As Moggridge *et al.* (2019) articulated, cross-cultural approaches promote Indigenous inclusion and Indigenous ways of knowing which not only add to deeper ecological understanding but also serve to support reconciliation and healing of Australia's social relations after the centuries of discrimination, genocide and cultural erasure of Aboriginal peoples that ensued after European colonisation. As stated by Dr Leah Talbot (2017 ESA Indigenous Keynote Speaker) and Teagan Goolmeer (Indigenous Reference Group, Threatened Species Hub), active involvement of Indigenous people is essential in ecology and conservation decision-making so that Indigenous knowledge is controlled, shared and maintained by Indigenous people (Talbot 2017; Goolmeer *et al.* 2022). In this special issue, Carter *et al.* (2022) detail how cultural authority can be used to drive inclusion of knowledge and culture in jointly managed parks. They outlined how the processes of Prior Informed Consent, participatory planning and power-shifting can be deployed to develop innovative, equitable, culturally appropriate and culturally informed conservation plans. Furthermore, active involvement of Indigenous people in ecological research and conservation *on-Country* serves to maintain cultural knowledge and practice, which are significantly threatened, and support intergenerational knowledge sharing (Bangalang *et al.* 2022; Carter *et al.* 2022; Daniels *et al.* 2022; Robin *et al.* 2022). Active involvement of multi-

generational Aboriginal groups in ecology and conservation has been shown to strengthen Aboriginal culture, identity, pride and activity, and hence lead to well-being and health benefits (Garnett *et al.* 2009; Campbell *et al.* 2011). This is exemplified by the Northern Territory's Learning on Country program (Fogarty 2012) and described in this special issue, with particular reference to female youth by Daniels *et al.* (2022).

Cross-cultural ecology also makes sense economically as Western scientists have limited capacity to access some Indigenous lands and work in the field for long periods of time. On the other hand, Indigenous people, such as Rangers, may live and be on Country for most of the year (Robin *et al.* 2022). In remote parts of central and northern Australia, where the vast majority of Indigenous Protected Areas occur, western scientific knowledge is relatively poor due to the remoteness and access restrictions (Preuss & Dixon 2012, Ens *et al.* 2012; Brennan *et al.* 2012; Wysong *et al.* 2022; Skroblin *et al.* 2022). However, Indigenous knowledge flourishes in many remote parts of Australia due to relatively less interference from colonisation and strong access and connections to Country compared to more densely populated parts of southern and eastern Australia (Hunt 2012). Deployment of Indigenous and Western methods in such remote regions has proven to benefit Indigenous community development and employment, as shown through many presentations at the annual ESA conferences and featured in this 2022 issue and the 2012 special issue of *Ecological Management and Restoration*.

The Future: Facilitating Indigenous-led Ecological Research and Conservation

As detailed in the growing literature on cross-cultural approaches to ecology, the practice of cross-cultural research and action requires constant reflexivity and communication between parties to ensure that the priorities, methods and preferred outcomes of each cultural group is well represented and empowered. Gone are the days of talking about building the

capacity of Aboriginal people; now, the common discourse in cross-cultural work is 'both-ways' capacity building—building the capacity of all participants to understand, value, deploy and empower practices from all participating cultures (Hill *et al.* 2012). Perhaps the more significant challenge is for the dominant (often Western) culture to relinquish control, devolve power, learn more about Indigenous knowledge systems and language (Marika-Mununggiritj 1991) and work to empower Indigenous people, knowledge and approaches, known as decolonising research and organisational practice are increasingly being documented and applied, underpinned by Linda Tuhiwai Smith's seminal book 'Decolonising Methodologies: Research and Indigenous People' (Smith 1999, 2012) and Martin Nakata's (2007) 'Disciplining the Savages, Savaging the Disciplines'.

Over the decade of ESA's Indigenous Ecological Knowledge symposia presentations, many lessons about the mechanics of devolution of power have been shared including: prioritising mutual benefits and reciprocity; ensuring plenty of time for relationship, knowledge sharing and project development; maintenance of Indigenous Intellectual Property; Indigenous empowerment; two-way capacity building; transparency and ethical project governance. These lessons feature throughout the papers of this special issue of and that of 2012.

Throughout the symposia, the broad range of presentations (see full list in Appendix 1) illustrated a fluidity in cross-cultural engagement and interaction. A spectrum of Indigenous engagement akin to the Public Participation Spectrum (IAP2 2007) was evident, from non-Indigenous domination of projects and methods (where Indigenous people were participants with little intellectual input) to projects where strong collaborations were apparent, through to empowered Indigenous-led research. Drawing on the principles of decolonising methodologies, the ESA Indigenous symposia has built a network and community of practice for cross-cultural ecology and conservation in Australia. Ultimately, the goal is for more

Indigenous-led and controlled research and management projects, as stated by many symposium participants. To achieve this, Indigenous researchers must be empowered which requires increased participation in higher education, or creation of alternative ways of building Indigenous research capacity, such as the Aboriginal Research Practitioners Network (ARNPNet) (Sithole *et al.* 2009). Nevertheless, both-ways literacy and knowledge gaps present a significant challenge to deeper cross-cultural understanding and increased Indigenous-led research and project management across Australia. Of the relatively few Indigenous researchers who have become adept at cross-cultural science and communication, high demands on their time and energy mean that many Indigenous research leaders are overburdened with requests to sit as Indigenous representatives on Advisory Committees and lead projects. A stronger network of Indigenous researchers needs to be supported by existing or new funding structures (Goolmeer *et al.* 2022).

The annual ESA Indigenous symposia have elucidated the need for increased support for Indigenous researcher development and devolution of power by non-Indigenous researchers to increase ethical and cross-cultural approaches in ecology and conservation.

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Appendix 1

List of ESA Indigenous Ecological Knowledge symposia (2010-2020) (based on the best available data)

Name	Symposium	Type	Location	State	Speakers Paper Title
Karissa Preuss	2010 Canberra	Land Council	Alice Springs	NT	Success factors for two-way land management in the Tanami Djelk Rangers working on, and caring for country, in the Djelk IPA, Arnhem Land.
Madeleine Dixon		Rangers	Yuendumu	NT	
Emilie Ens		University	Canberra	ACT	
Selma Campion		Rangers	Maningrida	NT	
Felina Campion		Rangers	Maningrida	NT	
Jodie Kelly		Rangers	Maningrida	NT	
Daryl Lacey	2011 Hobart	Rangers	Nhulunbuy	NT	Managing Country Combining Indigenous And Western Ecological Knowledge – Dhimurru’s Experience In North-East Arnhem Land Bradshaw land and resource company. . . working on our land our way The Warru Reintroduction Project Black Hands on the Steering Wheel Ningaloo Pest Animal Management Plan The Firesticks Project Bunya Mountains: A unique story of people, place and nuts Indigenous-led action research and the Importance of Campfires Working on Banbai Country Bardi-Jawi Rangers and Bardi-Jawi IPA Inclusive Engagement and Development: An indigenous perspective of community, business and sustainable development Kakadu: climate change and the world’s oldest living culture Living Country within the Greater Blue Mountains World Heritage Area Fencing sacred freshwater billabongs in south eastern Arnhem Land for cultural and conservation maintenance Sustainable use of natural resource facilitating traditional land management in the Thamurrur region Firesticks: Aboriginal fire to enhance biodiversity, connectivity & resilience Interactions in Monsoon Vine Thickets; People, Plants, Fauna, Fire and Restoration in the Dampier Peninsula, Western Australia Establishment of an Indigenous-driven Tropical Ethnobotany Centre Linking Indigenous and Western Ecologies in Australia’s Humid Tropical Forests Cultural Mapping and Freshwater Turtle Monitoring in Githabul Country Monitoring in the Angas Downs IPA Bunuba Business on Bunuba Country
Ben Hoffman		CSIRO	Darwin	NT	
Daniel Jones		Rangers	Timber Creek	NT	
Greg Kimpton		Land Council	Timber Creek	NT	
Jasmina Muhic		Rangers	Umuwa	SA	
Eric Abbott		Rangers	Umuwa	SA	
Wayne Barbour		University	Alice Springs	NT	
Mike Crisp		NGO	Beachlands	WA	
Oliver Costello		State Government	Blackheath	NSW	
Dave Calland		State Government	Brisbane	Qld	
Mal Collinge		Rangers	Bundaberg	Qld	
Peta-Marie Standley		State Government	Cairns	Qld	
Janette Owens		Rangers	Cairns	Qld	
Berenice Hetherington		Aus. Government	Canberra	ACT	
Lesley Patterson	Rangers	Guyra	NSW		
Mark Shadforth	Rangers	Djarindjin	WA		
Trevor Sampi	Rangers	Djarindjin	WA		
Donna Moodie	University	Glencoe	Qld		
Michelle McKemey	2012 Melbourne	NGO	Guyra	NSW	
Den Barber		State Government	Katoomba	NSW	
Emilie Ens		University	Canberra	ACT	
Priscilla Dixon		Rangers	Ngukurr	NT	
Edna Nelson		Rangers	Ngukurr	NT	
Angus Melpi		Rangers	Wadeye	NT	
Chris Brady		Rangers	Wadeye	NT	
Russell Hill		State Government	Forbes	NSW	
Wayne Barbour		University	Alice Springs	NT	
Oliver Costello		State Government	Blackheath	NSW	
Chris Sampi	Rangers	Broome	WA		
Malcolm Lindsay	NGO	Broome	WA		
Gerry Turpin	2012 Melbourne	State Government	Cairns	Qld	
Leah Talbot		NGO	Cairns	Qld	
Robyn Belaquiah		NGO	Cairns	Qld	
Joann Schmider		NGO	Cairns	Qld	
Nick McLean		University	Canberra	ACT	
Doug Williams		Rangers	Kyogle	NSW	
George Wilson		University	Canberra	ACT	
Clive Aiken		Rangers	Fitzroy Crossing	WA	
Dave Colnan		Rangers	Fitzroy Crossing	WA	
Emmanuel Namarnyilk		Rangers	Manmoyi	NT	

Appendix 1. (Continued)

Name	Symposium	Type	Location	State	Speakers Paper Title
Emilie Ens		University	Canberra	ACT	Indigenous knowledge is fundamental to management of Indigenous owned Australia: case study from Arnhem Land
Terrah Guymala		Rangers	Manmoyi	NT	Cross-cultural methods for managing Allosyncarpia rainforest patches on the West Arnhem Plateau
Jeremy Freeman		University	Darwin	NT	
Rebecca Phillips		State Government	Melbourne	VIC	Can Modern Science be akin to TEK? Case Studies: Linking Cultural Knowledge and Park management
Ray Ahmat		State Government	Shepparton	VIC	Working on YortaYorta Country
Annette Kogolo		Rangers	Three Mile Community	WA	Integrating traditional ecological knowledge with land management activities: Understanding ecological response to climate change in the Great Sandy Desert.
Sonia Leonard		University	Melbourne	VIC	
Eric Abbott		Rangers	Umuwa	SA	Working for Warru: An update on the reintroduction of Black-footed Rock Wallaby
Simon Booth		Rangers	Umuwa	SA	
Janelle Simms		Rangers	Warburton	WA	Women's Working on Country team: Young women harnessing traditional and contemporary land management techniques
Cecily Turner		Rangers	Warburton	WA	
Terri-Ann Robinson		Rangers	Warburton	WA	
Rebecca Aldred		Rangers	Warburton	WA	
Oliver Costello	2013 NZ	NGO	Blackheath	NSW	Cultural Burning—Diversity of Fire
Peta-Marie Standley		University	Cairns	Qld	The angel in the detail: Diverse burning for cultural and environmental outcomes in Australia
Gerry Turpin		State Government	Cairns	Qld	Bridging Indigenous Knowledge and Western Science in Innovative Ways for a Sustainable Future - The Tropical Indigenous Ethnobotany Centre
Gerry Turpin		State Government	Cairns	Qld	An indigenous-driven process for participatory scenario planning and cultural occupancy mapping in coastal central Qld
Anna Richards		CSIRO	Darwin	NT	Savanna burning, greenhouse gas emissions and Indigenous livelihoods: Introducing the Tiwi Carbon Study
Rebecca Phillips		State Government	Melbourne	VIC	Grassroots in Urban Landscapes: Aboriginal Leadership in Environmental Management within Government structures. Finding a common ground.
Maritza Roberts		Rangers	Ngukurr	NT	Caring for Aboriginal-owned Country in South Eastern Arnhem Land using innovative two-way learning and management approaches
Kiefer Hall		Rangers	Ngukurr	NT	
Emilie Ens		University	Canberra	ACT	
Juliane Chetham		NGO	NZ	NZ	A Framework for Maori Cultural Health Indicators for Kauri Ecosystems
Dr Huhana Smith		University	NZ	NZ	Manaaki Taha Moana
Aroha Spinks		University	NZ	NZ	
Marion Johnson		University	NZ	NZ	Transforming Agriculture with Native plants and Indigenous Knowledge
Nicola MacDonald		NGO	NZ	NZ	Emancipatory Resource Management: A Hapu Story
Wayne Barbour		Rangers	Wadeye	NT	Black Hands on the Steering Wheel
Preston Cox	2014 Alice Springs	Rangers	Beagle Bay	WA	Combining techniques to investigate the ecological and cultural significance of NyulNyul freshwater places
Zynal Cox		Rangers	Beagle Bay	WA	
Gerry Turpin		State Government	Cairns	Qld	
Cissy Tigan		Rangers	Djarindjin	WA	Protecting freshwater places through the eyes of the Bardi-Jawi people
Bernadette Angus		Rangers	Djarindjin	WA	
Chris Sampi		Rangers	Djarindjin	WA	

Appendix 1. (Continued)

Name	Symposium	Type	Location	State	Speakers Paper Title
Lesley Patterson		Rangers	Guyra	NSW	The Benefits of burning: cultural burning at Wattle Ridge IPA
Ben Church		NGO	Heywood	VIC	
Gary Mooney		Rangers	Mackay	Qld	Capturing traditional ecological knowledge and developing strategies to maintain traditional resources in a changing climate
Samarla Deshong		Rangers	Mackay	Qld	
Oliver Costello		NGO	Rosebank	NSW	Firesticks: cultural learning pathways
Andrew Johnstone		NGO	Rosebank	NSW	
Lachlan Sutherland	2015 Adelaide	State Government	Adelaide	SA	Ngarrindjeri Partnerships and describing the character of Yarlular-Ruwe
Mel White		State Government	Adelaide	SA	Incorporating Aboriginal use of plants and animals into water resource planning in Lake Eyre Basin
Mike Wouters		State Government	Adelaide	SA	Fire Regime Management - Connecting Science & Practice
Benjamin Kaether		Land Council	Alice Springs	NT	Changes in Fire Regimes through Warlpiri and Gurindji Fire Management in the Tanami Desert
Yoshi Akune		Rangers	Beagle Bay	WA	Nyul Nyul knowledge and conventional science: two models of freshwater ecosystems on Nyul Nyul country
Ninjana Walsham		Rangers	Beagle Bay	WA	
Mark Rothery		NGO	Beagle Bay	WA	Working with Rangers surveying the Monsoon Vine Thickets of Bunuba limestone country
Stephen Reynolds		NGO	Broome	WA	
Michelle Walker		University	Broome	WA	
Michelle Walker		University	Broome	WA	
Gerry Turpin		State Government	Cairns	Qld	
Debbie Sibosado		Land Council	Djarindjin	WA	Managing and monitoring Bardi-Jawi traditional oola (water) places from a cultural perspective
Kiefer Hall		Rangers	Ngukurr	NT	Looking after Bulbuluritj: Ngukurr Yangbala Project
Karis Robertson		Rangers	Ngukurr	NT	
Karmelina Daniels		Rangers	Ngukurr	NT	
Emilie Ens		University	Sydney	NSW	
Lena Long		Rangers	Wiluna	WA	Birriliburu IPA: Cross-cultural conservation in a desert landscape
Rita Cutter		Rangers	Wiluna	WA	
Vanessa Westcott		NGO	Wiluna	WA	
Rita Cutter		Rangers	Wiluna	WA	
Lena Long		Rangers	Wiluna	WA	
Conrad Bilney		University	Wodonga	VIC	Opening up a Can of Witchetty Grubs Projects, partnerships and time: how the Nyul Nyul Rangers work with others to manage country
Albert Wiggan	2016 Fremantle	Rangers	Beagle Bay	WA	
Daniel Oades		Rangers	Broome	WA	Right-Way Research on Kimberley Saltwater Country
Gerry Turpin		State Government	Cairns	Qld	Working with Indigenous Biocultural Knowledge in Natural Resource Management
Les Schultz		Rangers	Dundas	WA	Ngadju kala: Aboriginal fire knowledge and aspirations in the Great Western Woodlands
Harold Lucwick		Rangers	Hope Vale	Qld	Guugu Yimidhirr Ecosystems Vs 'Indigenous Ecosystems'
Anja Skroblin		University	Melbourne	VIC	Optimising monitoring of the bilby through cross-cultural connections
Stefania Ondeï		University	Sandy Bay	Tasmania	'Right-Way Fire' and Wulo: managing rainforests with fire on Wunambal Gaambera Country (Western Australia)
Daniel Sloane		University	Sydney	NSW	An Eco-cultural Investigation of Melaleuca Dieback in Laynhapuy IPA, North-East Arnhem Land, Australia
Vanessa Westcott		NGO	Wiluna	WA	

Appendix 1. (Continued)

Name	Symposium	Type	Location	State	Speakers Paper Title
Nyaparu Rose		Rangers	Bidyadanga	WA	Kakarratul (Marsupial Mole) Monitoring on Birriliburu Country
Steve Leonard		University	Bundoora	VIC	Nyangumarta wika: Using oral history and historical aerial photography to reconstruct traditional burning regimes.
Leah Talbot		CSIRO	Cairns	Qld	How can Indigenous governance and the application of Indigenous ecology support ecology being put into work
Gerry Turpin		State Government	Cairns	Qld	Obtaining a Critical Mass: How one Green Team became sustainable
Richard Kime		Land Council	Nelson Bay	NSW	
Melissa Wurrumarrba		Rangers	Ngukurr	NT	Cross-cultural biodiversity surveys in SE Arnhem Land
Sandra Blitner		Rangers	Ngukurr	NT	
Janita Gaykamangu		Rangers	Ngukurr	NT	
Emilie Ens		University	Sydney	NSW	
Oliver Costello		State Government	Rosebank	NSW	
Kiri Reihana		Government	Hunter Valley	NZ	Cultural Fire Management on NPWS managed lands in NSW WAIORA a kaupapa Maori assessment tool
Annette Williams		Rangers	Wiluna	WA	Looking after Birriliburu Bilbies: a two-way science approach
Vanessa Westcott		NGO	Wiluna	WA	
Lena Long		Rangers	Wiluna	WA	
Amanda Ingle		Rangers	Wiluna	WA	
Teghan Collingwood	2018 Brisbane	University	Brisbane	Qld	
Ashley Ross		Rangers	Bungalow	Qld	Nest predation of Alwal (golden-shouldered parrot <i>Psephotellus chrysopterygius</i>) on Olkola Country, Cape York Peninsula, Australia Bringing Alwal Home: A two-tool box approach for recovering the endangered Golden-shouldered Parrot
Gerry Turpin		State Government	Cairns	Qld	Marine macrofaunal communities of First Nations' clam gardens
Morgan Black		University	Canada	Canada	
Liz Cameron		University	Melbourne	VIC	Ngura Dharug, (place, people). The ancient roots of knowledge
Liz Cameron		University	Melbourne	VIC	Can Aboriginal Ecological Knowledge offer solutions in addressing our biodiversity crisis associated with human activity.
Anja Skroblin		University	Melbourne	VIC	Bilby monitoring with Martu: bringing together Indigenous knowledge and western science
Ben Kitchener		University	Sydney	NSW	Rediscovering biodiversity in East Arnhem Land; a cross-cultural approach
Lena Long		Rangers	Wiluna	WA	Saving the Bilby on Birriliburu country
Conrad Bilney		University	Wodonga	VIC	
Jodie Ward	2019 Launceston	Rangers	Kiwirrkurra	NT	Identification of Australian edible insects: applying bio-informatics and ethno-entomological knowledge
Rachel Paltridge		NGO	Alice Springs	NT	
Amos Atkinson		Rangers	Bendigo	VIC	Cat Kuka for Conservation of Ninu and Tjalapa on the Kiwirrkurra IPA
Ro Hill		CSIRO	Cairns	Qld	
Cathy Robinson		CSIRO	Brisbane	Qld	
Eduardo Maher		Rangers	Broome	WA	Understanding Country outcomes from ecosystem management practices
Monica Edgar		Rangers	Broome	WA	
Karajarri Rangers		Rangers	Broome	WA	Adapting the IUCN Green List to evaluate joint management effectiveness at Arakwal
Karajarri Rangers		Rangers	Broome	WA	
					Culture, Community, and Conservation: pursuing an Indigenous-led wildlife sanctuary brings new perspectives to an old idea
					Appeasing Bluetongue - Managing fire for wildlife in the Great Sandy Desert

Appendix 1. (Continued)

Name	Symposium	Type	Location	State	Speakers Paper Title
Karajarri Rangers		Rangers	Broome	WA	
Sarah Legge		NGO	Broome	WA	
Michael Wysong		Rangers	Broome	WA	Possible unintended impacts of feral cat control within an IPA
Karajarri Rangers		Rangers	Broome	WA	
Norman Graham		State Government	Byron Bay	NSW	Effective cross-cultural conservation planning for significant species
Gerry Turpin		State Government	Cairns	Qld	
Patrick Cooke		University	Cairns	Qld	Multidisciplinary approaches to retrace the dispersal of rainforest trees by ancient Australians
Monica Fahey		University	Sydney	NSW	
Roan Plots		University	Melbourne	VIC	Indigenous Ecological Knowledge enhances scientific communication and climate resilience in Oceania
Winston Thompson		Rangers	Ngukurr	NT	Yugul Mangi Faiya En Sisen Kelenda and Savanna Burning in South East Arnhem
Jana Daniels		Rangers	Ngukurr	NT	
Michelle McKemey		University	Guyra	NSW	Land IPA
Michael Douglas		University	Perth	WA	Making stronger voices for Wagiman people through research
Wagiman Rangers		Rangers	Daly River	NT	
Briohny Jackman		NGO	Wiluna	WA	Right-way science, why is it important and how does it shape how we work
Adena Williams		Rangers	Wiluna	WA	
Gerry Turpin	2020 Online	State Government	Cairns	Qld	
Teagan Goolmeer		University	Perth	WA	Improving the protection and recovery of culturally significant species
Georgia Ward-Fear		University	Sydney	NSW	Sharper eyes see shyer lizards: Collaboration with indigenous peoples alters the outcome of conservation research
Bridget Campbell		University	Sydney	WA	Wanaka Wan'kurra? Biocultural investigation of critical weight range mammal resilience in north east Arnhem Land.
Yirralka Rangers		Rangers	Yirralka	NT	
Bernadette Duncan		Rangers	Walgett	NSW	Bridging the gaps between traditional/western science to support Aboriginal women's health, wellbeing, and empowerment
Nat Raisbeck-Brown		CSIRO	Perth	WA	