

Review

Acknowledging Landscape Connection: Using Sense of Place and Cultural and Customary Landscape Management to Enhance Landscape Ecological Theoretical Frameworks

Diane Pearson ^{1,*}  and Julian Gorman ²

- ¹ Farmed Landscape Research Centre, School of Agriculture and Environmental Science, College of Sciences, Massey University, Palmerston North 4442, New Zealand
- ² School of People, Environment and Planning, College of Humanities and Social Sciences, Massey University, Palmerston North 4442, New Zealand
- * Correspondence: d.pearson@massey.ac.nz

Abstract: Landscapes are important socio-ecological systems. They are widely researched through landscape ecology to aid conservation and environmental management efforts, yet these efforts are not always as successful as they could be in terms of on-the-ground impact. Increasingly when considering conservation, it is being recognized that indigenously managed landscapes have slower rates of biodiversity loss and better environmental outcomes. Local knowledge and connection to the landscape can play a significant part in successfully managing these landscapes. Acknowledging that stewardship of the landscape is more effective when people are a part of the landscape with deep-rooted connection to place is important for understanding the significance of traditional ecological knowledge and the implementation of indigenous-led action. It has also been shown that researchers who have a stronger sense of place and connection to landscapes can also drive initiatives that have better environmental outcomes. This means that human connections to landscapes are important for management strategies, and a better understanding of the human cognition of landscapes is necessary in landscape ecological theoretical frameworks. This review paper explores literature that acknowledges cultural perspectives and cognition of landscapes and how this relates to landscape ecology. It makes recommendations about how landscape ecology can contribute towards better on-the-ground outcomes by embracing more effective mechanisms of collaboration and participation to incorporate local and indigenous knowledge.

Keywords: indigenous land management; traditional ecological knowledge; landscape connection; landscape ecology; local knowledge; sense of place; caring for country



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1. Introduction

Landscape ecology differs from standard ecology in ways that are not just associated with the scale of investigation. It also differs in relation to the systems and processes that are investigated. Landscape ecology is often described as the study of landscape patterns/structure, processes/function, and change [1,2]. The change component is very much influenced by humans and their interactions with the landscape, meaning that people sit front and center in determining what happens to landscapes and that humans, as drivers of change, need to be an important consideration for landscape ecology [3].

Patterns and processes observed in modern landscapes are often influenced by some form of human intervention. Ever since people have been on Earth, human activity has been impacting natural patterns and processes with the result that most of the landscapes we see today are the product of natural and human-induced processes that have been operating at different time scales [4,5]. This signals that landscapes are inherently socio-ecological systems, which means that taking a landscape ecological approach to managing them should involve considering a range of interactions that occur at the landscape scale.

The term landscape however varies in its interpretation and definition. These differences potentially impact the way we think about landscapes and undertake science relating to landscapes [6]. So, we need to be cognizant of the fact that the perspectives that influence landscape ecology can vary, and that the differing perspectives and interpretations of a landscape can as a result also impact the effectiveness of conservation or environmental management activities that are recommended from landscape ecological investigation.

Looking at some of the ways that landscapes have been described by landscape ecologists, we see that a landscape was described in early landscape ecological literature by Forman and Godron in 1981 as “a kilometers wide area where a cluster of interacting stands of ecosystems is repeated in similar form” [7] (p. 733). This description can be related to an ecological perspective of a landscape that fits with the spatial ecological understanding that has dominated landscape ecology synonymous with the North American school of thought. In comparison, Klink et al. in 2002 saw a landscape as being related to “the perception, observation, and view of the environment or living space of man” [8] (p. 1). This description emphasizes the human-centric focus associated with defining landscapes, which potentially fits more with the European school of thought, with the emphasis on the planning and design of landscapes [9]. These differences clearly demonstrate that even within landscape ecology, there are various ways of interpreting a landscape and this is reflected in the analysis conducted on them.

When we look back over the evolution of landscape ecology, we see that the European school of landscape ecology (in particular) has long considered landscapes as systems in which the biotic and abiotic components interact with people impacting them [8]. In the field of landscape ecology, much work has been undertaken quantifying and mapping changes in patterns and processes and relating these to possible drivers of change [5,10,11]. Landscape ecologists have tended to look extensively at the role people play as drivers of changes and the degradation of natural systems [12–16]. However, there has not been much investigation into what different societies and their cultural practices offer in terms of managing landscapes and preserving and maintaining important landscape services, and what their knowledge and connection to landscapes can contribute to sustainable landscape management. This is also noted as a failing in landscape ecology by scientists in the sister discipline of historical ecology who point out that “landscape ecology does not [usually] involve humans recapturing indigenous or local knowledge that could be of use to restoration ecology” [17] (p. 80). This highlights that, despite the important role that people have played in shaping landscapes or maintaining them, less attention is currently given in landscape ecology to the important role that traditional knowledge of landscapes is playing and can play in conservation and landscape sustainability. The significance of cultural aspects of landscapes and the relevance that landscapes have in providing important cultural resources and meaning for people has also not been at the forefront of landscape ecological research. Even though there is increasing recognition of the importance of integrating culture into landscape planning and the value of incorporating customary and traditional ecological knowledge in integrated landscape approaches for sustainable outcomes, landscape ecology has been lacking in terms of integrating models of culturally appropriate landscape management into its conceptual frameworks [18].

Back in 1995, Iverson Nassauer stated that “cultural knowledge, scientific knowledge, and design innovation are needed to accomplish cultural principles for landscape ecology” [19] (p. 236). In 2003, Field et al. [20] posited that landscape ecology should integrate more strongly with social landscape analysis, while in 2006, Brunckhorst et al. [21] recognized the importance of community participation in landscape ecology. However, Termorshuizen and Opdam in 2009 [22] showed that there was still a way to go for landscape ecology when it came to supporting collaborative planning and the interaction between landscape ecology and society. In 2010, Pearson and Gorman [23] suggested that if we are striving for sustainable landscape management, then landscape ecology should embrace human ecological holism as a conceptual framework to help with this. More recently, Walters et al. in 2021 [24] acknowledged the importance of integrating different knowledge

bases and incorporating them into landscape interventions for more sustainable outcomes. This means that there has been an academic appreciation of different knowledge, cultural pursuits, and customary practice in terms of the important contribution they can make to landscape ecology since the later part of the 20th century, but there still appears to be a need for further work to be done to fully embrace these ideas.

Given this perceived lack of cultural integration, it is therefore prudent to investigate a review of recent landscape ecological literature and associated disciplines to determine how well landscape ecologists are performing in terms of successfully integrating cultural principles, social understanding, and traditional ecological knowledge into landscape ecology. We posit that there has been progress in terms of recognizing the importance of cultural knowledge, but there are potentially still many lessons to be learned in landscape ecology from local and indigenous people in terms of their understanding of, and connections to, landscapes. It is also relevant to evaluate why and how these connections come about as well as the value of utilizing them by closer examination of the academic research that claims some understanding of this.

It is the aim of this review paper to explore the literature that acknowledges cultural perspectives and cognition of landscapes and how this relates to landscape ecology. The paper also investigates the important role that customary management of landscapes, often described as indigenous landscape management (in Australia), can play in sustainable landscape management. This evaluation leads to some recommendations about how landscape ecology can contribute towards better on-the-ground outcomes by embracing more effective mechanisms of collaboration and participation to incorporate local and indigenous knowledge and the connection to the landscape that informs that. The recommendations can also inform future landscape ecological theoretical frameworks by considering more integrated nature–society relationships where people are seen to be an integrated part of landscapes and not separate from them.

2. Landscape Perspectives

The online Oxford dictionary defines a landscape as “everything you can see when you look across a large area of land, especially in the country” [25]. This definition is in line with one utilized in the introduction, where Klink et al. described a landscape as “the perception, observation, and view of the environment or living space of man” [8] (p. 1). This fits with a geographic perspective of landscapes that takes a land use or land-based focus [26] and treats the landscape as something that we (as humans) view rather than are deeply connected with and are embedded within. It is consistent with how many in land planning in a Western society perspective perceive the landscape, i.e., that is as something humans look at, and where it is related to scenery and aesthetics [27]. Under this perspective, landscape is seen as something to be used by humans for economic production or personal gain. It could therefore be argued that this Western perception of landscape influences current dominant management approaches and thus the abilities of Western societies to sustainably manage landscapes. However, there are different perspectives to landscapes that recognize that the concept of landscape has more depth and meaning culturally than just something people look at.

From the extensive discourse in the literature around past and present concepts associated with landscapes, Tress and Tress [28] developed a transdisciplinary concept of the landscape built on five dimensions of landscapes. These five dimensions include landscape as the spatial entity, the mental entity, the temporal dimension, the nexus of nature and culture, and the systemic properties of landscapes, where landscape is a complex system. Similarly, Angelstram et al. [29] have categorized the interpretations of landscape into four main groups. These are summarized in Freeman et al. [6] as the biophysical—where the landscape is seen as just a natural phenomenon; the anthropogenic—where the landscape is seen as nature with some human constructions; the intangible—which views the landscape as being based on individual or social perceptions or interpretations; and the coupled social-ecological or integrated interpretation—where the landscape is seen as a whole in-

corporating the natural, human and spiritual dimensions. These characterizations illustrate the complexity of people–landscape interactions and acknowledge that there is increasingly a body of knowledge that recognizes that landscapes form a much deeper association with humans than one of just ‘land use’ or something that we ‘view’. These perspectives recognize that a response to landscapes varies by individual context and cultural affiliation. This means that human cognition of landscapes can influence what we do with them and how they are managed. This indicates that we need a greater understanding of human cognition of landscapes to manage them more sustainably.

Mark et al. [26] in their text that looks at ‘*landscapes in language*’ consider human cognition of landscapes in more detail. They discern that when considering landscapes, we often focus on the visual sense. Following this line of thinking, the landscape interpretation described by Klink et al. [8] tends to be consistent with those of other authors like Grano [30] who also perceive the landscape mainly through visual interpretations. However, Mark et al. [26] raise the point that other senses, such as sound and smell, might also be significant when understanding human perceptions of landscapes. Demonstrating this Feld [31] emphasized the importance of sound and smell in landscapes (from vegetation and water) as well as the sensation on the skin that comes from temperature and wind. Mark et al. [26] also state that it is important to consider when understanding human cognition of landscapes whether people perceive themselves as part of landscapes or apart from them. This means that we should consider whether the observer of a landscape is active or passive i.e., does the landscape contain them, or is it just a backdrop to their existence? How active or passive people are in a landscape will therefore influence their connection to that landscape and their experiences with it. This means that how a landscape is conceptualized as a whole is potentially significant in human cognition of landscapes [26], and thus, understanding this in more detail should inform the approach we need to take to appropriately manage them.

Along this line of thinking, an important concept of relevance to cultural understanding and perception of landscapes is *topophilia*. Tuan, as a geographer, used the idea of topophilia [32] to describe “the affective bond with one’s environment—a person’s mental and cognitive ties to a place” [33] (p. 117). He recognized that personal encounters with space (i.e., landscapes) could produce a ‘sense of place’ and that people form associations with place. *Topophilia* is therefore a term used to describe a strong sense of place that influences cultural identity [32]. Topophilia also relates to the pleasure people get from places. How much pleasure people derive from a place is thought not to be dependent on whether places are natural or vastly altered. This recognition acknowledges that, for some people, immense pleasure might be gained from urban over more natural landscapes. Whilst topophilia relates to positive associations and emotions associated with landscapes, it is also important to recognize that some landscapes can also create the reverse emotional response such as fear, dislike, and apprehension. This phenomenon is described as *topophobia* [34]. The fact that landscapes can generate such strong emotional responses either positive or negative needs to be considered when we evaluate how we manage them.

Tuan [32] also points out that visitors and natives/local inhabitants to a place have different perceptions of landscapes and will therefore focus on different aspects of the environment as being important. The idea being that local inhabitants, due to being immersed totally in the landscape, have a much more complex perception of the landscape than visitors who are just passing through [32]. Visitors are thought to evaluate the landscape from an aesthetic perspective—judging by appearance rather than from a deeper connection. This means that the perspectives and judgements made around the landscape are quite different due to their experiences and purpose with the landscape [32]. This could potentially explain a tendency for landscape ecologists and landscape planners to adopt a perspective of landscapes as one that they view because they are studying or assessing landscapes that they are visitors to rather than native to.

Tuan’s theories highlight the complexities involved in landscapes and landscape associations and the importance of recognizing perceptions, attitudes, and values associated

with landscapes. It is important to consider these wider concepts in landscape analysis since no two people perceive the same reality associated with a landscape and no two social groups evaluate the landscape the same way. This again will have implications for visitors in the form of researchers who might not have a strong connection to place. As a visitor, a researcher might consider a landscape of study differently from a local inhabitant because they are seeing it through a different lens due to a different connection to place and therefore conceptualize the landscape and its contents in a different way. This means that they will make management recommendations based on a different reality to what a local might do.

Building on the idea that people conceptualize landscapes differently, Mark and Turk coined the term *ethnophysiology* for studies that looked at how people conceptualize things in the landscape [35–37]. Ethnophysiology is related to the study of ‘place’, ‘sense of place’, and ‘place attachment’. Mark et al. [26] found that language and linguistics can help in understanding human–landscape relationships as landscape vocabulary can inform an understanding of knowledge systems, beliefs, and customs that relate to landscapes. Ethnophysiology considers whether people from different cultural and linguistic backgrounds think about landscapes the same way or whether this varies significantly across cultures. It also considers how influential culture, and the lifestyle of people are on their conceptualizations of landscape [26]. What cultural and spiritual considerations that turn a ‘space’ into a ‘place’ are also deemed significant. Exploring this line of thinking more deeply, Murton [38] describes landscapes as experienced by Māori in Aotearoa New Zealand as the ‘face of place’ that incorporates deep cultural and spiritual associations. He argues that although Māori did ‘gaze’ in the past and did have ‘visual forms of representing landscape’, the concept of landscape where it is mostly perceived through a visual sense as used in Western scholarly terms, is not appropriate for Māori, yet most scholarship associated with landscapes takes a more Western perspective [38] (p. 94). Talking to Māori elders, he was aware of the difference in terms of understanding a landscape in academic disciplines and from people of European descent to the Māori understanding. He goes on to explain that in Māori understandings of the world i.e., through *Matauranga Māori*, the “Cartesian dichotomy between an observing thinking self and the outside world cannot exist” [38] (p. 82). In a Māori worldview, all physical landscapes are inseparable from ancestors, events, occupations, and cultural practices. For Māori ‘to know’ something is to locate it in space and time through genealogy (*whakapapa*). *Whakapapa* provides a framework for understanding historical descent, pattern, and linkages, whereby everything animate and inanimate is connected in a single-family tree or ‘taxonomy of the universe’. This is further demonstrated in the use of the term *whenua*, which means both earth and placenta. This metaphorically represents a connection of people to their origins. Māori bury the placenta symbolically recognizing this connection between people and place by inserting the individual into the landscape of origin and *whenua*, therefore, becomes like a mirror where “the land and the people reflect each other and are each other” [38] (p. 86).

Ethnophysiology has also been explored with Aboriginal people in Australia, e.g., the Yindjibarndi people [39], showing the complex relationship they have with landscapes or ‘their country’. Significant cultural and spiritual associations to landscapes can be identified in Aboriginal culture, but many of these are of a secret or sacred nature. Mark and Turk [35] noted that indigenous Australians do not separate spirituality and topography, e.g., each water hole (*yinda*) has a spirit (*warlu*) and this influences how people act at that place. Toussaint et al. [40] emphasize the connectivity that Aboriginal people have with water courses. They highlight cultural responsibility for water and land. This is demonstrated, for example, through teaching good environmental practices to children and passing on the importance of practicing water etiquette in the form of particular songs and chants to use when approaching a site. It is also illustrated by the way a stranger is introduced to a place, the ceremonies that are held for particular species, and the way knowledge about special places and their cultural significance is communicated [39,40].

Johnson [41] uses Canada as an example to apply an *ethnoecological* approach to look at landscapes. An ethnoecological understanding of landscape sees it as being “perceived and imagined by the people who live in it, the land seen, used and occupied by members of a local community” [42] (p. 1). Ethnoecology is a scientific study that is interested in people’s knowledge and interactions with the landscape. It considers how different people understand the ecosystems in their surrounding landscapes. That is, it has been described as investigating the “local understandings of the environment, of land and the entities that dwell there, and of the relationships among them, including the relationships of people to other living beings and land” [41] (p. 292). So, it considers human–landscape interactions and relationships over time. Johnson [41] points out that there are two main aspects to an ethnoecological approach to the landscape—one that deals with structure and the other emphasizes relationships, movement, flow, and meaning. In exploring ethnoecology, indigenous and local understandings of landscape are deemed important, recognizing the way traditional people of the land perceive and manage it [42], which means that there is an emphasis on exploring traditional ecological knowledge.

Similarly historical ecology, which is described by Balee [17] as a research program that is “concerned with the interactions of time between societies and environments and the consequences of these interactions for understanding the formation of contemporary and past cultures and landscapes” (p. 76), treats landscape as an important unit of space [43] and recognizes the importance of human interactions with the landscape in terms of creating specific pathways of landscape development [5]. Hence, it acknowledges the importance of traditional/local knowledge in understanding landscapes as complex systems [44].

Together, these concepts ranging from topophilia to the exploration of ethnoecology and ethnophysiology illustrate the complex cultural relationships that exist with landscapes with deep-rooted and often boundaryless connections to landscapes and an intimate knowledge of these important socio-ecological systems that need to be considered in landscape analysis and management. It also demonstrates the connections that indigenous cultures have with landscapes and how some of the depth of understanding and interrelationship has been lost in Western perspectives of landscapes and hence the Western scientific approaches to landscape management. The significance of this traditional knowledge for sustainable landscape management is explored in the next section of this paper.

3. The Importance of Traditional Ecological Knowledge and Customary Landscape Management—‘Caring for Country’

Traditional ecological knowledge (TEK) (often referred to as indigenous knowledge) is a term that has been used to describe the “evolving knowledge acquired by indigenous and local peoples over hundreds or thousands of years through direct contact with the environment” [45] (p. 1). However, it is noted that the concept of TEK has numerous meanings and is thought to encompass wider concepts such as responsibility and action associated with moral and societal obligations [46]. Overall, TEK can be seen to encompass ‘knowledge, beliefs, traditions, practices institutions, and worldviews’ held by indigenous people, which has been developed through long-term interaction and association with the landscape [47–49].

Indigenous land or landscape management in Australia that incorporates TEK has been described by Hill et al. as activities that include “environmental and natural and cultural resource management” that are carried out for “customary, community, conservation, and commercial reasons” and that form part of ‘holistic relationships’ established from Aboriginal and Torres Strait Islander people living for over 50,000 years on country (their customary land) [50] (p. 1). As such, indigenous land management is often simply referred to in Australia as ‘caring for country’. The customary sense of obligation associated with ‘caring for country’ stems from strong cultural and spiritual connections to landscapes. It is born out of worldviews where indigenous people have a strong feeling of interconnectedness with nature and the land. Their relationship with the landscape often

involves stewardship out of obligation to their ancestors and future generations [51]. This differs from more modern Western society worldviews of nature and land that are more firmly situated in land and resource utilization for human gain [52]. Aboriginal and Torres Strait Islander people are not alone in their strong customary relationships with landscapes. Many indigenous people across the world have been applying traditional knowledge and customary laws to manage and govern landscape for centuries with an important component being their connection with the land and their ancestral spirits [51]. We can now recognize that the strategies of ‘caring for country’ amongst many indigenous people are very well-aligned with the aspirations of sustainable landscape management [53].

In recognition of the role of indigenous people in the successful management of landscapes and in particular biodiversity, Indigenous and Community Conservation Areas have been declared with 70 Indigenous Protected Areas (IPAs) recognized by the Australian Government. This land, which was formally counted within the National Reserve System, makes up 7% of Australia’s land (some 65 million ha) and 40% of the National Reserve [54]. To manage the IPAs, TEK is being integrated with knowledge of non-indigenous partner agencies utilizing participatory and community-based approaches for monitoring and management [54]. In Australia, this has been capitalized upon over the last 10–15 years through governments, scientists, and other key landscape and conservation stakeholders engaging in joint initiatives or by financially supporting landscape management activities with the aim of having more effective on-the-ground landscape management outcomes [50]. However, there is still more work to be done to connect science and practice and to make TEK and ‘caring for country’ an integral part of successful sustainable landscape management at the global scale.

The significance of integrating TEK into effective landscape management has been scientifically proven. Research shows that environmental degradation and loss of biodiversity are happening at a slower rate on indigenous-managed land according to a report from the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) [55]. Sneed [56] cites McElwee (one of the authors of the IPBES report) as stating that the report forms a “watershed moment in acknowledging that indigenous and local communities play really important roles in maintaining and managing biodiversity and landscapes that the rest of us can learn from”. Given that a quarter of the Earth’s land is described by Sneed [56] as owned, used, or managed by indigenous people, this is particularly significant. The Millennium Ecosystem Assessment [57] also recognized the importance of TEK for conservation, and the Intergovernmental Platform on Biodiversity and Ecosystem Services stresses the important role of TEK in sustaining ecosystem services [47]. It is noted that TEK is exceptionally relevant to the Global South, which plays host to a large proportion of the world’s biodiversity whilst also facing considerable challenges associated with agricultural land use and negative social and environmental implications of global economic pressures [58]. The recent review article by Loch and Riechers [58] that investigates the integration of indigenous and local knowledge in coastal management of the Global South highlights the benefits of TEK for research and land management associated with species conservation and protection of habitat and biodiversity in the Global South. Their review also demonstrates the socio-economic and political benefits of TEK [58].

The IPBES report [55] showed that sometimes this customary knowledge can involve applying different forms of land management practices, which could include traditional burning practices that help support biodiversity (as is the case in Australia) through to restoration of native habitats (e.g., in the US) [56]. This means that landscape ecologists should not only be more receptive to learning important aspects of relevant environmental stewardship from indigenous land management and TEK to support a wide range of landscape management, but also that landscape ecology should actively encourage researchers and policymakers to partner with indigenous land managers in conservation and restoration projects for more successful outcomes.

As the value of TEK has been acknowledged more widely in association with the conservation and protection of ecosystem services, this has encouraged international policy

processes, such as the UN's Declaration on the Rights of Indigenous Peoples 2007 [59] and the Convention on Biological Diversity 1993 [60], to promote the protection of TEK as part of national legislation. However, despite the increasing recognition of the importance of TEK for conservation, sustainable use of biodiversity, and as a wider tool to apply in natural resource management, it is being lost in many parts of the world. Globalization is being cited as a cause, with Gomez-Baggethun et al. [47] attributing its demise to formal education, loss of local language, the dominance of certain religions, changes in land use, market integration, loss of access to resources through conservation programs, mechanization of resource systems, and industrialization processes. This is very significant considering that indigenous people have been determined to have rights to and manage at least 37.9 million km² of land across most continents [61]. This means that not only can disciplines like landscape ecology do more to raise the profile of the importance of indigenous land management, but also to protect the important knowledge that these traditional custodians have.

Where TEK is being practiced, the success of indigenous management is attributed by Eduardo Brondízio (co-chair of the IPBES global assessment and an anthropologist at Indiana University Bloomington) in Sneed [56] to an intricate understanding and focus on the "function of landscapes and what is important in terms of connectivity, how different habitats can be managed to complement each other". In this context, indigenous people are seen to have connection to nature and ingrained understanding of the functioning of the ecosystems in which they live rather than having a relationship that sees land as only for human use [56]. This would appear to be very valuable knowledge to complement landscape ecological scientific understanding. Sneed [56] also quotes Brondízio as saying that the reciprocal way of viewing nature and the cultural values indigenous people put on nature makes them inseparable from it in terms of their own identity, which in turn influences the way that nature is used. This emphasizes the interconnectedness of people–landscape relationships that form the basis of indigenous landscape management and the significance of being seen as being part of a landscape rather than separate from it. It relates to the local perceptions of place and an associated place attachment recognized by Tuan [32] and, therefore, the need for scientists (and policymakers) to join forces with indigenous people to help conserve and restore important landscape features and ecosystem services by building on the knowledge that arises from long-term place attachment. Again, this seems pertinent to the success of landscape ecology in achieving sustainable landscape management.

Despite recognition of the significance of customary knowledge and governance strategies for effective on-the-ground landscape management, it has been noted by landscape ecologists, such as Wu [18], that scientific disciplines like landscape ecology have more to do when it comes to reconnecting culture and nature. Wu suggests that "landscape ecology needs more integrated studies that consider cultural landscapes as co-evolved holistic systems of culture and nature" [18] (p. 315). Wu also states that "the cultural dimension of the landscape has not been completely ignored in landscape ecology (especially in Europe), but more emphasis is needed" [18] (p. 307). Many landscape ecologists have also recognized that despite some increase in attention towards landscape governance in landscape ecology, this is still of a limited nature [62–70]. Furthermore, given its value, it would seem prudent for landscape ecologists to be working to help preserve TEK as part of their pursuits to achieve the protection of vulnerable landscapes. However, it is important to recognize that TEK is not static, it has evolved, and is being applied as an adaptation to new socioeconomic and ecological conditions. Issues and challenges associated with the integration of TEK into land management are mentioned in nearly 90% of the articles written about the Global South reviewed by Loch and Riechers [58]. These challenges are associated with external forces such as globalization; partnerships and collaboration especially related to power imbalances, establishing trust, and entering into 'colonial paradigms'; governance and state institutions, especially local socio-political complexities; and in appropriate research methods for capturing and recognizing TEK [58]. Nevertheless, there does seem to be a role for landscape ecologists to consider the implications of TEK more broadly and to attempt

to facilitate its integration and adaptation into modern landscape management scenarios. Importantly, if we want indigenous land managers to enter into partnerships in science, it is important to consider the human rights of the people of the land. This includes ensuring that partnerships are equitable and respectful, and that the balance of power in decision making lies with those who have the deepest understanding of, and connection to, the landscape [56].

4. Reconnecting People and Landscapes through a Landscape Approach

Exploring the importance of local and indigenous knowledge in collaborative landscape management approaches, Adade Williams et al. [71] undertook a review that showed that, although widely recognized as important, the incorporation of local and indigenous knowledge in land management and governance is still largely overlooked and undervalued. They state that it is being increasingly acknowledged that there is still more research needed to “explore ways to link indigenous local knowledge (ILK) and scientific knowledge more effectively in landscape studies, particularly in the co-management of these social-ecological systems. More studies that confirm the usefulness of ILK, recognize multiple landscape values and their interaction with structures and policies dealing with landscape management and conservation are necessary for enhanced sustainability” [71] (p. 1). They also state that more research is needed to “explore ways to link ILK and scientific knowledge more effectively in landscape studies through collaborative, knowledge co-production processes that give specific attention to the voices of local land users and other stakeholders. Furthermore, more systematic documentation of the experiences, learning, and relationships built through such processes and how these influence landscape governance and management is required. Lastly, more studies that confirm the usefulness of ILK, recognize multiple landscape values and their interaction with structures and policies dealing with landscape management and governance are necessary for wider adoption of landscape approaches that incorporate ILK as a key element” [71] (p. 17). In the same Special Issue on collaboration and multi-stakeholder engagement in landscape governance and management in Africa, *Lessons from Practice*, Favretto et al. [72] highlighted nine lessons that could be used to support the integration of knowledge to develop more resilient and equitable landscapes. These included codesign and co-produce; building on what already exists; acknowledging the role of history and context; finding a neutral convenor; being transparent and open; widening the net of participants; using emerging tools and approaches; developing agency, capacity, and trust; and building common and inclusive knowledge. They also highlighted the importance of multi-stakeholder processes in landscape governance and management for transformative change. Above all, they emphasize the importance of processes being open, accountable, inclusive, transparent, and legitimate necessitating the use of innovative tools to ensure that trust-building is facilitated, power differentials are reduced, marginal voices can be heard, and collective learning can occur [72].

In reviewing the current state of play in landscape ecology, we might ask ourselves why, if there is a strong recognition of differing cultural perceptions of landscapes and the importance of indigenous knowledge in helping to address landscape issues, is there still work to be done in terms of integrating this thinking into the conceptual framework of landscape ecology. To evaluate this, we need to look more closely at what is involved in undertaking landscape ecology and what constitutes a landscape approach, and the level of complexity required to fully embrace the incorporation of different knowledge systems around landscapes and human–landscape connections.

Given the complexity around interpretations and perceptions of landscape, it is not surprising that there is also diversity and a fair degree of ambiguity around what taking a landscape approach to addressing environmental and conservation problems means [6]. Although it is extensively embraced by large NGOs involved in conservation and land management to help work towards more sustainable use of the landscape and conserve biodiversity, what it means to take a landscape approach within complex socio-ecological sys-

tems is ambiguous and open to a variety of levels of interpretation [6]. Taking an integrated definition of landscape, Freeman et al. describe a landscape approach as “1. Addressing social-ecological systems at the landscape scale, 2. Related to resource management and/or environmental goals, and 3. Framed around the concept of multifunctionality with the aim of achieving multiple objectives through the approach” [6] (p. 3). Focusing on the integrated landscape approach, they describe the purpose of such an approach to be one that uses a transparent collaborative participatory process to determine change logic and/or to clarify objectives and that the management approach is adaptive and collaborative, yet these strategies are potentially what makes the successful application of a landscape approach difficult.

Participation and collaboration are seen to be important components of an integrated landscape approach but again there are different types of participation that can be applied. Stringer et al. [73] identify some of these as follows: consultation—determining the views of stakeholders; engagement—bringing multiple actors together in dialogue; social learning—where there are opportunities to exchange and learnings between stakeholders; and devolution—where participants are given decision-making power. To avoid disempowerment of marginalized stakeholders’, collaborative participation, i.e., that which treats all stakeholders on an equal level, is recommended [6,74].

With sustainable landscape management taken as the ultimate goal for landscape ecology, Walters et al. [24] acknowledge the importance of integrating different knowledge bases (science to practice), multi-stakeholder engagement, the co-production of knowledge, and a shared understanding of landscape sustainability in order to improve landscape sustainability. This involves collaboration with local communities and decision makers. In our paper in 2010, we stated that “it is fundamental that the design of landscapes considers the views and inherent knowledge of a range of stakeholders to optimize landscape utilization and ensure harmonious interrelationships between people and landscapes” [23] (p. 1172). The focus of the paradigm discussed was one that centered around nature–society relationships and collaboration, cooperation, and knowledge sharing between scientists and landowners/stakeholders. Local knowledge, particularly traditional or indigenous knowledge, therefore, seems like an important component to include in the conceptual framework underlying landscape ecology, but how to successfully integrate these different knowledge bases is a challenge. To address this, Stringer et al. [73] and Freeman et al. [6] encouraged the idea of promoting social learning to ensure an even balance of power and to allow for two-way flows of information as both ways of learning can help in terms of integrating local and indigenous knowledge with scientific knowledge.

Walters et al. [24] demonstrate how scientists can engage with local communities, NGOs, and resource managers to work toward landscape sustainability with an emphasis on the coproduction of knowledge to develop appropriate landscape management interventions. In their study, they looked at landscapes in the Central African region of the Congo Basin. They suggest using an embedded science approach, which places scientists within the landscape bringing together the subject and the researcher rather than separating them. They note that embedded science is like action science practiced within agriculture where scientists and farmers collaborate. They call for landscape ecologists to undertake action research with the people responsible for the landscape. This involves transdisciplinary teams situated directly in the place of study, so they become connected to the place and understand local resource use [24]. It involves intense and long-term engagement with the place for place-based co-production of knowledge. Other researchers such as Lazdinis et al. [75] also emphasize the need for place-based landscape approaches. Walters et al. [24] also recognized the importance of integrating culture into landscape planning by engaging with communities and bringing together social and biological scientists and practitioners. In line with the ideas of Tuan [32] and visitor–native differences, they feel that researchers must ‘actively engage’ in the landscapes of work, describing the need for long-term inductive research being necessary to fully understand the ‘complexity of landscape processes’ and to adequately engage with local people and stakeholders. Furthermore, trying to

instigate landscape change through plans that are externally driven and conceived is not likely to be successful. However, the intensity and duration of active engagement that are required are likely to present challenges for most landscape ecologists, but it does highlight the importance of relationship building and adequately understanding the perspectives of people on the ground as well as completely understanding the landscape and the context in which the local people interact and connect with it.

Boedhihartono et al. [76] also recognize the disconnect between academic solutions to conservation issues and ‘complex local realities’. They state that “solving on-the-ground problems requires long-term engagement, deep local knowledge, strong social networks, and the flexibility to try new things while learning and adapting or muddling through” [76] (p. 2). Recognizing that academic research projects often are at the mercy of short-term funding cycles and focusing specifically on the tropics they state that conservation initiatives often fail to be successful because it is not a long-term process that acknowledges the patience required for adequate stakeholder consultation, learning, negotiation, and compromise. Boedhihartono et al. [76] argue that academic achievement is recognized by publication in high-impact journals, not on-the-ground impact, causing some countries to place restrictions on international researchers through skepticism about their agenda especially given their approach to research is largely fly-in-fly out, and long-term local engagement is not supported in the funding mechanisms or career development pathways of researchers. They suggest that to improve the connection to local realities, there is a need for integrated models to work towards solutions with the co-production of knowledge with land managers and scientists working together through management that is adaptive. They call for incentives for young scientists to be part of long-term engagement with practitioners and that they are rewarded in their careers for this service. They also recognize a need for international literature to report on failures as well as successes when it comes to conservation initiatives and interventions so effectiveness can be evaluated, and lessons can be learned from an open debate. However, they note that publications of this nature are not favored and do not necessarily advance an academic career, hence the difficulty in adequately reporting what does not work over what might have worked.

Gossa et al. [77] also highlight that conservation research often does not translate to action. They looked at the use of peer-reviewed literature by practitioners in developing countries and found that they tend to use open-access journals and do not really consider impact factors and prefer direct collaboration to ensure research is fit for purpose. This highlights the challenges of getting science outside of academia and relevant to on-the-ground land managers. This was described by Knight et al. [78] as the ‘research implementation gap’. The survey by Gossa et al. [77] revealed that 50% of respondents wanted more collaboration with researchers at the ‘site level’ and for researchers to spend more time in the field to improve the credibility and secure involvement from local people, as well as sharing freely the findings of any studies undertaken with relevant people on the ground first. They also strongly acknowledged the need for the coproduction of knowledge which can result in more evidence-based conservation, better interactions between scientists and managers, and better conservation outcomes. Turnhout et al. [79] stress the perils of not listening to and taking on board the knowledge of traditional and ordinary citizens. They stated that this can undermine the possibilities of innovation when it comes to landscape management. They call for the bringing together of scientific and evidence-based experience and the establishment of partnerships. Sunderland et al. [80] discuss some of the many reasons for the implementation gap, which include access to published literature, poor literacy of people on the ground, issues of relevance of the outputs, a failure to embrace interdisciplinarity, and a reluctance to report experiences (negative and positive). They discuss the fact that graduates are not taught the skills necessary for effective implementation—calling for more extensive field-based and management-related experience for graduates and stronger recognition of the need to focus on broader issues other than the biological ones to address the wider socio-economic, legislative, and governance issues so that there is more meaningful delivery of conservation with more successful outcomes. Angelstram

et al. [29] also discuss how learning can be “enhanced if the stakeholder groups involved include different sectors and levels and different interests and if participants have different experiences and backgrounds” [29] (p. 139). They go on to say that learning is complex and requires stakeholders to be open-minded and willing to participate and can benefit from facilitation.

The work of these authors that have considered the shortcomings in the effective integration of local and traditional knowledge have considerable commonalities in terms of presenting lessons that could be learned for landscape ecology. These can be summarized as being associated with the preservation of knowledge, the development of good relationships based on equality and equity, long-term engagement especially situated in the landscape, and coproduction of knowledge that is developed on site with local people. Other important factors include the production of research outputs that are in a more useable format for land managers than peer-reviewed journal articles only accessible through subscription. It also appears that integrated landscape approaches could also be more successful with a stronger inclusion of collaboration based on social learning.

In 2007, Bohnet and Smith [81] discussed the creation of a social-ecological framework for developing sustainable landscapes utilizing the concept of landscape that represents the relationship between people and place. Their framework creates opportunities for better collaboration, co-production of knowledge, and a shared vision for future landscapes. An example of a research project that successfully integrates indigenous knowledge and landscape ecology is collaborative research carried out by Vigilante et al. [54] in the Wulo Monsoon Rainforest in Wunambal Gaambera Country in the North Kimberly of Australia. This is one of the largest areas of rainforest in the Australian monsoon tropics and is part of the Unguu Indigenous Protected Area (IPA) declared in 2011 by the Wunambal Gaambera Corporation. This project investigated monsoon vine thickets looking at the correlates associated with their current distribution and historical drivers of patch formation since 1949 using remote sensing methods. Wildfires and invasive species were seen to be the biggest threat to the rainforest. Wildfire, in particular, can be a threat to the natural and cultural values of the monsoon rainforest, while invasive grass species can increase fuel loads causing a risk of high fire intensity and severity. Other invasive species such as non-native woody weeds and vines can cause a thickening of the thickets altering their structure and composition. Combining knowledge and approaches to assess risk and threats to the rainforest demonstrates the value of using modern monitoring technology like remote sensing alongside TEK to quantify changes to landscape pattern and to understand the environmental implications of change. This study illustrates the benefits from taking more of an historical ecological approach to combining modern science with TEK to build up a picture of the human–environment interactions to understand the dynamics of landscape development and the implications of changes to management regimes. The advantage being able to utilize a combined knowledge system to inform Healthy Country Planning (the plan developed to manage the IPA) and natural resource management strategies implemented by traditional owners of the land.

Similarly in 2013, Bohensky et al. [82] contributed to a Special Issue on integrating indigenous ecological knowledge and science in natural resource management. This special issue of *Ecology and Society* viewed the integration of these knowledge systems through a social-ecological systems-based approach. Australia has been proactive in recent decades in “recoupling indigenous relationships with traditional lands and sea country” [65] (p. 1) with major environmental management benefits. This has come about due to the high biodiversity values of indigenous land and the lack of employment opportunities for indigenous landowners. However, articles such as Davis et al. [83] illustrate that early collaborations took much more of a Western view of the separation between nature and people rather than a more indigenous view. Other issues arise due to the imbalance of power between organizations in collaboration, and where different values and perspectives exist cross-cultural tensions can arise. This means that the integration of knowledge systems

is not without its challenge but can have considerable benefits, especially when there are people involved who can communicate well across knowledge systems.

5. Recognizing ‘Sense of Place’

If we know that we need to spend more time in the landscapes we study and listen to, learn from, and apply traditional ecological knowledge, what action can landscape ecology take to facilitate the integration of these approaches in science, and what can we learn from the work of landscape ecologists and others who have been striving to make a difference in this space? Over recent years, there has been significant work conducted in the field of landscape ecology and related disciplines and sense of place (SOP) theory. In 2017 Masterson et al. [84] undertook a review that helped to determine the contribution that sense of place theory could make to social-ecological system research. SOP theory can be used to better understand people–place interactions [85,86]. Masterson et al. describe four key assumptions that help make SOP relevant to social-ecological systems (SES) research: (1) SOP forms through experience, although experience is not solely individualistic, but also social; (2) SOP emerges from human interaction with the biophysical environment; (3) place meanings and attachments are subjective, but they vary systematically, so although each person’s SOP is basically unique, the variation is patterned rather than random; and (4) patterned relationships with place help to predict specific types of behavior. They go on to examine SOP in relation to the stewardship of ecosystem services [84].

Chapin and Knapp argue that ‘capitalizing’ on the attachment people feel for place “can provide a foundation for stewardship strategies” [87] (p. 39). They highlight that SOP can assist in SES scholarship in four ways. It can help to identify what underpins protective and restorative actions, i.e., SOP theory can help understand the root of pro-environmental action, map and assess patterns of variation, evaluate how SOP patterns influence the resilience of a system, and assess stewardship outcomes and priorities. Through their review, they show that “research on stewardship, sense of place and literature can offer a language and a set of robust conceptual building blocks that help unpack a person’s relation to their physical and natural environment. This can help to explain the emergence of stewardship and build a theoretical and methodological framework that better incorporates competing values and preferences in ecosystem governance and assessments” [87] (p. 49). They also state that “Sustainability is about defining and working toward creating a tenable place for humanity to live. Whether place refers to one’s backyard or the planet as a whole, understanding how people relate to places is key to sustainable development. One of the major challenges and opportunities is to develop integrated methods and indicators that could make these phenomena more tangible and measurable without neglecting the subjective, qualitative nature of the sense of place. This, in turn, has direct implications for management of both small and vast SES that provide our home as humankind” [87] (p. 49).

The recent paper by Gottwald et al. [86] looks at how the sense of place theory can be combined with ecosystem services in a participatory mapping study for landscape ecological benefit. They focus specifically on river landscapes and the subjective perceptions that people have towards them. However, it is identified that there is a gap in terms of understanding the emotional connections with landscapes [86]. They highlight the importance of building on the work undertaken around the concept of sense of place described by Tuan [32] to help with landscape planning and management. This approach helps with understanding landscape values and the relationships that exist between biophysical and socio-economic variables with the knowledge that the results can help to determine and facilitate enhanced environmental stewardship. Gottwald et al. [86] discuss how ‘place attachments’ can be broken down into the intensity and dimensions of the attachments such as place identity and place dependence. They describe place identity as “an emotional dimension of attachment, measured with items such as ‘I feel X is a part of me’” whilst place dependence focuses on the “functional attachment” as “assessed with items such as ‘X is the best place for what I like to do’” [86] (p. 634). Place meanings are used to describe the reasons for connections, e.g., aesthetic beauty, spiritual values, or variety of plants

and animals. They state that “there is no meaning without attachment and no attachment without meaning.” [86] (p. 634). The same place can have different meanings and equally strong attachments for different individuals or the same meaning but differently strong attachments. Assessing place attachment, identity, and/or meaning is where the challenges lie especially in a spatial context where they must use administrative boundaries rather than an individual’s interpretation of space and place.

To assess SOP spatially, Brown and Raymond 2007 [88] asked respondents to map special places/places of value, and this could proxy as an attachment. However, Brown et al. [89] argued that “mapping place values is an operational means to assess both explicit and implicit place relationships” [89] (p. 3), but Gottwald et al. [86] argued that this fails to recognize the intensity of the human–nature relationships and connections and the specific meanings that are related to them. Hence, Gottwald et al. [86] integrated cultural ecosystem services with SOP to assess people–place relationships. In their study, they explored which meanings and attachments have been attributed to meaningful places located by respondents and how physical environmental and socio-economic variables influence meanings and attachments of meaningful places. They found that assessing specific types of place meaning can help to understand the relationship between the sense of place and biophysical and socioeconomic variables. The work of Gottwald et al. [86] highlights the important gaps in landscape ecological knowledge and the need to consider the concept of sense of place more strongly in landscape ecological analysis.

It is also thought that understanding how people relate to a place through the language they use about it, building on ideas from ethnophysiology can assist landscape ecologists. Mark and his colleagues’ exploration of ethnophysiology [26] has largely been within the context of GIS and indigenous knowledge and mapping systems where conceptualizing landscape and capturing different ways of naming landscape features is important. The aim is to improve the cognitive and cultural aspects of GIS [90]. This has contributed to the development of GIScience and has helped to support the preservation of indigenous culture and language [39]. However, to date, the translation of this into landscape ecological applications has been limited.

6. Recommendations and Conclusions

This review clearly shows that, despite the plethora of research on landscapes and landscape approaches, there is still a diversity of interpretations of landscape. This is not surprising if we acknowledge that landscape means different things culturally. Focusing on integrated landscape approaches, Freeman et al. [6] suggest that collaborative participation, transdisciplinary/cross-section approaches, managing adaptive capacity, and applying iterative processes to cope with the complexity will be required to undertake an effective landscape approach. This is deemed even more important if there is also recognition of the complex cultural relationships that exist with landscapes and the significant intimate and specialized knowledge that local people especially indigenous people have associated with their landscapes.

The literature suggests that the disconnect researchers have with the landscapes they study through a lack of in-depth sense of place might be contributing to the lack of success of conservation programs. This means that disciplines like landscape ecology need to not only recognize that researchers need to spend more time in the field connecting to the landscape, but also learn from and integrate important traditional and local knowledge. However, supporting landscape ecologists to spend more time in the landscapes they study is not without its challenges, least of all the financial implications. However, the benefits to conservation in restoration on traditionally managed lands like the IPAs in Australia, which are managed through priorities determined by traditional knowledge, can inform Healthy Country Plans and ‘caring for country’ management action, demonstrate the value of locally led and informed landscape management, and thus demonstrate the need for landscape ecologists to embrace integrating knowledge systems and spending time on relevant ‘country’ themselves.

If landscape ecology is to respond to the need of preserving TEK and also embrace it more strongly in landscape analyses, then approaches that can help to capture important cultural dimensions of landscapes need to be found and integrated. Research agendas can be expanded to include sense of place theory and to incorporate important aspects of human–landscape cognition. Expanding ways to acknowledge and incorporate the language used when indigenous land managers refer to landscapes can also help not only preserve important TEK, but also adapt it into mainstream landscape ecological thinking. Ensuring that landscape ecology remains out of the ivory tower of Western science perspectives and integrates more strongly with on-the-ground situations and people of place, especially ensuring that researchers connect to country, embrace indigenous knowledge, and recognize the importance of longstanding connection to the place of study is also of utmost importance.

We feel that a modern landscape ecological framework should be one that considers connections to landscapes and acknowledges customary pursuits and knowledge within approaches used to manage landscapes. This marks a move away from a framework that has arguably been traditionally based on a Western nature–society perspectives in which humans are seen as being separate from landscapes and recognizes theories that have already been developed in other branches of ecological thinking such as historical ecology. Considering connections to landscapes within the context of a ‘sense of place’ potentially holds the key to work towards sustainably managing landscapes more effectively in the future. Recognizing that people are a part of landscapes presents opportunities to expand the theories and paradigms that underpin landscape ecology to incorporate cultural landscape connections more strongly. It would also enable landscape ecology to capitalize on the value this can bring in management approaches, which in turn can achieve better outcomes towards sustainability goals.

Clearly, the future of sustainable landscape management will benefit from the acknowledgment of important local and indigenous connections to landscapes and strategies for management that co-produce action and incorporate local knowledge. There is room in the evolving modern landscape ecological paradigm to put more emphasis on integrating cultural perspectives into the conceptual design of research projects to ensure connection and sense and knowledge of place become important pillars in future landscape ecological theoretical frameworks.

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References

1. Forman, R.T.T.; Godron, M. *Landscape Ecology*; John Wiley and Sons Ltd.: New York, NY, USA, 1986.
2. Turner, M.G. Landscape Ecology: The effect of pattern on process. *Annu. Rev. Ecol. Syst.* **1989**, *20*, 171–197. [[CrossRef](#)]
3. Pearson, D.M.; McAlpine, C.A. Landscape Ecology: An integrated science for sustainability in a changing world. *Landsc. Ecol.* **2010**, *25*, 1151–1154. [[CrossRef](#)]
4. Ellis, E.C.; Gauthier, N.; Klein Goldewijk, K.; Watson, J.E.N. People have shaped most of terrestrial nature for at least 12000 years. *Biol. Sci.* **2021**, *118*, e2023483118. [[CrossRef](#)]
5. Tappeiner, U.; Leitinger, G.; Zariņa, A.; Bürgi, M. How to consider history in landscape ecology: Patterns, processes, and pathways. *Landsc. Ecol.* **2021**, *36*, 2317–2328. [[CrossRef](#)]
6. Freeman, O.E.; Duguma, L.A.; Minang, P.A. Operationalizing the integrated landscape approach in practice. *Ecol. Soc.* **2015**, *20*, 24. [[CrossRef](#)]

7. Forman, R.T.T.; Godron, M. Patches and Structural Components for a Landscape Ecology. *BioScience* **1981**, *31*, 733–740. [[CrossRef](#)]
8. Klink, H.J.; Potschin, M.; Tress, B.; Tress, G.; Volk, M.; Steinhardt, U. Chapter 1: Landscape and landscape ecology. In *Development and Perspectives of Landscape Ecology*; Bastian, O., Steinhardt, U., Eds.; Springer: Berlin/Heidelberg, Germany, 2002.
9. Pearson, D.M. Landscape ecology: Its role as a transdisciplinary science for rangeland sustainability. *Rangel. J.* **2013**, *35*, 363–371. [[CrossRef](#)]
10. Bürgi, M.; Hersperger, A.M.; Schneeberger, N. Driving forces of landscape change-current and new directions. *Landsc. Ecol.* **2005**, *19*, 857–868. [[CrossRef](#)]
11. Wickham, J.D.; Norton, D.J. Mapping and analyzing landscape patterns. *Landsc. Ecol.* **1994**, *9*, 7–23. [[CrossRef](#)]
12. Halbac-Cotoara-Zamfir, R.; Polinesi, G.; Chelli, F.; Salvati, L.; Bianchini, L.; Marucci, A.; Colantoni, A. Found in Complexity, Lost in Fragmentation: Putting Soil Degradation in a Landscape Ecology Perspective. *Int. J. Environ. Res. Public Health* **2022**, *19*, 2710. [[CrossRef](#)]
13. Sklenicka, P. Classification of farmland ownership fragmentation as a cause of land degradation: A review on typology, consequences, and remedies. *Land Use Policy* **2016**, *57*, 694–701. [[CrossRef](#)]
14. Smiraglia, D.; Tombolini, I.; Canfora, L.; Bajocco, S.; Perini, L.; Salvati, L. The Latent Relationship between Soil Vulnerability to Degradation and Land Fragmentation: A Statistical Analysis of Landscape Metrics in Italy, 1960–2010. *Environ. Manag.* **2019**, *64*, 154–165. [[CrossRef](#)] [[PubMed](#)]
15. Alados, C.L.; Pueyo, B.; Barrantes, O.; Escos, J.; Giner, L.; Robles, A.B. Variations in landscape patterns and vegetation cover between 1957 and 1994 in a semiarid Mediterranean ecosystem. *Landsc. Ecol.* **2004**, *19*, 543–559. [[CrossRef](#)]
16. Jongman, R.H.G. Homogenisation and fragmentation of the European landscape: Ecological consequences and solutions. *Landsc. Urban Plan* **2002**, *58*, 211–221. [[CrossRef](#)]
17. Balée, W. The research program of Historical Ecology. *Annu. Rev. Anthropol.* **2006**, *35*, 75–98. [[CrossRef](#)]
18. Wu, J. Chapter 20. Integrating nature and culture in landscape ecology. In *Landscape Ecology in Asian Cultures, 301 Ecological Research Monographs*; Hong, S.-K., Ed.; Springer: Berlin/Heidelberg, Germany, 2011; pp. 301–321.
19. Iverson Nassauer, J. Culture and changing landscape Structure. *Landsc. Ecol.* **1995**, *10*, 229–237. [[CrossRef](#)]
20. Field, D.R.; Voss, P.R.; Kuczenzki, T.R.; Hammer, R.B.; Radeloff, V.C. Reaffirming social landscape analysis in landscape ecology: A conceptual framework. *SocNatResour* **2003**, *16*, 349–361. [[CrossRef](#)]
21. Brunckhorst, D.; Coop, P.; Reeve, I. ‘Eco-civic’ optimization: A nested framework for planning and managing landscapes. *Landsc. Urban Plan.* **2006**, *75*, 265–281. [[CrossRef](#)]
22. Termorshuizen, J.W.; Opdam, P. Landscape services as a bridge between landscape ecology and sustainable development. *Landsc. Ecol.* **2009**, *24*, 1037–1052. [[CrossRef](#)]
23. Pearson, D.M.; Gorman, J.T. Exploring the relevance of a landscape ecological paradigm for sustainable landscapes and livelihoods: A case application from the Northern Territory Australia. *Landsc. Ecol.* **2010**, *25*, 1169–1183. [[CrossRef](#)]
24. Walters, G.; Sayer, J.; Boedihartono, A.K.; Endamana, D.; Angu Angu, K. Integrating landscape ecology into landscape practice in Central African rainforests. *Landsc. Ecol.* **2021**, *36*, 2427–2441. [[CrossRef](#)]
25. Oxford University Press. Oxford Learner’s Dictionaries. 2023. Available online: https://www.oxfordlearnersdictionaries.com/definition/english/landscape_1?q=landscape (accessed on 1 January 2023).
26. Mark, D.M.; Turk, A.G.; Burenhult, N.; Stea, D. Landscape in Language: An Introduction. In *Landscape in Language: Transdisciplinary Perspectives*; Mark, D.M., Turk, A.G., Burenhult, N., Stea, D., Eds.; John Benjamins Publishing Co.: Amsterdam, The Netherlands, 2011; pp. 1–24.
27. Brabyn, L.; Mark, D.M. Classifying landscape character. In *Landscape in Language: Transdisciplinary Perspectives*; Mark, D.M., Turk, A.G., Burenhult, N., Stea, D., Eds.; John Benjamins Publishing Co.: Amsterdam, The Netherlands, 2011; pp. 395–409. [[CrossRef](#)]
28. Tress, B.; Tress, G. Capitalising on multiplicity: A transdisciplinary systems approach to landscape research. *Landsc. Urban Plan.* **2001**, *57*, 143–157. [[CrossRef](#)]
29. Angelstram, P.; GRodzynski, M.; Andersson, K.; Axelsson, R.; Elbakidze, M.; Khoroshev, A.; Kruhlov, I.; Naumov, V. Measurement, collaborative learning, and research for sustainable use of ecosystem services: Landscape concepts and Europe as laboratory. *Ambio* **2013**, *42*, 129–145. [[CrossRef](#)]
30. Granö, J.G. *Pure Geography*; Johns Hopkins University Press: Baltimore, MD, USA, 1997.
31. Feld, S. *Waterfalls of Song: An Acoustemology of Place Resounding in Bosavi, Papua New Guinea*; Feld, S., Basso, K.A., Eds.; School of American Research Press: Santa Fe, NM, USA, 1996; pp. 91–135.
32. Tuan, Y.F. *Topophilia. A Study of Environmental Perception, Attitudes and Values*; Columbia University Press: New York, NY, USA, 1974.
33. Heimer, H. Topophilia and quality of life: Defining the ultimate restorative environment. *Environ. Health Perspect.* **2005**, *113*, A117. [[CrossRef](#)]
34. Relph, E. Topophobia. Placeness, Place, Placelessness. 2015. Available online: <https://www.placeness.com/topophobia/> (accessed on 31 January 2023).
35. Mark, D.M.; Turk, A.G. *Ethnophysiology*; Workshop on Spatial and Geographic Ontologies: Ittingen, Switzerland, 2003.
36. Mark, D.M.; Turk, A. Ethnophysiology and the ontology of landscape. In *GIScience 2004, Extended Abstracts and Poster Summaries*; Egenhofer, M., Freksa, C., Miller, H., Eds.; Regents of the University of California: Santa Barbara, CA, USA, 2004; pp. 152–155.

37. Mark, D.M.; Turk, A. Ethnophysiography. In *The International Encyclopedia of Geography*; Richardson, D., Castree, N., Goodchild, M.F., Kobayashi, A., Liu, W., Marston, R.A., Eds.; Wiley: Hoboken, NJ, USA, 2017. [CrossRef]
38. Murton, B. Embedded in place: 'Mirror knowledge' and 'simultaneous landscapes' among Māori. In *Landscape in Language: Transdisciplinary Perspectives*; Mark, D.M., Turk, A.G., Burenhult, N., Stea, D., Eds.; John Benjamins Publishing Co.: Amsterdam, The Netherlands, 2011; pp. 73–100. [CrossRef]
39. Mark, D.M.; Turk, A.; Stea, D. Progress on Yindjibarndi Ethnophysiography. In Proceedings of the COSIIT 2007—International Conference on Spatial Information Theory, Melbourne, Australia, 19–23 September 2007; Springer: Berlin/Heidelberg, Germany, 2007; pp. 1–19.
40. Toussaint, S.; Sullivan, P.; Yu, S. Water Ways in Aboriginal Australia: An Interconnected Analysis. *Anthropol. Forum* **2005**, *15*, 61–74. [CrossRef]
41. Johnson, L.M. Language, landscape and ethnoecology, reflections from northwestern Canada. In *Landscape in Language: Transdisciplinary Perspectives*; Mark, D.M., Turk, A.G., Burenhult, N., Stea, D., Eds.; John Benjamins Publishing Co.: Amsterdam, The Netherlands, 2011; pp. 291–326. [CrossRef]
42. Johnson, L.M.; Hunn, E.S. *Landscape Ethnoecology. Concepts of Biotic and Physical Space*; Berghahn Books: Brooklyn, NY, USA, 2010.
43. Matthew, D. A View from the East: An Interdisciplinary 'Historical Ecology' Approach to a Contemporary Agricultural Landscape in Northwest Kenya. *Afr. Stud.* **2010**, *69*, 279–297. [CrossRef]
44. Crumley, C.L. Historical ecology and the study of landscape. *Landsc. Res.* **2017**, *42*, S65–S73. [CrossRef]
45. US Fish and Wildlife Service. Traditional Ecological Knowledge for Application by Service Scientists. 2011. Available online: <https://www.fws.gov/sites/default/files/documents/TEK-Fact-Sheet.pdf> (accessed on 1 January 2023).
46. Whyte, K.P. On the role of traditional ecological knowledge as a collaborative concept: A philosophical study. *Ecol. Process* **2013**, *2*, 7. [CrossRef]
47. Gómez-Baggethun, E.; Corbera, E.; Reyes-García, V. Traditional ecological knowledge and global environmental change: Research findings and policy implications. *Ecol. Soc.* **2013**, *18*, 72. [CrossRef]
48. Berkes, F. Traditional Ecological Knowledge in perspective. In *Traditional Ecological Knowledge: Concepts and Cases*; Inglis, J.T., Ed.; International Program on Traditional Ecological Knowledge: Ottawa, ON, Canada, 2004.
49. Toledo, V. *Ethnoecology: A Conceptual Framework for the Study of Indigenous Knowledge of Nature. Ethnobiology and Biocultural Diversity*; International Society of Ethnobiology: Georgia, GA, USA, 2002.
50. Hill, R.; Pert, P.L.; Davies, J.; Robinson, C.J.; Walsh, F.; Falco-Mammone, F. *Indigenous Land Management in Australia: Extent, Scope, Diversity, Barriers and Success Factors*; CSIRO Ecosystem Sciences: Cairns, Australia, 2013.
51. UN Environment Programme. Indigenous People and Nature: A Tradition of Conservation. 2017. Available online: <https://www.unep.org/news-and-stories/story/indigenous-people-and-nature-tradition-conservation> (accessed on 31 January 2023).
52. Buggy, S. An Approach to Aboriginal Cultural Landscapes. Historic Sites and Monuments Board of Canada. 1999. Available online: https://publications.gc.ca/collections/collection_2016/aanc-inac/R62-467-1999-eng.pdf (accessed on 31 January 2023).
53. Bocco, G.; Winklerprins, A. General principles behind traditional environmental knowledge: The local dimension in land management. *Geogr. J.* **2016**, *182*, 375–383. [CrossRef]
54. Vigilante, T.; Ondei, S.; Goonack, C.; Williams, D.; Young, P.; Bowman, D.M.J.S. Collaborative Research on the Ecology and Management of the 'Wulo' Monsoon Rainforest in Wunambal Gaambera Country, North Kimberley, Australia. *Land* **2017**, *6*, 68. [CrossRef]
55. Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services. (IPBES). *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*; Brondizio, E.S., Settele, J., Diaz, S., Ngo, H.T., Eds.; IPBES Secretariat: Bonn, Germany, 2019; 1148p. [CrossRef]
56. Sneed, A. What Conservation Efforts Can Learn from Indigenous Communities. Available online: <https://www.scientificamerican.com/article/what-conservation-efforts-can-learn-from-indigenous-communities/2019> (accessed on 1 January 2023).
57. Island Press. *A Report of the Millennium Ecosystem Assessment. Ecosystems and Human Well-Being*; Island Press: Washington, DC, USA, 2005.
58. Loch, T.K.; Riechers, M. Integrating indigenous and local knowledge in management and research on coastal ecosystems in the Global South: A literature review. *Ocean. Coast. Manag.* **2021**, *212*, 105821. [CrossRef]
59. United Nations. UN's Declaration on the Rights of Indigenous Peoples. 2007. Available online: https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf (accessed on 31 January 2023).
60. UN Environment Programme. The Convention on Biological Diversity. Available online: <https://www.cbd.int/convention/> (accessed on 31 January 2023).
61. Garnett, S.T.; Burgess, N.D.; Fa, J.E.; Fernández-Llamazares, Á.; Molnár, Z.; Robinson, C.J.; Watson, J.E.; Zander, K.K.; Austin, B.; Brondizio, E.S.; et al. A spatial overview of the global importance of Indigenous lands for conservation. *Nat. Sustain.* **2018**, *1*, 369–374. [CrossRef]
62. Wu, J. Landscape sustainability science (II): Core questions and key approaches. *Landsc. Ecol.* **2021**, *36*, 2453–2485. [CrossRef]
63. Nassauer, J.I.; Opdam, P. Design in science: Extending the landscape ecology paradigm. *Landsc. Ecol.* **2008**, *23*, 633–644. [CrossRef]
64. Swaffield, S. Empowering landscape ecology-connecting science to governance through design values. *Landsc. Ecol.* **2013**, *28*, 1193–1201. [CrossRef]

65. Foo, K.; McCarthy, J.; Bebbington, A. Activating landscape ecology: A governance framework for design-in-science. *Landscape Ecol.* **2018**, *33*, 675–689. [[CrossRef](#)]
66. Opdam, P.; Luque, S.; Nassauer, J.; Verburg, P.; Wu, J. How can landscape ecology contribute to sustainability science? *Landscape Ecol.* **2018**, *33*, 1–7. [[CrossRef](#)]
67. Bormpoudakis, D.; Tzanopoulos, J. The science-practice interface of connectivity in England. *Landscape Ecol.* **2019**, *34*, 2669–2685. [[CrossRef](#)]
68. Sarkki, S.; Parpan, T.; Melnykovich, M.; Zahvoyska, L.; Derbal, J.; Voloshyna, N.; Nijnik, M. Beyond participation! Social innovations facilitating movement from authoritative state to participatory forest governance in Ukraine. *Landscape Ecol.* **2019**, *34*, 1601–1618. [[CrossRef](#)]
69. Cumming, G.S.; Epstein, G. Landscape sustainability and the landscape ecology of institutions. *Landscape Ecol.* **2020**, *35*, 2613–2628. [[CrossRef](#)]
70. Opdam, P. Navigating the space between landscape science and collective action for sustainability: Identifying key factors in information processing. *Landscape Ecol.* **2020**, *35*, 2629–2639. [[CrossRef](#)]
71. Adade Williams, P.; Sikutshwa, L.; Shackleton, S. Acknowledging Indigenous and Local Knowledge to Facilitate Collaboration in Landscape Approaches—Lessons from a Systematic Review. *Land* **2020**, *9*, 331. [[CrossRef](#)]
72. Favretto, N.; Stringer, L.C.; Dougill, A.J.; Kruger, L. Knowledge exchange enhances engagement in ecological restoration and rehabilitation initiatives. *Restor. Ecol.* **2022**, *30*, E13565. [[CrossRef](#)]
73. Stringer, L.C.; Dougill, A.J.; Fraser, E.; Hubacek, K.; Prell, C.; Reed, M.S. Unpacking participation in the adaptive management of social-ecological systems: A critical review. *Ecol. Soc.* **2006**, *11*, 39. [[CrossRef](#)]
74. Duff, G.; Garnett, D.; Jacklyn, P.; Landsberg, J.; Ludwig, J.; Morrison, J.; Novelly, P.; Walker, D.; Whitehead, P. A collaborative design to adaptively manage for landscape sustainability in north Australia: Lessons from a decade of cooperative research. *Landscape Ecol.* **2009**, *24*, 1135–1143. [[CrossRef](#)]
75. Lazdinis, M.; Angelstam, P.; Püzl, H. Towards sustainable forest management in the European Union through polycentric forest governance and an integrated landscape approach. *Landscape Ecol.* **2019**, *34*, 1737–1749. [[CrossRef](#)]
76. Boedhihartono, A.K.; Bongers, F.; Boot, R.G.A. Conservation Science and Practice Must Engage With the Realities of Complex Tropical Landscapes. *Trop. Conserv. Sci.* **2018**, *11*, 1. [[CrossRef](#)]
77. Gossa, C.; Fisher, M.; Milner-Gulland, E.J. The research-implementation gap: How practitioners and researchers from developing countries perceived the role of peer reviewed literature in conservation science. *Oryx* **2014**, *49*, 80–87. [[CrossRef](#)]
78. Knight, A.; Cowling, R.; Rouget, M.; Balmford, A.; Lombard, A.; Campbell, B. Knowing but not doing: Selecting priority conservation areas and the research-implementation gap. *Conserv. Biol.* **2008**, *22*, 610–617. [[CrossRef](#)]
79. Turnhout, E.; Bloomfield, B.; Hulme, M. Listen to the voices of experience. *Nature* **2012**, *488*, 454–455. [[CrossRef](#)] [[PubMed](#)]
80. Sunderland, T.; Sunderland-Groves, J.; Shanley, P.; Campbell, B. Bridging the gap: How can information access and exchange between conservation biologists and field practitioners be improved for better conservation outcomes? *Biotropica* **2009**, *41*, 549–554. [[CrossRef](#)]
81. Bohnet, I.; Smith, D.M. Planning future landscapes in the wet tropics of Australia: A social-ecological framework. *Landscape Urban Plan.* **2007**, *80*, 137–152. [[CrossRef](#)]
82. Bohensky, E.L.; Butler, J.R.A.; Davies, J. Integrating indigenous ecological knowledge and science in natural resource management: Perspectives from Australia. *Ecol. Soc.* **2013**, *18*, 20. [[CrossRef](#)]
83. Davies, J.; Hill, R.; Walsh, F.J.; Sandford, M.; Smyth, D.; Holmes, M.C. Innovation in management plans for community conserved areas: Experiences from Australian indigenous protected areas. *Ecol. Soc.* **2013**, *18*, 14. [[CrossRef](#)]
84. Masterson, V.A.; Stedman, R.C.; Enqvist, J.; Tengö, M.; Giusti, M.; Wahl, D.; Svedin, U. The contribution of sense of place to social-ecological systems research: A review and research agenda. *Ecol. Soc.* **2017**, *22*, 49. [[CrossRef](#)]
85. Stedman, R.C. Subjectivity and social-ecological systems: A rigidity trap (and sense of place as a way out). *Sustain. Sci.* **2016**, *11*, 891–901. [[CrossRef](#)]
86. Gottwald, S.; Albert, C.; Fagerholm, N. Combining sense of place theory with the ecosystems services concept: Empirical insights and reflections from a participatory mapping study. *Landscape Ecol.* **2022**, *37*, 633–655. [[CrossRef](#)]
87. Chapin, F.S.; Knapp, C.N. Sense of place: A process for identifying and negotiating potentially contested visions of sustainability. *Environ. Sci. Policy* **2015**, *53*, 38–46. [[CrossRef](#)]
88. Brown, G.; Raymond, C. The relationship between place attachment and landscape values: Towards mapping place attachment. *Appl. Geogr.* **2007**, *27*, 89–111. [[CrossRef](#)]
89. Brown, G.; Reed, P.; Raymond, C.M. Mapping place values: 10 lessons from two decades of public participation GIS empirical research. *Appl. Geogr.* **2020**, *116*, 102156. [[CrossRef](#)]
90. Turk, A.; Stea, D. David Mark’s contribution to ethnophysiography research. *IJGIS* **2014**, *28*, 1246–1265. [[CrossRef](#)]

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