Relational Thinking for Landscape Management and Conservation: can we really embrace a human/nature continuity?

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Abstract

It is increasingly recognized that the conservation of natural and degraded landscapes requires rethinking our relationships with nature by considering social-ecological complexity. Currently, managers are faced with a wealth of knowledge in landscape ecology, restoration ecology and related fields, that are all mobilized to solve management problems. However, many conceptual propositions fall inadvertently in the same human/nature divide that they try to surpass if based only on a systemic approach. In this article, we analyse the varying degrees to which restoration, reconciliation and reclamation ecologies have been influenced by relational thinking bringing together the cultural, social and ecological spheres. The greatest challenge remains to understand human-nature relationships as continuous, facilitating the integration of diversity of relationships, values and worldviews that require necessarily larger research and management teams, something not always possible to fund.

Introduction

Within the global scope of conservation sciences and applied ecology, managers have today at hand several theoretical and practical tools stemming from landscape ecology, reclamation, rehabilitation and restoration ecology, among others. All these fields propose strategies and conservation actions that are situated at the interface between human societies and nature. Under this "restoration continuum", i.e. Gann et al. (2019), researchers, managers and stakeholders typically formulate conservation actions without questioning the nature of the relationships between human and nature. For instance, restoration ecology tends towards the "original" biodiversity and functions of ecosystems (Gerwing et al., 2021; but see also discussions in Gann et al., 2022 and Bullock et al., 2021), whereas reclamation ecology seeks to reinvest in highly degraded or

human-dominated landscapes to stimulate their ecological functions (Gerwing et al., 2021; Lima et al., 2016).

Questioning the nature of the interface between humans and nature to consider the diversity of relationships between humans and other living entities has been recognised as paramount for conservation science and practices, something that has been dubbed a 'relational turn' in conservation (Bennett et al., 2017; West et al., 2020). This relational turn is accessible through 'relational thinking' enabling to consider the complexity of social-ecological systems, promoting interdisciplinary and transdisciplinary approaches (Eyster et al., 2023). Concerning the issues of coexistence between humans and other species, adopting relational thinking seems just as necessary as it is difficult as it implies to redefine the categories shaping the discipline, for example nature and culture in eco-anthropological studies (Descola, 2013); relational landscape and biogeographical landscape, and artificial and natural in philosophy studies, among others (Stenseke, 2018).

However, while there is an urgent need to make this relational turn in conservation science and practice, the practical "keys" to adopting relational thinking within landscape ecology and the different fields of ecological restoration have yet to be identified. Through the analysis of the "restoration continuum" (i.e. reclamation, rehabilitation and restoration ecology; Gann et al., 2019), insights can be gained into how relational thinking can help managers in choosing the right conceptual and practical tools for conservation programs.

The relational approach in the broad sense is not unfamiliar to ecological sciences, and it is omnipresent in the field of landscape ecology, but it traditionally does not address values themselves. Landscape ecology considers the spatial structure of a landscape and external spatial features as influencing ecological processes. Landscape ecology then understands ecological processes in relation to contextual factors (Wiens, 2009), which can be thought of being of relational type by default. Therefore, we can question whether a body of work in landscape ecology might promote a relational approach to the fields of reclamation, rehabilitation, restoration and reconciliation ecology, which in turn would promote a relational value thinking in them.

Here, we will explore some leads for bridging the gap between theory and action through relational approaches for conservation when landscape rethinking is broken down into nouns such as reconciliation, restoration, and reclamation, and how they relate to the field of landscape ecology. We provide a hypothetical example to illustrate how each field approaches relational thinking and how that translates into management.

Revisiting the "re"- ecologies

Three examples of applied ecological practices are restoration ecology, reclamation, and reconciliation. Their theoretical foundations come from the ecological sciences sensu lato: for restoration and reconciliation mostly biogeography and functional ecology and especially biogeography and landscape ecology for reconciliation. These three fields share the use of the prefix -re, coming from the same Latin prefix signifying "of the same meaning," marking repetition, resumption. Whether it is re-storation, re-clamation or re-conciliation, each term conveys the idea of a reformation of at least two entities underlying a relationship.

"Reclamation" comes from the Latin reclamatio, meaning acclamation, protest through shouting. The term reclamation, therefore, only through its etymology, invokes explicitly the notions of both relationship and action. The ecology of reclamation is defined by Gerwing et al. (2021) as: "The process of assisting the recovery of severely degraded ecosystems to benefit native biota through the establishment of habitats, populations, communities, or ecosystems that are similar, but not necessarily identical to surrounding and naturally occurring ecosystems". The ecology of reclamation, therefore, adopts a functional perspective of ecosystems to justify and promote its action.

The term "restoration" calls for the relationship of entities and the action of putting them again together. Restoration ecology is defined by Gann et al. (2019) as: "The process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed". The term "restoration" comes from Latin, restaurare, which designates the action of rebuilding, of repairing. Restoration ecology, therefore, adopts a perspective of ecosystem balance to justify its action. The moral underpinning is that something has been degraded and that it is a moral obligation to return to a reference state, a position shared with the other two types of action to a greater or lesser extent. Contrary to the other

two re-ecologies, restoration ecology has grown as a solid community with journals and societies being recognized as practitioners of it. The other two terms appear more as a variation with different meanings of the restoration process.

Finally, the term “reconciliation”, from the Latin reconciliare, which means to reconcile, coming together again, embodies openly the notions of relationship and action. Reconciliation ecology is defined by Rosenzweig (2003b) as: “the science of inventing, establishing, and maintaining new habitats to conserve species diversity in places where people live, work and play”. Unlike the ecology of restoration and reclamation, reconciliation ecology does not consider the concept of pristine nature as the guiding concept of its action, but calls for “inventing, establishing and maintaining” habitats (Rosenzweig, 2003a). Reconciliation ecology therefore calls for defining new forms of relationships according to a certain continuity of living beings, from all species to Homo sapiens (please refer to Box 1 that summarizes the main driving dimensions of the practice).

These examples of applied ecology all highlight the importance of the concept of relationship, but each one with a different twist. Restoration ecology considers the relationship from a historical perspective by referring to an assumed state of the ecosystem outside of human action (but see discussions in Barra, 2024; Bullock et al., 2022; Gann et al., 2019). In this respect, restoration ecology considers the relationships between human and non-human populations as discontinuous, meaning a separation between humans and nature (naturalism). In terms of action, restoration ecology strategy is essentially reformist, with actions targeting specific aspects of the system to match the preconceived idea of a previous landscape configuration. According to the typology of stewardship action proposed by Mathevet et al. (2018), restoration ecology actions could be considered as belonging to the reformist stewardship action category. While restoration ecology questions our relationships with the landscape, it still has a conception of coexistence shaped by a narrow set of relationships and associated values, as expressed, for example, in Hallett et al. (2023), considering coexistence as the product of causal relationships only.

Reclamation ecology recognises the relationship between humans and nature from a functional perspective of ecosystems by proposing a relational discontinuity between

humans and non-humans. By proposing to create habitats with similar functions but not necessarily identical to natural environments, the ecology of reclamation does not call into question the nature/human divide but rather offers a new interpretation of it. In terms of its action, reclamation ecology is also reformist but aims to promote novel systems with similar functions. Reclamation ecology is thus promoting action that could be categorized as also belonging to reformist stewardship action position, but including an adaptive dimension (Mathevet et al., 2018).

Reconciliation ecology, on the other hand, recognises relationships from an ontological perspective in considering direct relationships between humans and other species without preconceptions of artificiality or naturality (Box 1), therefore by recognising relationships within nature as continuous (Rosenzweig, 2003b). This is a fundamental difference with restoration and reclamation ecologies because in terms of the actions made under reconciliation ecology assumptions, the aim would be to implement both reformist and innovative actions to tends towards a novel system with a new set of relationships characterizing either sustainability or transformative stewardship positions (Mathevet et al., 2018).

Thus, the fundamental difference between these applied ecological approaches lies not in the action per se that they propose but rather in the underlying conception of relationship continuity: historical for restoration ecology, functional for reclamation ecology and ontological perspective for reconciliation ecology, although all three will share perspectives of the other two. The ontological perspective of reconciliation ecology seems of particular interest to link relational thinking to conservation science and practice because it matches the needed ontological redefinition of conservation (to change the object of research), inducing epistemological and methodological redefinitions (Preiser et al., 2018). In his book “Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise”, Rosenzweig (2003b) describes reconciliation ecology through a suite of empirical examples. We identified 7 main principles highlighted by these examples characterizing reconciliation ecology that are not necessarily exclusive to it, but that serve us to highlight ways in which relational thinking can be used by managers when designing and implementing management programs:

- Use spatial ecology: Space is a key aspect of reconciliation ecology. Based on the relationship between the area available for wildlife species and biodiversity, reconciliation ecology's main objective is to “create, maintain, and develop” suitable habitats for wildlife species in shared landscapes.

Example: Western and Mose (2023) investigated spatial patterns of elephant movement in and outside Amboseli National Park, Kenya. The authors highlight the importance of providing elephants mobility beyond protected areas, especially at the interface with livestock, to increase habitat heterogeneity and vegetation diversity.

- Examine cross-scale issues: Considering the interweaving of scales is essential for reconciliation ecology. This is directly related to the spatial ecology dimension. Processes observable at a given scale can have important effects at a different scale. It is thus important to adopt a cross-scale approach to consider this nesting effect of scale.

Example: Segar et al. (2022) question the potential for urban conservation gardening of native species and identify the critical need to consider multiple scales to characterise species' nativeness and decline.

- Engage in participatory approaches: In many examples, Rosenzweig highlights the critical importance of local knowledge in identifying viable mechanisms of landscape reconciliation between humans and wildlife.

Example: Cosens et al. (2018) investigated the reconciliation between development and maintaining of ecological function of the Columbia River Basin. One of their key findings is the importance of implementing participatory processes to design win-win solutions and promote adaptive governance mechanisms.

- Be aware of historical issues: Rosenzweig mentioned the importance of considering social-environmental practices as potential solutions for reconciliation. One of the key dimensions of reconciliation ecology is perpetuating practices or drawing inspiration from them. Reconciliation ecology is part of the continuity of the landscape.

Example: Ward et al. (2022) envisage reconciliation ecology on the private lands of the Mid-Murray Valley in Australia from a historical perspective in engaging with multiple actors. They put into perspective the historical trajectory of land-use change, policy

evolution and past land management to emphasise the need to consider complex relationships to foster effective collaboration between private landowners and governmental entities and tend towards reconciliation.

- Be prospective and experimental: Reconciliation ecology also aims to invent new forms of relationships within shared landscapes. The prospective approach, the anticipation of the future landscape is then important to reconciliation ecology.

Example: Lindon and Root-Bernstein (2015) explore the anticipation of potential scenarios by key informants for the reintroduction of guanacos in Chile. Using different methodologies, including photomontages, the authors stimulated anticipation of the potential implications of guanaco reintroduction to identify key values (relational, intrinsic and to a lesser extent instrumental values) articulating guanaco conservation and benefits to human activities.

- Work for community empowerment: Rosenzweig (2003b) insists on the importance of shared landscapes. It implies a "win-win scenario" with humans benefiting from this new set of relationships provided by reconciliation ecology. This win-win situation implies just relationships within society and thus the empowerment of local people.

Example: Rastogi et al. (2012) realised a literature review on tiger conservation in India. They highlight the difficulty to get support from local communities living close to protected areas and often excluded from policymaking. The establishment of exclusive protected areas can undermine the traditional structure of governance, creating antagonism between local communities and conservation initiatives. Empowering local communities through their integration into decision-making through collaboration with other responsible entities could help to identify the complex social aspects of potential coexistence and ultimately reconciliation. The authors report several studies (e.g. Adams et al., 2004; McShane et al., 2011) highlighting the limits of this aspect when considered on its own.

- Consider psycho-environmental determinants: Rosenzweig (2003b) has recognised the motivations behind reconciliation ecology implementation. Emotions,

beliefs, or values are important to consider when redefining landscapes for human-wildlife reconciliation in the same place.

Example: Elliot et al. (2016) investigated the attitudes towards coyotes in two cities in North America, USA. They identified a diversity of attitudes towards coyotes among residents (fear, joy, indifference), influencing the potential success of conservation strategies in urban environments and thus for reconciliation.

While the above principles are found in research programs of several branches of ecology, ecological restoration and conservation sciences, the important message to keep in mind is that relational aspects are of many kinds and do not restrict to simple human/nature interactions studies.

Pushing the boundaries in landscape ecology

In addition to the re-ecologies summarized above, landscape ecology is also part of the research fields and disciplines used to make informed management decisions. However, landscape ecology does not consider a continuity between system's entities and thus relational complexity because it is not its main objective. Landscape ecology focuses on places as embedded in a landscape mosaic and is interested in how spatial structure and dynamic influences ecological processes (Wiens, 2009). It mobilizes indicators for both human presence in the one hand, and biodiversity in the other, and can explain spatial patterns guiding spatial planning in conservation (Wiens, 2009). Typically, landscape ecology provides an interpretation of social-ecological processes through the lens of inferred causality through geo-statistical tools. Moreover, it is widely recognised that landscape ecology is paramount to investigate human-wildlife coexistence issues and thus to understand the underlying processes that could benefit biodiversity conservation. Functional diversity identified through landscape ecology studies can indeed be associated to specific values, but these values are restricted to the ecosystem or landscape-entity for themselves (intrinsic value) or for the benefits that we could get from these functions (instrumental value). The question that follows is if the integration of landscape ecology with its positive science of relations based on causality, can foster a wider relational thinking like in the re- ecologies.

In our opinion, it is not unrealistic that teams of researchers can work together to use the spatial insights given by landscape ecology to nurture and receive feedback from team coworkers engaged in the other principles of relational thinking summarized above. As previously mentioned, reconciliation ecology focuses on the landscape by conceiving the spatial dimension as key for biodiversity (principle 1), just like in landscape ecology studies. So, the same argument could be made to extend the use of the other principles in multidisciplinary teams.

Box 1. Practical implications of the three re-ecologies under different relational assumptions: a hypothetical case-study.

Anand and Radhakrishna (2024) investigated human-rhesus macaque coexistence in a coal-mining area of Southern India. They used households' interviews and landscape ecology analyses to understand the underlying processes of the issue. Mine reclamation has been performed in the surroundings of active mine sites with plantations. Landscape ecology analyses show that macaques tend to avoid mining areas, and that the extent of the conflict increases with the distance to the mining area. Proximity to plantations is positively correlated to conflict, whereas proximity to dense forests is negatively correlated. Anand and Radhakrishna (2024) suggest that mining activity modifies landscape structure and, by excluding macaques from these areas, pushes them towards human settlements, initiating conflicts. Reclamation with monospecific vegetation is not attractive for macaques, and the authors conclude that reclamation (rehabilitation) should be adapted to accommodate macaque populations.

Re-ecology	Objectives	Relational perspective	Human-macaque relationships	Potential practical implications under their own relational conception	Potential practical implications under relational continuity
Reclamation	Reinvest degraded landscapes	Functional	Mostly discontinuous	Abandoned mining sites and reclaimed surroundings planted with native or non-native vegetation provided non-native vegetation benefits ecosystem functions.	In favoring the plantation of tree species identified collectively with local communities, the aim would be to rehabilitate abandoned mining areas with the contribution of macaques in disseminating seeds rehabilitating mining sites soils for potential future agroforestry practices (Heymann et al., 2019; Heymann et al., 2022)
Restoration	Tend towards "original" functions of ecosystems	Historical	Discontinuous/ Continuous	Mining sites and surroundings restored with native species identified from the dense forest to recreate the original functions of the ecosystem with the aim to encourage macaque to move back in the forest.	Social-ecological trajectory is investigated to understand both worldviews, values and attitudes shaping human-macaque interactions and social ecological processes promoting complexity. For instance, while Guillerme (2013) highlighted the importance of agroforestry in rural areas of southern India, several authors identified agroforestry as reducing the extent of human-primates conflict (e.g. Estrada, 2006; Meijaard, 2016; Siljander et al., 2020; Sodik et al., 2020). However, to consider relational continuity these interesting possibilities should emerged through discussion with a diversity of stakeholders including mine owners to collectively implement this kind of response.
Reconciliation	Suitable habitats for biodiversity	Ontological	Continuous	Local communities and macaques are part of the same system and de facto a "society" structured around agroforestry benefiting humans through increased harvesting of rice and cotton (benefiting from agroforestry and macaques' maintenance through seed dispersal, e.g. Amassaghrou et al., 2021) whilst reducing the intensity and extent of conflict with human livelihoods promoting a win-win scenario	

Putting it all together

According to Cash et al. (2003), the gap between conservation science and practice can be overcome when science is credible (trusted), salient (matching decision-making) and legitimate (diversity of perspectives and worldviews considered). Credibility is achieved by integrating relational values from local experience and specific knowledge of individuals at stake, enhancing potential support and credibility. Salience can stem from the identification of relational approaches that can provide decision-makers with the contextual critical elements reflecting real-world conservation challenges to move research from theory to practice. Legitimacy would be gained by recognising a diversity of worldviews and the values associated to those worldviews to ensure that conservation strategies match cultural and local contexts, enhancing long-term success

Hence, our argument is if relational thinking can be embraced, not as a special case in certain studies, but as a standard approach built upon the information provided by landscape ecology on the one hand, and by assuming credibility, salience and legitimacy goals for conservation actions on the other hand, if continuity is the leitmotiv around which the management program is conceived.

Clearly, the scope and human effort needed to embrace relational studies is not the same as mono-disciplinary studies and not all agencies can afford large multidisciplinary teams, but the increasing recent literature in this regard suggest that relational approach is not something that can be ignored either.

Implications for teaching

Probably the most important implication of our arguments, is that no matter what the field is, whether landscape ecology, restoration ecology, reclamation ecology or reconciliation ecology, the object of study is how the continuity of relationships of humans within ecosystems change over time. This is a different approach not necessarily taught at programs training students in the traditional ecological fields like population biology, community ecology and ecosystem science, and even in conservation biology approaches whose study object is mostly biological. But current literature in the field is already acknowledging that urgent need (Reyers & Bennett, 2025).

Beyond conceptual discussions, we consider it is important for the training of young biologists, ecologists, and natural area managers, that those intangible relations between the organisms we observe, are as important as the organisms they want to protect. One cannot be protected without the other, and both change constantly.

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