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RESEARCH: A RELATIONAL TURN IN SUSTAINABILITY

Pathways to synergize reductive with relational logics in environmental policy

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ABSTRACT

Transformative policies and policy instruments that effectively and equitably address climate change, biodiversity loss and social-ecological inequality are essential. This paper examines how environmental policy can better integrate reductive with relational logics to accommodate diverse worldviews and improve conservation outcomes. We argue that current approaches are largely defined by reductive logics that function to separate, isolate and objectify – to simplify – and could be improved through the integration of relational logics that encapsulate complexity via the conceptualization of dynamic interconnectivity and interdependence. To do so, we explore how time, space, and entities are conceptualized differently under reductive and relational logics. We illustrate these concepts through multiple cases including: market-based instruments such as biodiversity offset markets, legislative changes to World Heritage Convention Criteria and the Te Urewera Act of 2014 in Aotearoa New Zealand. Our analysis reveals the potential of relational logics to transform environmental policy, leading to more inclusive, culturally appropriate, and effective governance strategies. We propose four key practices for navigating towards a plurality of logics in policymaking: 1) recognizing different logical frameworks and adapting language and metrics; 2) accounting for power dynamics; 3) embracing culturally appropriate co-construction; and 4) contextualizing social-ecological systems with place-based knowledge. We conclude by discussing future directions for policy development in environmental governance, emphasizing the need for ongoing experimentation, evaluation, and refinement in the practical implementation of relational logics in policy.

KEY POLICY HIGHLIGHTS

- Environmental policies are shaped by logic, or form of reasoning, especially with regard to how they conceptualize time, space, and entities.
- Presently time, space and entities often featured in policy as defined by reductive logics, while relational logics remain underrepresented.
- Case examples, such as biodiversity offset markets, World Heritage Criteria, and the Te Urewera Act of 2014 in Aotearoa New Zealand demonstrate how logics influence policy.
- Practices to support more pluralistic policymaking include 1) recognizing different logical frameworks and adapting language and metrics; 2) accounting for power dynamics; 3) embracing culturally appropriate co-construction; and 4) contextualizing social-ecological systems with place-based knowledge.

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Introduction

Record breaking climate change, biodiversity loss rates, and environmental degradation demand innovative and logical approaches for the creation of policies and policy instruments that are comprehensive, adaptable and effective enough to address the complex and interdependent social-ecological problems of the 21st century (Pascual et al. 2023; Raymond et al. 2023; Pörtner et al. 2023). To address these complex social-ecological challenges, the application of logic offers different pathways for characterizing what/who, when and where environmental policy and policy instruments are designed to intervene.

While ontology, such as substance or naturalist ontology (see Hertz et al. 2020; Merçon 2025) delineate ways to define the characteristics of time, space and entities, logic directly shapes how we determine what is relevant, how problems are framed, and how solutions are constructed (Kerr 1976; Pauly 2016). In contrast to imaginaries (Laterra et al. 2021;

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Celermajer et al. 2024), or ways of knowing (e.g. metaphors, Raymond et al. 2013; songspirals; Bawaka Country et al. 2022), a focus on logic places attention on examining the reasoning behind what might shape or be reflected in policy approaches (Rickard and Ludwig 2024; Boelens et al. 2024). In general terms, logic here refers to the underlying frameworks or systems of reasoning that determine patterns of perception, understanding and interaction with the world, outlining the ways in which different concepts such as time, space, and actors or entities relate to one another not just what they are (Pauly 2016). A focus on logic encompasses not only how worldviews and knowledge systems are constructed but also how they translate into specific approaches of policy design and implementation.

A basis on logic offers several analytical advantages, such as: examining the often-implicit assumptions shaping policy problems and solutions (Pauly 2016; etc); providing a framework for understanding why certain approaches persist despite limitations (Pérez-Hämmerle et al. 2024; Weir et al. 2024); and creating space for recognizing different logical frameworks, including historically marginalized ones (Moon and Pérez-Hämmerle 2022). Understanding these logical frameworks become crucial for developing more effective environmental policies, as they fundamentally shape how we conceptualize and address complex-social-ecological challenges across multiple scales and timeframes.

Two broadly distinct frames logic emerge as particularly relevant for environmental policy: reductive and relational. Reductive logic serves to simplify complex systems into discrete, manageable components, enabling clear measurements to be taken and analyses to be made (Elbow 1993). Relational logic contrasts by reflecting on interconnections and interdependencies within complex systems, providing more holistic perspectives across multiple scales and timeframes (Fang et al. 2011; West et al. 2020). For instance, the *Well-being of Future Generations (Wales) Act 2015*, demonstrates relational logic in practice by taking a comprehensive and adaptive approach whereby public bodies must, by law, balance short-term needs with long-term sustainability by taking into account short-term needs with the need to safeguard the ability to meet long term needs, especially where things done to meet short term needs may have detrimental long-term effects" (see WFGA 2015, clause 5.2(a)).

In general terms, reductive logics typically approach time-space-entities where: time is often viewed as linear and quantifiable, with policies focusing on short-term goals and measurable outcomes; space is frequently defined by clear, fixed boundaries, such as property lines or political jurisdictions; and entities are usually categorized and managed separately, with a focus on individual species or specific ecosystem services (Elbow 1993; Fang et al. 2011). An example of reductive logic is a traditional protected area policy that might set a target to conserve a certain percentage of land within clearly defined boundaries by a specific date, with a focus on maintaining particular species or habitat types (e.g. Convention on Biological Diversity, 30×30Target). In contrast, relational logics approach time-space-entities differently, where: time is often seen as cyclical or non-linear, with policies considering long-term, intergenerational impacts and relationships; space is viewed as interconnected and fluid, recognizing the relationships between different areas and scales; and entities are understood as part of complex, interconnected systems, with policies addressing the relationships between various actors and elements (Graham and Healey 1999). A policy based on relational logics might, for instance, focus on maintaining and restoring biocultural relationships between communities and their environments, considering historical connections and future generations (e.g. Healthy Country Plans).

The application of reductive and relational logics can lead to different policy outcomes and therefore become important elements of policy and policy instrument formation to evaluate. While reductive approaches have enabled clear target-setting and quantifiable assessments (e.g. CBD's 30x30), they often struggle to capture the intricate dynamics of social-ecological systems and thus fall short in addressing complex problems, such as the injustices associated with climate change and biodiversity loss (e.g. land rights). Relational approaches can offer the potential for more comprehensive and adaptive policies that capture the complexity of social-ecological challenges and have significant capacity to improve conservation strategies (Vigliano Relva and Jung 2021; Roland Holst and Zegers 2025).

This reductive-relational framework shares important connections with disciplines that study socio-ecological systems, resilience and sustainability thinking, that for decades have explored tensions between mechanistic reductionism and holistic complexity (e.g. Berkes et al. 2008; Elmqvist et al. 2019; Voulvoulis et al. 2022; Longo et al. 2025). Some of these tensions include the integration of spatial and temporal dimensions that recognize change across scales and the creation of policies that move beyond static, bounded solutions, to incorporate adaptive governance, transformative capacity, and multi-dimensional approaches (Sahle et al. 2025). For instance, the adaptive management cycle explicitly incorporates cyclical and non-linear time while SES research and analytics highlight the interconnectivity of systems, entities, power, and place-based governance (Berkes et al. 2008).

It is important to be cautious in contrasting reductive with relational logics in a way that avoids creating a false binary between the two or a simplified dualism (e.g. 'Western' versus 'Indigenous' thinking), by highlighting differences and diversities in patterns of reasoning to foster more pluralistic approaches to policy and environmental governance (Agrawal 1995; Merçon 2025). Further, when discussing Indigenous perspectives, one must be careful to avoid the problematic tendency to reduce ontological differences to mere 'cultural perspectives' on a singular reality (Merçon 2025). Indigenous knowledge systems need to be understood in their own right, each with practices and institutions to craft legitimate and useful knowledge (Tengö et al. 2021). When fundamental ontological differences are reduced to 'cultural beliefs', they become easy to dismiss within dominant policy frameworks that privilege scientific, social-political, and economic rationalities (Bingham et al. 2021; Rarai et al. 2022; Merçon 2025).

Despite the recognized value of combining reductive with relational logics, reductive logic dominates environmental policy spheres while relational logics have yet to be mainstreamed and scaled in prevailing regional, national and global policies or the use of policy instruments across these contexts (Blaney and Tickner 2017; Goldman et al. 2018; Chilisa and Mertens 2021). This imbalance may exacerbate the systemic marginalization and oppression of particular groups of people and knowledge systems, an inequality that must be addressed in and through the development of policies and policy instruments if they are intended to be effective while redressing ongoing injustices and exclusions (Lockie 2013; Reyes-García et al. 2022). As such, examining the function and relative representation of logic in policies can assist in understanding the strengths and limitations of policy instruments while providing an opportunity to develop more effective and equitable approaches.

This perspective is guided by two aims:

(1) To compare, contrast and show the interrelationships between reductive and relational logics in the environmental policy theater, and how they shape the conceptualization of time, space, and entities in policy contexts.
(2) To examine how relational logics can be meaningfully integrated into environmental policies to create more inclusive, adaptive, and effective governance approaches.

Our work extends existing frameworks by more explicitly engaging with power dynamics and pluralism by directly addressing questions of whose knowledge counts, how boundaries are determined, and who benefits from particular policy approaches.

We begin with a brief positionality statement, then introduce the concepts of reductive and relational logics, illustrating their differences through the case of biodiversity offsets and the World Heritage Convention. Next, we present the framework of time-space-entities as a tool for understanding how different logics manifest in environmental policy and management. We then examine the Te Urewera Act 2014 in Aotearoa New Zealand to demonstrate the practical implications, potential, and challenges of incorporating relational logics into policy and practice. Finally, we propose four key practices for navigating toward a plurality of logics in environmental policy-making: acknowledging the value of diverse logics (e.g. reductive, relational); accounting for power dynamics; embracing culturally appropriate co-construction; and contextualizing social-ecological systems with place-based knowledge.

Throughout this analysis, we acknowledge the intricacies and diversity of both reductive and relational approaches, as well as the power dynamics that influence which logical frameworks are privileged in policy contexts. Our goal is not to universalize, nor replace one system with another, but to create space for more pluralistic, context-sensitive approaches for environmental governance that can address the complex challenges of the 21st century and beyond.

Positionality statement

We, as co-authors, acknowledge our perspective and work is constrained by our positionality (McLean et al. 2019; Weir et al. 2024). We write from across different nations and cultural and linguistic contexts (e.g. Australia, the United States, Finland); we do not identify as Indigenous and do not intend to speak for, or over, Indigenous people. Although trained in western contexts where reductive logics are commonly applied, our intention is not to reinforce or create further binary thinking or dualism.

Crucially, we recognize that our simplified representation of relational logics should not be conflated with the heterogeneous forms of relationality, Indigenous worldviews, knowledge systems, values, Indigeneity, decolonization, and sovereignty, that exist across the diverse lived experiences of past, present and future Indigenous Peoples. Indigenous worldviews are complex, varied, and evolving and cannot be reduced to a singular 'relational logic' or presented as simple, static, perfect or universally harmonious in nature (Hunt 2014; Todd 2016). We acknowledge that the abstraction required for analysis risks flattening this diversity and complexity and caution our readers to not treat any one perspective or conceptualization as a panacea or 'silver bullet' instrument that can or will resolve social, ecological or political challenges. Instead, we suggest in chorus with many scholars that to engage respectfully with different worldviews and knowledge systems requires recognizing the inherent value of their diversity, their

embeddedness in specific geographic, cultural and historical contexts, and their ongoing evolution in response to shifting contemporary circumstances (Weir et al. 2024).

Our dialectic approach pragmatically aligns with elements of 'strategic essentialism' (Spivak and Harasym 2014), which necessitates a deliberate assertion of diverse cultural and linguistic traits. For instance, our use of hyphens (e.g. time-space-entities, human-nature, social-ecological), quote marks (e.g. 'as'), slashes (e.g. what/who) and capitalizations (nature versus Nature) emerges from a need to use reductive techniques that indicate more complex relationships and meaning. We approach language critically, striving to take into account the limits of our respective positionalities and nuances of power, identity and representation embedded within the words being used. We acknowledge this approach is guilty of being reductive and do so cautiously, while also being aware that our assertions are not neutral or apolitical and thus imbued with power (Pauly 2016; De La Bellacasa 2017; Turnhout 2018; Turnhout et al. 2020; Pérez-Hämmerle et al. 2024). Further, we acknowledge the cautions raised by scholars (See Todd 2016) and are aware that our individual and collective positionality may inadvertently simplify, romanticize, or instrumentalize worldviews and knowledge systems that differ from our own, specifically Indigenous ontologies, epistemologies, values and ethics. We are aware of our limitations and strive to avoid presenting any one worldview uniformly or as inherently 'superior', instead aiming to emphasize the nuance of diversity, complexity and ongoing challenges of pluralism and environmental governance.

Understanding how reductive and relational logics are used in environmental policy instruments

Logics shape our understanding and approach to complex problems and therefore play a crucial role in policy development and implementation. Policy, in this context, refers to the general principles, rules and guidelines created to achieve problem solving goals. Policy instruments are the specific tools and mechanisms used to implement policies, such as economic incentives, regulations and legislation. The logic underpinning policy and its instruments, whether reductive or relational, fundamentally shapes how environmental challenges are perceived, defined and addressed. The following sections explore these implications by examining how logics influence biodiversity offsetting and the World Heritage Convention.

Reductive and relational logics in policy instruments: the case of biodiversity offsets

Reductive logics describe the world mechanistically, separating and bounding entities in time and space. While this approach has benefits in certain contexts (e.g. monitoring endangered species populations), it has the potential to lead to policies that fail to account for complex interconnections. For example, biodiversity offset markets rely on the assumption that elements of biodiversity can be separated, quantified, and traded across time and space (Table 1). This approach, while administratively convenient, does not capture the full complexity of ecosystems and their cultural significance to the degree that relational logic might (West et al. 2020; Morgain et al. 2023).

For a biodiversity offset market to function and achieve 'no net loss', a reductive logic enables separating elements of biodiversity (i.e. life) into discrete, extractable, and independent objects from the system at large (e.g. as a species, ecosystem unit, or service). Those elements can then be commodified, reducing complex systems into divisible objects to be bought, sold or traded under the assumption that each commodity or product is replaceable across spaces and over a period of time (i.e. biodiversity becomes a fungible unit, whether it exists now or in the future). For example, a government approves a property developer to build on a parcel of land, where the habitat for a range of native plants, animals, soils and services are represented as biodiversity 'tokens' or 'credits'. To ensure there is 'no net loss' of biodiversity, the government requires the property

Table 1. Reductive and relational logics applied to biodiversity offset policies. Reductive logics enable an approach for measurable biodiversity units to be traded across time and space, while relational logics focus on maintaining ecosystem relationships and cultural connections.

	Reductive Logic	Relational Logic
Assumptions	Linear causality Isolated variables Fixed boundaries Standardized metrics Limited scalability	Complex interactions Interconnected systems Fluid boundaries Context-specific indicators Multi-scale perspective
Time	Linear, quantifiable (e.g. offset duration)	Cyclical, intergenerational (e.g. long-term ecosystem dynamics)
Space	Fixed boundaries (e.g. offset site)	Interconnected, fluid (e.g. ecological corridors, soil hydrology and biophysics)
Entities	Separate, quantifiable (e.g. species counts)	Interconnected, holistic (e.g. symbiosis, ecosystem functions)

developer to purchase or invest in equivalent 'tokens' or 'credits' elsewhere at some point in time to compensate for the biodiversity losses incurred by the development. These credits or tokens allow for the trading of biodiversity units through the exchange and sale of compensatory credits or tokens, an arrangement that permits a prioritization or hierarchy to be generated (e.g. Threatened Species Index); assuming demands of the market are met (e.g. demand for a specific type of ecosystem credit or token) (Lockie 2013).

In essence, the entities representing biodiversity value as 'credits' or 'tokens' must be assumed to be separable from the space in which they are located and transferable over time. However, the technical success of offsets is limited by factors, such as time lags, uncertainty, quality of evaluation and measurability of biodiversity (Maron et al. 2012; Lindenmayer et al. 2017). For instance, it is difficult to know how much time is required to compensate for losses when processes underpinning biodiversity and its offsets, such as species, habitats and ecosystem services can take decades if not thousands of years to be created or restored, if at all (Maron et al. 2012, 2018; Pope et al. 2021).

In contrast, relational logics, defined by assumptions of interdependence, inseparability and interrelatedness, cannot treat biodiversity as an abstract concept existing 'out there', at some point in time, that can be 'offset'. Rather life is viewed and experienced as a reciprocally co-constructed way of being, encompassing humans and more-than-human entities *as* Nature and *as* life itself (RiverOflife et al. 2021; Kenter and O'Connor 2022). The health and sustainability of the system are impossible to measure using static indicators (e.g. tokens or credits), but rather assessed by functions of reciprocal processes embedded in places across multiple timelines (Bawaka Country et al. 2016). Relational logics are observed in instruments such as those of kinship and a culture of custodianship from which place-based governance emerges that is situated through entities in time-and-space (Tomas 2011; Whyte 2021; Tynan 2021). For example, Nyikina people of the West Kimberly region in Western Australia place emphasis on the quality of relationships between people, animals, lands and waters; each of which exists and whose health depends on the relations each has with the other across times-and-spaces (Milgin et al. 2020; RiverOflife et al. 2023). Biodiversity off-setting, where areas of biodiversity become restricted or destroyed, can result in a disruption of peoples' place relations (e.g. kin, culture of custodianship) and negatively impact well-being and access to Nature (Iniesta-Arandia et al. 2014; Kalliolevo et al. 2021; Ulrich et al. 2022). These relational values, defined by the relations that form the experience of 'place', cannot be compensated with protections of biodiversity elsewhere (Reid and Sieber 2020).

From reductive to relational logics in legislation: the case of World Heritage

Logic that defines time-space-entities produces our perception of what futures are brought into the realm of possibility, and thus probability, in decision-making contexts. An example is the assignment of UNESCO World Heritage sites (Barad 2014; Pauly 2016; Moon and Pérez-Hämmerle 2022; Pérez-Hämmerle et al. 2024). To illustrate, the listing of Budj Bim Cultural Landscape in Australia in 2019 demonstrates a shift towards recognizing the interconnections between culture and nature and an expansion from reductive toward more relational logic (Jackson 2022). This recognition required that UNESCO revise its criteria, moving away from separate evaluations of cultural *and* natural heritage. From inception in 1972, UNESCOs past Operational Guidelines had six criteria for the inclusion of cultural heritage and four criteria for natural heritage, with the two streams considered separately (Gfeller 2013), until they were merged into one set of ten criteria (UNESCO 1972; UNESCO 2017). This merging occurred in the aftermath of the incorporation of the term 'cultural landscape' in 1992 that aimed to recognize significant interactions between people and the natural environment, collapsing the distinction between 'natural' and 'cultural' values expressed over time and across spatial scales (Smith et al. 2019). The inclusion of cultural landscapes provided an avenue for UNESCO to recognize the relational logics embedded in diverse places (Gfeller 2013), and better account for Indigenous people's holistic relations with land.

For example, Song-lines (the deep time Dreaming stories expressed by First Nations Australians through dance, painting, and song) could now count as evidence despite not necessarily leaving physical traces on a landscape (Gfeller 2013). Local entities of 'Outstanding Universal Value' could thus be recognized in adhering to a relational logic as co-constituted by cultural *and* natural processes, as reflected in the two criteria (iii, v) that led to the listing of Budj Bim Cultural Landscape (Smith et al. 2019). Recognition of sites such as Budj Bim Cultural Landscape as a distinct group of cultural landscapes within the World Heritage system acknowledges the global significance of traditional ecological knowledge and sets a precedent for nominations of additional sites that similarly express Indigenous eco-cultural connections (Smith et al. 2019). The challenge now is to improve criteria beyond recognizing linkages between culture and Nature, because those linkages are acknowledged to exist, but rather consider ways

to more inclusively recognize and represent the diversity of linkages and their values across all heritage listed and proposed sites over time and spatial scales (Larsen and Wijesuriya 2017). This case highlights how international policy frameworks can: evolve to include relational perspectives; be adapted to recognize interconnected cultural-natural values; provide avenues to recognize relational concepts such as cultural landscapes and acknowledge diverse relationships with land; and reveal challenges that remain in balancing universal significance with place-based values.

Given underlying logics shape environmental policies and instruments, we can gain deeper insights into the strengths and limitations of policy approaches by analyzing how reductive and relational logics influence our understanding of time, space, and entities. In the following section, we will explore how different logic serves to shape environmental policy.

Understanding how time-space-entities manifest in environmental policy

The concept of time-space-entities provides a useful framework for understanding how different logics manifest in environmental policy because they indicate how policies conceptualize and engage with the past, present, and future (time); define and interact with physical and conceptual boundaries (space); and identify and relate to various actors, both human and more-than-human (entities). The space-time-entities framework draws upon several theoretical lineages across scientific and philosophical disciplines, most notably 'space-time-mattering', which emphasizes how matter and meaning are co-constituted through entangled relationships rather than existing as separate entities (Barad 2007). By examining various dimensions of matter and meaning through contrasting logic underpinning the conceptualization of time, space and entities, we can evaluate how environmental policies are framed and explore opportunities for integrating relational logics.

More specifically, time, space, and entities fundamentally shape how we implement, and evaluate environmental policy and management. For instance, how time is conceptualized in policy affects how goals are set, progress is measured and outcomes are anticipated. Policies based on short-term, linear time frames may overlook long-term biophysical processes, temporary ecological fluctuations (i.e. transients) or intergenerational impacts (Hastings 2004; WFGA 2015). For example, forest management policies focused predominantly on annual timber yields might neglect cycles of forest succession, the soil biome, or long-term carbon sequestration potential that are important to capture because neglecting these aspects can undermine both the resilience of forest ecosystems, the cultural practices beyond timber production, and biophysical function, ultimately threatening biodiversity, ecosystem stability, and climate regulation (Tedesco et al. 2023; Morgain et al. 2023). Conversely, policies that incorporate cyclical or non-linear concepts of time may better align with social processes (e.g. building trust), ecological timeframes and biocultural rhythms (Hastings 2004; Whyte 2018, 2020).

Similarly, how space is considered in policy instruments determines the scale and boundaries of its possible interventions. Reductive approaches often delineate strict geographical boundaries, which may not align with ecological realities or social networks (e.g. such as political alliances or economic trade agreements) (Guerrero et al. 2015; Sayles and Baggio 2017). For example, protected area policies that ignore landscape connectivity and hydrology can fail to safeguard migratory species or maintain ecosystem functions that extend beyond a protected area's borders. Relational approaches to space recognize the interconnectedness of social-ecological systems and can lead to more effective landscape-level conservation strategies (Liu et al. 2013; Tedesco et al. 2023).

The way entities are conceptualized – be they species, ecosystems, or communities – profoundly affects who or what is considered in the design of a policy instrument (Pauly 2016; Moon and Pérez-Hämmerle 2022). A narrow definition of entities might focus solely on charismatic species or economically valuable resources, while a broader, relational view might consider entire food webs, including microorganisms, or incorporate cultural activities as integral parts of ecosystems (Gallegos-Riofrio et al. 2022; Gould et al. 2023). This expanded view, a feature of Healthy Country Plans, can lead to more holistic and effective conservation outcomes (Woodward et al. 2020).

Reductive approaches to time-space-entities

Reductive logics (Figure 1) are based on the premise that rules of separation, independence and extraction are possible, and acceptable, through the practice of objectification that creates 'entities' (Higgins and Higgins 2021). Objectification defines difference through separation, allowing the 'object' to become extracted from its context and subsequently simplified, valued and contrasted (Haila 1997). For example, the independent or interactive effects of a set of variables (e.g. protected area, species, carbon emissions, demographics) can be measured to determine the success of a set of sustainability outputs (e.g. the CBD's 30x30; SDGs).

These logics of separation, independence and the extractable isolation of objects can be applied

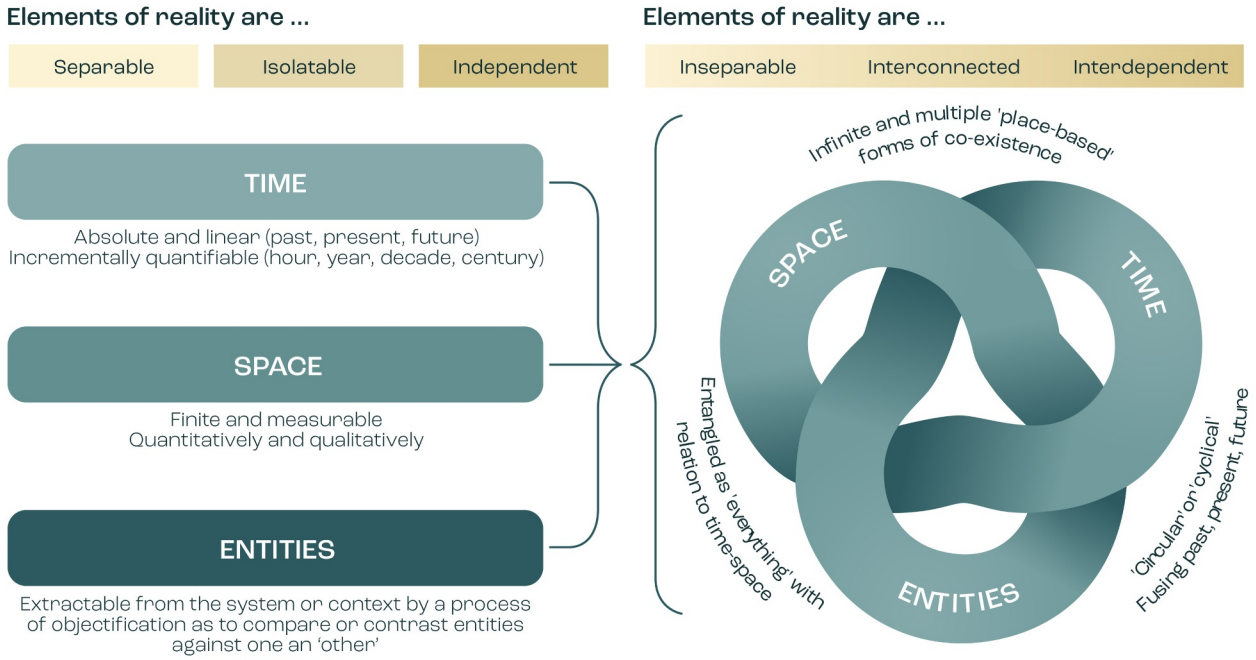

Figure 1. Contrasts reductive and relational approaches to reality, or worldviews, by the nature of time, space, and entities. On the left, elements of reality are viewed as separable, isolatable, and independent, with time seen as absolute and linear, space as finite and measurable, and entities as distinct objects for comparison, manipulation and hierarchy. The right side presents a more interconnected perspective, where time, space, and entities entangle to become inseparable, interconnected, and interdependent. Time is described as circular, space as infinite and place-based, and entities as entangled with all aspects of across multiple realities.

to more abstract concepts, like time and space, where time is rendered absolute and space as delimited (Capra and Luisi 2014). For instance, time as absolute can be construed using clocks and calendars (e.g. the Gregorian calendar) and thought of temporally or chronologically, as described by the linear relationship between past, present and future (Koselleck 2004; Andersson 2012; Ogle 2019). Time as absolute can be objectively measured by a linear 'clock-time' reality that conceives of time as a commodity of distinct and divisible units (i.e. decades, years, hours, milliseconds) independent of space or entities (Saunders et al. 2004). This conceptualization can be seen in phrases such as 'save time', 'kill time', 'take time', 'waste time'.

Space, under reductive logics, can become instrumentally valued by a quantitative measure, such as when it is described geographically or via coordinates (e.g. map/graph/territory). To illustrate, space can be ascribed value, whether it be physical (e.g. land and airspace) or virtual (e.g. cyberspace), whereby its properties can become described as productive, wasteful or empty (Burman 2017). Here, the significance of space lies not in its mere existence, but rather in its ability to serve specific needs. For instance, space can be ascribed qualifiers that are numerical (square meters), legal (property rights), economic (market valuations), social (sacred or symbolic of an equality gap) or subjective (remote, far, large) (Graham and Healey 1999; Wolford and Nehring 2015; Brown et al. 2019; Latham and Layton 2019; Beckert et al. 2021).

Relational approaches to time-space-entities

Relational logics (Figure 1) of time and space do not consider how things evolve or change *in* time (when) or *in* space (where), but rather how things change with respect to each other and with relation to what surrounds it (place) (Howitt 1993; Massey 2004; Rovelli 2018). In other words, spacetime is the composition of relations that entangle entities (Barad 2007; Rovelli 2018; Yunkaporta 2019). Unlike objects, relational logics posit that entities do not exist by and in themselves, but refer to assemblages of relations between events through time and space that entangle (who, what and how); also described as 'space-time-mattering' and 'vibrant matter' (Barad 2007, 2014; Bennett 2010; Rovelli 2018).

For example, a relational approach to endangered species conservation would not necessarily focus on area, or species, based targets. It would be concentrated on creating processes that integrate ecological, cultural and community-based values, knowledges and outcomes that not only benefit the species and their habitat but also fosters social cohesion and care; such as is accomplished through ceremony or the designation of totems (Harris and Wasilewski 2004; Di Giminiani 2013; DiNovelli-Lang 2013; Rose 2013; Craft 2018; Barlo et al. 2020; Coombes 2020; Gallegos-

Riofrío et al. 2021; Tynan 2021; Hernandez 2022; Gould et al. 2023). Additional examples of this approach include, cultural knowledge exchange in relation to the species in question, community-led restoration projects, and rights being ascribed to elements of land, water, people and species (Morris and Ruru 2010; Wilson and Inkster 2018; Barlo et al. 2020; Coombes 2020; Redvers et al. 2020; Stage et al. 2020; Tănăsescu 2020; No'kmaq et al. 2021 RiverOflife et al. 2021; Reyes-García et al. 2022; Tedesco et al. 2023;). Simply, if space-time-entities are entangled, their defining features, including their cultural significance, manifest on the basis of the nature of relations, rather than being reduced to individual objects, at specific times, in particular places (Le Bihan and Barton 2021; Weir et al. 2024).

Under the premise of inseparability, interconnectedness and inter-operability, the system is predisposed for decision-making and governance to be tactically based on process, such as through practices designed to build trust or place-based knowledge (Yates et al. 2017; Wilson and Inkster 2018; West et al. 2020). Considering process, in addition to targets, is crucial for enabling the cross-scale and multi-temporal decisions and actions that are required to sufficiently redress systemic problems such as climate change, biodiversity loss and social-ecological injustices because of the complex way in which processes can permeate systems (Craft 2018; Craft et al. 2018; Goldman et al. 2018; Artelle et al. 2019; Yunkaporta 2019; Walsh et al. 2021; DePuy et al. 2022).

Implications of logics for policy: the case of Te Urewera Act of 2014

To illustrate the practical implications of incorporating relational logics into environmental policy, we focus on a tangible case study: the recognition of Te Urewera as a legal entity in Aotearoa New Zealand. This case demonstrates how policy-makers can navigate a greater plurality of logics in a concrete, real-world context.

The Te Urewera Act of 2014 represents a significant shift from reductive to relational logics. For example, the ancestral homeland of the Tūhoe people, was the first to be legally recognized as a 'natural' entity under common law (Binney 2009; Tănăsescu 2020). Prior to this case, Te Urewera was protected by law as a national park for the benefit and use of the public. Yet, this designation of space was incompatible with Māori cosmovisions, which negate such a disembodied relationship between humans, lands and waters (Dancer 2021). In contrast to this reductive approach, the Māori worldview emphasizes reciprocal relationships among all entities, including peoples, gods, and natural elements like rivers and mountains, which are revered as ancestors (Morris and Ruru 2010). The new Act, however, recognizes Te Urewera as a legal entity with its own rights and identity, embodying a more relational approach (Table 2).

Legal transformation of reductive to relational logics *could begin* when Te Urewera was formally

Table 2. This table illustrates the contrasting approaches of reductive and relational logics across time, space, relation, and entities. It provides specific examples from the Te Urewera Act 2014 in Aotearoa New zealand, to demonstrate how relational logic can be applied in environmental policy as a legislative policy instrument. The Te Urewera case exemplifies a shift from a reductive logic prolific in common law, to a more relational approach that incorporates māori worldviews and relationships with Te Urewera as a place and living entity.

	Reductive Logic	Relational Logic	Te Urewera Act, 2014
Time	Linear (past, present, future) Categorized Quantified (hour, year, decade, century)	'Circular' Continuous/ Generational	Perpetuity Te Urewera is ancient and enduring, a fortress of nature, alive with history; its scenery is abundant with mystery, adventure, and remote beauty. For Tūhoe, Te Urewera is Te Manawa o te Ika a Māui; it is the heart of the great fish of Maui, its name being derived from Murakareke, the son of the ancestor Tūhoe.
Space	finite measurable area, volume, geolocation/ coordinates	Cross-scale 'place-based'	Te Urewera is a place of spiritual value, with its own mana and mauri. For Tūhoe, Te Urewera is their ewe whenua, their place of origin and return, their homeland.
Relation	Directional binary/categorical (on/off/in/out) hierarchical power relation	Reciprocal Degrees of obligation/ responsibility flat/ decentralized power relation	*Te Urewera expresses and gives meaning to Tūhoe culture, language, customs, and identity. There Tūhoe hold mana by ahikāroa; they are tangata whenua and kaitiaki of Te Urewera.* *Iwi and hapu with Te Urewera* Decision making affecting relationship of iwi and hapū with Te Urewera (1) The Board must consider and provide appropriately for the relationship of iwi and hapū and their culture and traditions with Te Urewera when making decisions …
Entities	Separate Independent Individual Competitive in time, in space, in relation to one and to the 'other"	Connected Interdependent Collective Function of time, space and relation	Te Urewera has an identity in and of itself, inspiring people to commit to its care. Subpart 3—Legal identity of Te Urewera and vesting of Te Urewera land Legal entity 11 Te Urewera declared to be legal entity (1) Te Urewera is a legal entity, and has all the rights, powers, duties, and liabilities of a legal person. *Note-entity has not been defined as person or human, although the same rights of a legal person are granted.

declared to be a legal entity* with all the rights, powers, duties, and liabilities of a legal 'person' because it expanded the possibility of ways in which Te Urewera as an entity could be related to, and with, beyond solely serving an instrumental purpose for the benefit of 'human' rights (New Zealand Government 2021). While the full implications of these legal developments continue to unfold (Tănăsescu 2020; Cribb et al. 2024), it is worthwhile examining the language expressed in *Te Urewera Act (2021)* regarding perceptions of time, space, and the nature of entities and beings involved. In contrast to reductive logics of separation, the *Te Urewera Act (2014)* acknowledges more relational approaches to time-space-entities by formally recognizing that for the Tūhoe People:

> Te Urewera has an **identity** in and of itself, **as** son of the ancestor Tūhoe, inspiring people to commit to its care as **ancient** and enduring, a fortress of nature, **alive with history**; its scenery is abundant with mystery, adventure, and remote beauty. In **respect to space, Te Urewera is a place** of spiritual value, with its own mana* and mauri* and for Tūhoe, their ewe whenua, their place of origin and return, their homeland. Te Urewera expresses and gives meaning to Tūhoe culture, language, customs, and id**entity**.

The *Act* formally recognizes relationships between ancestors, place and the living, and the inalienable obligations Māori have to their *rohe* (territory) across *wātea* (time/space) (Winter 2021); and 'recognizes the mana and intrinsic values of Te Urewera by putting it beyond human ownership' (New Zealand Government 2021). Consequently, this legal instrument supports political endeavors that aim to extend recognition of rights and legal standing to a broader range of entities, such as land, rivers, mountains, animals (including humans), plants, and spirits of the past, present and future.

In Aotearoa New Zealand, the inclusion of rights for Nature also served as a mechanism for addressing Treaty of Waitangi claims (Coombes 2020), representing a significant development in how to potentially restore and secure Māori relations and improve ongoing injustices stemming from colonisation (Salmond 2017). Additionally, the case created a legal precedent from which additional legislation recognizing the rights of Nature could emerge, such as the *Te Awa Tupua (Whanganui River Claims Settlement) Act 2017*, that recognises Te Awa Tupua as, 'a living and indivisible whole comprising the Whanganui River from the mountains to the sea, incorporating its tributaries and all its physical and metaphysical elements' (New Zealand Government 2022).

> **Note-entity has not been defined as person or human, although the same rights of a legal person are granted. It is important to note that there are criticisms of defining more-than-human entities as 'persons' at all because it limits the possible essence of their more-than-human Nature by our 'human' capacity for understanding and interpretation and action.*
>
> *** (Winter 2021* defines mana and mauri, as Māori metaphysical elements that animate all being – human and nonhuman, living and elemental – with respect-worthiness and potentiality)

This case illustrates how policymakers can practically incorporate relational logics through language into environmental policy instruments. Key aspects of this shift include the: acknowledgement of Te Urewera's inherent worth, moving beyond its instrumental value for human use; incorporation of Māori worldviews with the policy explicitly recognizing Tūhoe People's relationship with the land, including spiritual and ancestral connection; redefinition of governance where Te Urewera is now governed with a board that includes Tūhoe representatives; and shift in language and framing whereby the Act uses language that reflects relational concepts, such as describing Te Urewera as having its own 'mana' and 'mauri'. More relational approaches such as these serve as models that may lead to more inclusive and culturally appropriate policies, provide a framework for addressing social and ecological injustices, and offer new legal and governance models for environmental protection.

The case of the Te Urewera Act demonstrates how legal frameworks can create space for Indigenous worldviews and their complexity to be better accounted for in policy. These cases, however, should not be viewed as ideal or unproblematic manifestations of 'relational governance' (Coombes 2020). For instance, the Whanagnui River case, has been argued to indicate that a focus on legal personhood can sometimes deflect attention from critical issues such as sovereignty, land ownership, systemic injustice, and resource control (Coombes 2020). Similarly, legal recognition alone does not guarantee effective protection or meaningful inclusion of Indigenous perspectives into a more pluralist form of governance (Tănăsescu 2022), as can be seen in the 'constitutionalisation' of Nature in Ecuador (Tănăsescu et al. 2024) or Bolivia's Law of Rights of Mother Earth (Calzadilla and Kotzé 2018); nor does it automatically translate into effective environmental protection or social justice. The granting of legal standing, while possibly perceived as symbolically powerful, does not necessarily address underlying imbalances or drivers of environmental degradation, nor political, social or economic injustices.

Importantly, incorporating relational logics into policy instruments can present significant challenges. Policymakers must navigate complex geographic, linguistic, legal, political and cultural landscapes, balance diverse stakeholder interests, and develop new governance and regulatory structures (Weinstein

et al. 2019). For instance, the case of the Yamuna River in India illustrates the limitations of policy approaches. In this instance, despite the declaration of legal personhood with rights, the Yamuna remains amongst the most polluted rivers in the world (Eckstein et al. 2019; Samui et al. 2025). The need to redress embedded power structures and social and cultural inequality is also critical to consider in this process suggesting the need for practices that enable policy-makers to more readily evaluate and navigate a greater plurality logic, which we explore in the next section.

Pathways for navigating toward a plurality of logics

In this section, we explore practices that create space for more relational logics in conceptualizations of time-space-entities to emerge. These practices aim to balance reductive and relational logics by finding new connections and relationships between variables representative of and between time-space-entities to permit a greater plurality of logic to be included (Taylor et al. 2016; McDuffie and Poelina 2018; O'Donnell et al. 2020; Redvers et al. 2020; RiverOflife et al. 2021; Poelina et al. 2022; Spoel et al. 2023).

The integration of different logics allows for policies that adequately account for the complex interconnections between people, ecosystems, and cultures while still maintaining necessary structure and measurability (Thornton et al. 2012; May 2022). Effective policies often require a balance between relational and reductive approaches, adapting to the specific context and goals of the policy area. It is important to recognize that integrating different logics is an ongoing process and we recommend building in mechanisms for regular review and adaptation of policy frameworks as understanding evolves and new perspectives emerge (Figure 2). However, integration and expansion of relation logics requires also critically questioning and the underlying hegemonic and non-relational paradigm of 'nature' so that the shifts do not remain on a superficial level reinforcing the purely reductionist logics in environmental governance (Roland Host and Zegers 2025; Merçon 2025).

Acknowledge that both reductive and relational logics to time-space-entities have value

In co-constructing the bounds of time-space-entities, from a dominant reductive configuration (e.g. 30x30), to a more relational and place-based one (e.g. an increase in Indigenous tenure and place-based regional governance), one can employ the collaborative and improvisational 'Yes, and … ' technique (Milstein et al. 2023). 'Yes, and … ' technique serves as a methodological approach to explore new possibilities for defining policy boundaries by providing time and space for participants to potentially derail cultural and ideological assumptions through sense-making, reflection and communication (Milstein et al. 2023). This methodology encourages a deconstruction of approaches to bounding rather than immediate negation or dismissal of pre-existing notions and generates space to break from conventional thinking for the exploration of new possibilities in how time-space-entities may be (re)defined via co-construction (Weir et al. 2024).

In environmental policy contexts, 'Yes, and … ' can be applied when and where diverse perspectives meet to encourage participants to build upon rather than negate others' contributions. For example, when debating biodiversity conservation targets, a reductive approach might establish specific, measurable protected area targets. A 'Yes, and …' response would acknowledge these objectives while providing space to add relational consideration: 'Yes, we need 30% protected area coverage, *and* we must ensure these areas maintain cultural connection for local communities'. This technique creates a forum for participants to potentially challenge underlying assumptions through sense-making and reflection without immediate dismissal of existing frameworks (Milstein et al. 2023). Rather than positioning different logical frameworks as competing or mutually exclusive, this technique enables their complementary integration in policy development processes *or* serves to highlight where deep incommensurabilities between reductive or relational approaches to notions of time-space-entities may lie and must be specifically acknowledged and addressed.

In the time dimension, for instance, reductive logic often considers fiscal year planning and short-term measurable outcomes, while relational logic of time considers long-term ecological cycles and intergenerational impacts. To balance these approaches, policies can be designed to include both annual performance metrics and longer-term ecological indicators that span generations. For example, combining specific target dates with language about ongoing custodianship and perpetual care, such as in Healthy Country Plans in Australia, allows for measurable goals while recognizing the continual nature of environmental relationships (Moorcroft et al. 2012; Carr et al. 2017).

In the space dimension, reductive logic often strictly adheres to administrative and jurisdictional borders, while relational logics recognize and evaluate how ecosystems and bioregions transcend political borders. To overcome this divide, spatial boundaries can be reimagined by moving beyond strictly defined geographic coordinates to incorporate place-based

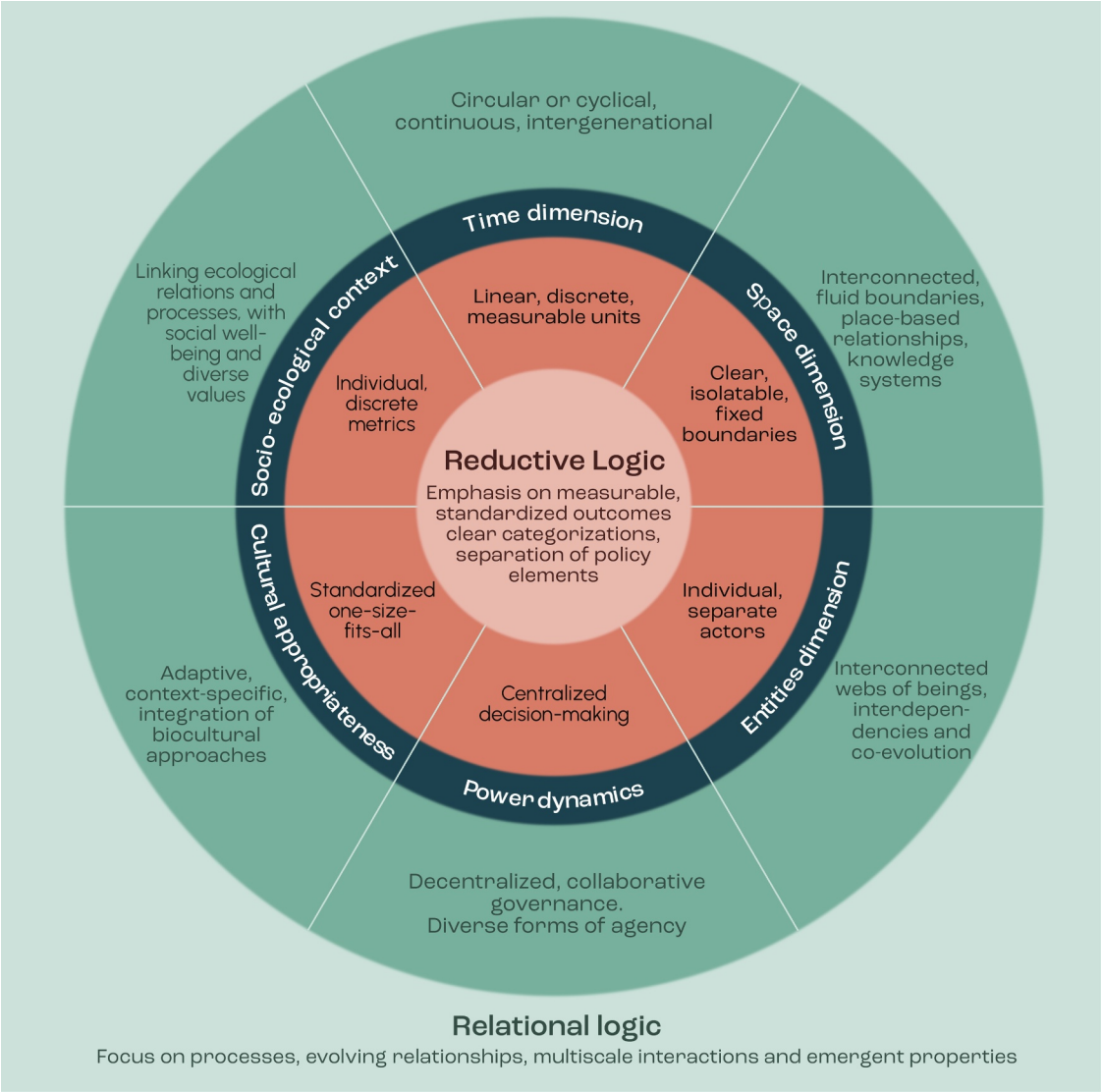

Figure 2. This framework contrasts reductive and relational logic for analysing and developing policy. Reductive logic emphasizes measurable outcomes, clear categorizations and standardized approaches while relational logic focuses on interconnectedness, emergent properties and evolving relationships. Time dimension: reductive logic considers fiscal year planning and short-term measurable outcomes, while relational logic of time considers long-term ecological cycles and intergenerational impacts. In reductive logic of space, on strictly adheres to administrative and jurisdictional borders, while relational logic of space recognizes and evaluates how ecosystems and bioregions transcend political borders. A reductive logic in the dimension of entities focuses primarily on human actors and institutions, while relational logic includes actors beyond the human (e.g. wildlife and ecosystems). For the dimension of power dynamics, reductive logic emphasizes centralized decision-making and expert-derived policies, while relational logic promotes collaborative governance and inclusion of diverse knowledge bases. In the dimension of cultural appropriateness, reductive logic applies standardizes, one-size-fits-all approaches, while relational logic aims to integrate and center local cultural practices, languages, and knowledge sources. For the dimension of social-ecological context, reductive logic treats social and environmental issues as separate policy domains, while relational logic considers complex interactions within and between social and ecological systems.

understandings. For instance, Integrated Landscape Approaches can reference specific locations while also acknowledging the interconnectedness and multifunctionality of ecosystems and cultural landscapes (Reed et al. 2020). This form of integrated approach is pragmatic in that it respects both administrative needs and holistic environmental perspectives.

In the entities dimension, reductive logic often focuses primarily on human actors and institutions, while relational logic includes actors beyond the human, such as more-than-human species and ecosystems. One can thus expand on the concept of entities by broadening the definition of relevant actors beyond individuals or distinct organizations. Consider how policies can recognize collective entities, more-than-human actors, and complex webs of relationships. This work may involve granting legal status to natural features (e.g. the Whanganui River as a legal entity) or explicitly including Indigenous people's ongoing relationships with the land.

While relational logics offer potential benefits for environmental policy, it is crucial to recognize that

they too can lead to perverse or destructive outcomes if not carefully implemented. For instance, an overly broad application of relational logic without proper safeguards could potentially obscure accountability by obfuscating individual responsibilities, lead to negative externalities (e.g. unsustainable levels of tourism) or allow for the exploitation of interconnected systems, Indigenous Peoples, local communities and marginalized groups (e.g. 'black cladding') (Van Noordwijk et al. 2023; Jones et al. 2024).

Account for power dynamics

Processes informed by reductive logic often emphasize centralized decision-making and expert-derived policies, while processes informed by relational logic promote collaborative governance and inclusion of diverse knowledge bases. By forming mechanisms of accountability to ensure responsibility is taken, we can seek to ensure the relevance of decisions being made and by whom, or what, in any given time or place.

It is important to examine critically how different logics distribute power in decision-making processes by questioning underlying assumptions, recognizing systems of governance are imbued with power, and evaluating relationships that trigger the perception and experience of difference, inclusion, and/or exclusion (Clement 2019). Power mapping techniques offer visual representations of power relationships and dynamics by identifying key decision-making forces (Schiffer 2007; Noy 2008). By making power structures, networks and assumptions explicit, policymakers can work to create more inclusive and equitable decision-making processes (Moon and Pérez-Hämmerle 2022).

In general terms, processes informed by reductive logic tends to centralize power into hierarchies (Keller 2019), while a relational logic typically diffuses power across time-space-entities to be shared and negotiated on the basis of respect (Harris and Wasilewski 2004; Brown 2012; Müller 2015; Bachrach and Baratz 2017). Relational power in governance is inherently context-dependent, manifesting as a network of relationships rather than a top-down force (Graham 1999; Azmanova 2018). In the case of Te Urewera, power moved from a reductive logic that recognized Te Urewera solely as a national park for the public benefit to a relational one that could respect a legal entity known by Tūhoe to be ancestral and based on place-in-practice.

Rather than advocating for a universal application of any singular logics, we propose a nuanced, place-based approach that critically examines power relationships in each specific context (DePuy et al. 2022). In practice, this means embedding mechanisms, such as power mapping or other forms of analysis into policy creation and evaluation (See McIlwain et al. 2023), to regularly evaluate whose voices are amplified or silenced, how decision-making processes are structured, and how different knowledge systems are valued in each unique policy context and the interrelations between these forms of power (Pauly 2016; Moon and Pérez-Hämmerle 2022).

This practice focuses on being responsible for the ways in which time-space-entities are acted upon, irrespective of the underpinning logic. Responsibility is an embedded practice within relational systems of logic, defined as 'recognizing the duty to deal with something' (Barlo et al. 2020). When we are responsible, we take accountability 'for what materializes, for what comes to be', making it critical that we consider diverse roles in constituting 'who' and 'what' comes to matter (Barad 2007, p. 361).

To illustrate, powers of logics refer to the dynamics between the logics underpinning the conceptualization of time-space-entities *and* their relations or respective contributions in a decision-making process (Mol 2002; Müller 2015; Blaney and Tickner 2017; Goldman et al. 2018; Botha et al. 2021; Molnár and Babai 2021). A power of logic refers to the relative abilities of time-space-entities, in association with their underpinning assumptions (i.e. reductive, relational) to bring about change (Müller 2015; Williams 2019). For instance, the degree to which time might play a role in decision making compared to relation or location or vice versa. Power in a decision-making process refers to the arrangements that influence decision-making processes (e.g. when and how bounded time-space-entities trigger a decision to be made or an action to be taken (Bachrach and Baratz 2017; Tabaczek 2019). Power is thus a set of abilities and possibilities capable of bringing about difference according to context (Jackson 1998; Müller 2015; Williams 2019; DePuy et al. 2022).

Different arrangements of power privilege particular conceptualization of time-space-entities and influence the ways in which they are materialized. Those in positions of decision-making power determine who/what is privileged in the making of decisions, where, when and why (i.e. the sets of assumptions underpinning the conceptualization of time-space-entities) (Rose 2012; Burman 2017; Turnhout et al. 2020; Thambinathan and Kinsella 2021; Gallegos-Riofrio et al. 2022; Reyes-García et al. 2022). Once again, it becomes imperative to dedicate political resources (time, space, entities) to evaluate power dynamics and examine the ethical implications of logics and associated processes that underpin all/any decision-making processes (Graham and Healey 1999; Rose 2012; Dépelteau 2013; Blaser 2014; De La Bellacasa 2017; Tuck and Yang 2021; Cortes-Capano et al. 2022; Tornel 2023).

Embrace culturally appropriate co-construction

Reductive logic often applies standardized, one-size-fits-all approaches, while relational logic aims to integrate and center local cultural practices, languages, and knowledge sources. The challenge here lies in negotiating a balance between the need for measurable outcomes and more holistic, relationship-based approaches. Integrating relational perspectives into existing policies and policy instruments will inevitably be a challenge for those that are inherently time-bound (e.g. political cycles) and space-bound (e.g. property lines, exclusive economic zones and political jurisdictions – local councils, catchment authorities, nation states). Further, the common practice of objectification and quantification of entities is important in defining success within these systems, and includes not only the existence but also the nature of entities (e.g. the carbon sequestration potential of a trees) (Tynan 2021; Moon and Pérez-Hämmerle 2022; Pérez-Hämmerle et al. 2024).

Boundary spanning methodologies, such as fuzzy cognitive mapping, have been shown to deliver effective ways to weave knowledge systems for more collaborative policy development in a culturally sensitive way (Badry et al. 2024). For example, Cree Elders in North America were invited to participate in identifying variables (e.g. spirit, respect, and knowledge sharing) as important for moose habitat (See Badry et al. 2024). Traditionally, a policy may have sought to achieve defined outputs within a defined timeframe and would be deemed successful or unsuccessful if it achieved those outcomes on the basis of space and/or time, such as the number of moose and area of habitat under protection by 2030. To elicit a more relational approach, fuzzy cognitive mapping across culturally diverse interest groups (e.g. Cree Elders and government officials), could help reveal what is, or was, excluded from mattering in moose conservation (e.g. spirit, respect and knowledge sharing), in addition to who might have been involved, the extent to which the relationships are based on trust, how they may have participated, which moose are tracked with GPS, when, where and why, and the actions between the moose, other entities and place as a whole (Badry et al. 2024). It becomes imperative then to pay attention to how the logic underpinning identified variables are reductively and/or relationally bounded and practice re-envisioning boundaries through a co-constructive process, with a particular focus on what/whom delineate those boundaries (Pauly 2016; Raymond et al. 2021; Moon and Pérez-Hämmerle 2022; Badry et al. 2024; Weir et al. 2024).

Contextualize social-ecological systems with place-based knowledge

Reductive logic often treats social and environmental issues as separate policy domains, while relational logic considers complex interactions within and between social and ecological systems. Prioritizing the inclusion of place-based knowledge, particularly from Indigenous Peoples and local communities, ensures that policies are grounded in deep understanding of specific contexts and long-standing relationships with the immediate environment.

Indigenous Peoples and local communities represent the most place-based source of knowledge and mechanisms must be developed to ensure meaningful participation, leadership and power-sharing in decision-making with respect to how time, space and entities are defined in policy-terms. The respective peoples, languages and biocultural practices of care should therefore be centered in all aspects of decision-making contexts, including problem and solution-framing (Woodward et al. 2020; Weir et al. 2024). To create an environment conducive to challenging the status quo and invite transformation, a number of methodologies can be used with the intent to center marginalized groups and their perspectives and (re)evaluate fundamental biases, terminologies, and discriminatory processes (Tuhiwai-Smith et al. 1999; Rose 2004; Todd 2016; Blaney and Tickner 2017; Kings 2017; Ndlovu-Gatsheni 2017; Goldman et al. 2018; Clement 2019; Held 2019; Domínguez and Luoma 2020; Botha et al. 2021; Gram-Hanssen et al. 2021; Kramm 2021; Thambinathan and Kinsella 2021; McAllister et al. 2023; Weir et al. 2024). For instance, knowledge-exchange methodologies, such as participatory action research, can facilitate co-learning between multiple actors in a community (Bradbury and Reason, 2008), while decolonizing methodologies, can serve to challenge and reframe western-centric paradigms and colonial objectives (Tuhiwai-Smith et al. 1999) and Indigenous methodologies function to help ensure Indigenous sciences and ways of knowing and being are acknowledged, valued, and respected (Wilson 2008; Chilisa 2019). By employing a diverse toolkit of methodologies, policymakers can work towards creating more inclusive and equitable environments for environmental policy.

Understanding knowledges, how they are situated, and the extent to which they are place-based can assist in determining how to balance the operationalization of reductive and relational logics and return scalable flexibility to environmental policy (Merçon et al. 2019). Having found recent traction in educational theory, place-based knowledge is a conceptualization of knowledge that is located and embedded in the landscapes, languages and the

collective consciousness of communities and individual experiences of its members (Ortiz 2007). Fundamentally, recognizing how knowledge and language is situated in, and to, 'place' can support a well-structured and participatory process that can lead to improved outcomes because it ensures a range of worldviews and expertise, particularly of those entities interacting with and co-creating places (Durkalec et al. 2015; Krause et al. 2015; Bignall et al. 2016; Woodward et al. 2020; RiverOflife et al. 2021; Reihana et al. 2023).

Conclusion and future directions

To transform environmental policy, several key takeaways emerge. Relational logics offer a complementary approach to reductive logics, potentially leading to more holistic and inclusive environmental policies by challenging the boundaries of how time, space and entities are conceptualized. Specifically, the concept of time-space-entities provides a useful framework for understanding and operationalizing relational logics in policy contexts to accommodate non-linearity, complexity of scale and more-than-human actors. We recognize, however, that incorporating relational logics may require significant shifts in legal frameworks, policy-making processes, and policy language. Importantly, while relational logics share some similarities with Indigenous relationalities, they are not identical and not inherently representative of Indigenous People's worldviews, knowledge systems, values, nor their embodied experiences (Hunt 2014). Relational logics, as discussed here, represent a broader conceptual framework that can be applied in various contexts, while respecting and learning from Indigenous wisdom. Therefore, the leadership and engagement of Indigenous people in the appropriate application of logics surrounding time-space-entities into new policy and governance structures and processes is vital. While we argue for increased consideration of relational logics in environmental policy, we recognize that advocating for their universal application would ironically constitute a reductive, universalizing move. Instead, we propose a context-sensitive and situated negotiation, where the balance between reductive and relational approaches is determined by the specific needs and characteristics of each policy situation. This approach acknowledges the value of both logical frameworks while avoiding the pitfall of replacing one universal system with another. As such, the practical implementation of relational logics in policy remains an evolving field, requiring ongoing experimentation, evaluation, and refinement. Future research might explore how different frameworks of logic interact in specific policy contexts, examine the institutional conditions that enable or constrain pluralistic policy approaches, and develop methods for evaluating the outcomes of policies that incorporate both reductive and relational logic systems. Ultimately, addressing the complex social-ecological challenges of the 21st century, from climate change to biodiversity loss to social-ecological justice, requires governance approaches that can accommodate diverse worldviews, knowledge systems, and values (Merçon 2025). By fostering greater plurality in the logical frameworks that underpin environmental policy, we can work toward more adaptive, inclusive, respectful, and effective responses to the existential challenges.

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