Perspective

Unearthing assumptions and power: A framework for research, policy, and practice

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https://doi.org/10.1016/j.oneear.2024.01.003

SUMMARY

Addressing complex problems like biodiversity loss and climate change will likely fail to respect diverse worldviews, knowledge systems, and values unless underlying assumptions and power are explicitly recognized, accurately situated, and carefully analyzed. Assumptions and knowledge about the world, known as onto-epistemologies, underpin all problem and solution framing. Yet, practical information about the onto-epistemological assumptions themselves, associated power dynamics, and principles to support more respectful engagement with diverse worldviews and knowledge systems remains elusive within and across research, policy, and implementation. We provide a framework that encompasses real, relative, and relational assumptions and situate them with respect to one another using worked examples with an emphasis on biodiversity conservation. Finally, we offer five principles to guide research, policy, and implementation practices by (1) situating assumptions, (2) considering power dynamics, (3) respecting (in)commensurabilities, (4) (re)framing assumptions with the intent to create space for inclusion, and (5) practicing onto-epistemological analytics often and carefully.

INTRODUCTION

We urgently need informed actions to contend with systemic problems, such as biodiversity loss and climate change, across scales.[1] Many organizations, including intergovernmental institutions such as the Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), specify the need for research, policy, and implementation to be pluralist, inclusive, and equitable of diverse worldviews and knowledge systems to adequately and ethically address systemic injustices. These approaches are called on to reduce problematic processes that continue to lead to the exclusion, marginalization, and oppression of many, such as Indigenous and First Nations Peoples, local communities, women, countries of the "Global South," small island nations, and more.[2–9] Addressing inequalities in practice across scales, however, is challenging, in part due to the complexities associated with understanding and situating different worldviews and forms of knowledge.[10] This challenge intensifies when social and political structures privilege some worldviews and knowledge systems (i.e., onto-epistemologies) over others, creating power dynamics that influence the degree to which people are able to express their authentic selves and realities.[4,11–14] Nonetheless, we must respond to these challenges if we seek a more equitable, sustainable, and just world[7] and propose that one way of doing so is by examining the origins from which knowledge is produced when making sense of the world and the power dynamics shaping these processes.[13]

The importance of being more inclusive of diverse worldviews and knowledge systems has been put forward many times but efforts have largely failed to remove the structures underpinning the injustices we must redress. We have reflected on this failure and strive to go beyond the recommendations that have been made to date, noting that we cannot prevent the same patterns of injustice from occurring but offer a framework in an attempt to reduce the harm or risk of practices that are excluding and/or oppressive. We do so by formulating a language and logic that dissects aspects of research, policy, and practices in ways that enable underpinning assumptions to be specifically addressed, monitored, and challenged.

In this perspective, we aim to create greater awareness of the onto-epistemological assumptions that underpin worldviews and knowledge systems and explore the consequences of power imbalances. We go beyond outlining the need for diversity or inclusivity by taking a pragmatic approach to "framing" realities in a way that challenges the notion that onto-epistemologies are static, entrenched, and discrete from one another while acknowledging the influence of power and politics.[15,16] We use the term "frames of reality" to allow for and imply multiplicity, plurality, and dynamism. The terminology permits frames to be thought of as fixed, as well as transformative, and serves to inspire a possible sense of agency by (re)situating frames while accounting for incommensurability (i.e., where worldviews and/or knowledge systems do not align). Further, we encourage a sensitive and respectful approach to be taken by presenting guiding principles with regard to (in)commensurabilities as they

arise (i.e., the degree to which there are common measures between differences).[17]

The frameworks and guiding principles offered serve as tools to enrich dialogues in practical ways. We do not suggest that they will eliminate systemic issues of exclusion or oppression but offer them to make visible the invisible assumptions that underpin elements of decision-making.[18] Thus, this perspective aims to be an entry point to enable observations, senses, and feelings based on diverse worldviews and knowledge systems to become an informative, practical, and accessible part of research, policy, and practice. Necessarily, we cover a large body of scholarship, requiring us to favor breadth over depth. The fields and disciplines concerned with ontology (i.e., worldviews), epistemology (i.e., knowledge), and power (e.g., deontology, ethics) consider multiple conceptions of realities (e.g., philosophical, sociological, anthropological, political, etc.), the power and ethics of knowledge systems, and the consequences of marginalization and oppression (e.g., colonization).[3,11,19–42] We acknowledge that we only scratch the surface in articulating how deeply theories and debates regarding worldviews, knowledge, values, and power matter.

Here, we synthesize a highly complex field, grappling with the onto-epistemological assumptions that underpin realities and knowledge systems into a sense-making framework that we consider has meaning and value to biodiversity conservation and beyond.[43] This paper is organized into three main parts. The first part provides a summary of onto-epistemologies, describing what they are and how they frame realities and knowledge systems. We present frameworks that situate them to show their influence and pervasiveness in defining and informing social processes. The second part explores how power privileges different onto-epistemologies, emphasizing why responsible approaches in examining power are critical. Using worked examples of biodiversity conservation research, we highlight the dynamic interplay of power within and between onto-epistemological interactions. In the final section, we present five guiding principles to support a more nuanced understanding of diverse worldviews and knowledge systems by (1) situating assumptions, (2) considering power dynamics, (3) respecting (in)commensurabilities, (4) (re)framing assumptions, and (5) practicing onto-epistemological analytics. These principles serve to help unearth the theoretical and practical implications of the assumptions that underpin our worldviews and knowledge systems and bring their "messiness" to light in the context of research, policy, and practice.

ONTO-EPISTEMOLOGIES: HOW ASSUMPTIONS FRAME REALITY

The term onto-epistemology encapsulates the entangled nature of ontology (i.e., what exists) and epistemology (i.e., what is "known" to exist and *how*).[44,45] Onto-epistemological assumptions determine how perceptions of realities are constructed, meaning is derived, and how realities are interacted with and why.[45,46] In broad terms, onto-epistemological assumptions frame realities by defining what we assume is "real" and how we "know" it to be real.

Together, the assumptions we make about realities and knowledges come to influence the ways in which we experience and "navigate" worlds. Onto-epistemological assumptions set the stage to explain how different forms of knowledge come to be, while social processes and power structures legitimize them, such as those derived from classical scientific methods (e.g., physics, chemistry, biology), procedural experience (e.g., medicine, engineering, teaching), and Indigenous ways of knowing (e.g., story mind, pattern mind, kinship mind).[47] They attract the creation of particular forms of knowledge (e.g., seeking information that is objective [e.g., patterns of species richness], subjective [e.g., prioritizing conservation investments], or intersubjective [e.g., caring for Country]). Not understanding or paying attention to these assumptions that define our realities, or how they function, makes aligning, integrating, and situating knowledge for problem solving challenging, especially under circumstances where power relations are unequal.[11,15]

While many different and overlapping onto-epistemologies exist, we focus on three encompassing framings and how they interact: real, relative, and relational. As an orienting overview (see Figure 1), a realist framing asserts that aspects of a reality are objectively observable and measurable. A relative framing asserts that observable and measurable aspects of reality are subjective and multiple. A relational framing asserts that realities are emergent and dynamic, whereby observation and measurement occur intersubjectively with respect to the system(s) as a whole and shape it. While the underlying ontological assumptions are quite different from one another, the epistemological boundaries between them are fuzzy, with interrelations and overlaps between frames.[48] Of course, they do not function as discrete "bins" of assumptions or binary categorizations[48]—there are complementary elements between them.[49] Neither do these three framings encompass or frame all onto-epistemological possibilities and philosophical, social, cultural, political, and ethical dimensions.[11,15,19–22,31,50–60] What they do show, however, is the complexity of onto-epistemological assumptions and their role in understanding and interacting with the worlds around us, which we explore further below.

Realist framing

In the realist frame, assumptions are commonly applied to identify, describe, and modify the components of a system that can be described as one reality (Figure 1, 1) (e.g., as applied in construction, medicinal surgery, taxonomy). Under this frame, knowledge is often gained through a Popperian null-hypothesis testing paradigm.[63] One of the main assumptions of realist framing is that reality is objectifiable and "out there," existing independently of the observer, who can technically and, at times, precisely identify, define, catalog, and empirically measure elements of reality in a neutral, typically objective, way.[44] In essence, the focus is on the process of determining objective definitions and measurements of reality, which are assumed to exist independently of the (separated) observer. Examples of observer-independent phenomena of reality include force, mass, gravitational attraction, atoms, photosynthesis, the solar system, and plate tectonics.[38] Realist assumptions in natural history, biology, ecology, and, most recently, conservation parameterize the object of their study (e.g., taxonomy, genomics, species interactions, or nutrient cycling) using confirmable and generalizable definitions, terms, measurements, and standards of error. System knowledge viewed through a realist lens is

Onto – Epistemologies: how real, relative and relational assumptions frame realities
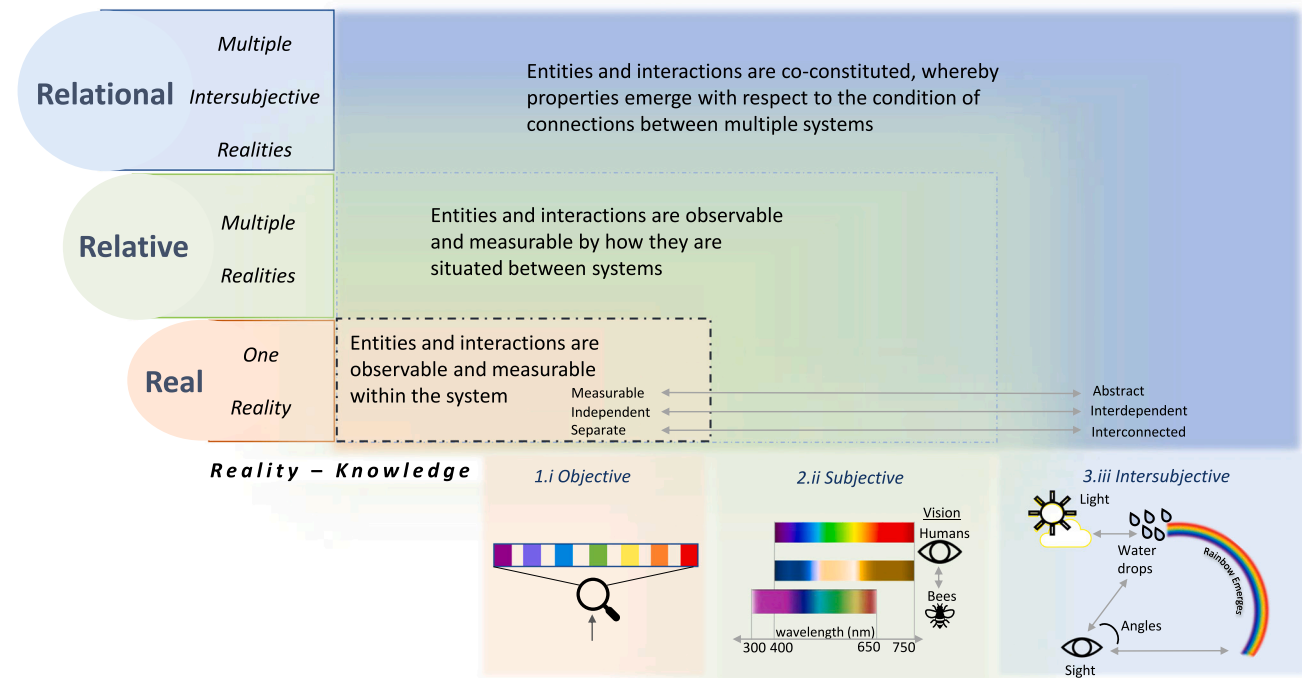
Figure 1. Onto-epistemologies: How real, relative, and relational assumptions frame realities
The distinctive framing between real, relative, and relational ontologies that define reality (see y axis) become fuzzier as the objective (1.i), subjective (2.ii), and intersubjective (3.iii) natures of their associated epistemologies or assumptions about knowledge regarding reality/realities become known and the limits become apparent (see x axis). Collectively, onto-epistemological assumptions serve as a lens through which we can make sense of the world around us. Objective knowledge requires the subject and the object to be separate and seeks to define and measure (e.g., separate and categorize colors). Relative knowledge is multiple/subjective and seeks to compare and contrast (e.g., vision by different wavelength receptors and experiences, as illustrated by differences between taxa, such as bees and humans, and within species, such as human colorblindness). Relational knowledge is multiple/intersubjective and seeks to contextualize and interrelate (e.g., the conditions from which a rainbow emerges is interdependent between a number of factors [i.e., light diffracted by water drops and visible at particular angles to an eye that is neurologically receptive to the visible light spectrum]). The utility of each frame can be sensitive to scale, in which switching frames to be more realist or relational becomes more practical. Complex problem-solving across real, relative, and relational frames can be done in interdependent and complementary ways so long as their underpinning differences are explicitly understood.[61] Problem-solvers can then test the assumed ability for each frame to find and explain useful information and meaningful solutions for the complex problems being addressed.[62] The utility of each frame can be sensitive to dimensions of scale because a point can be reached where scale makes switching frames more practical. For example, at some point, a realist frame can become limiting because of its inherently reductive and mechanistic parameters and requires a wider scope to account for emergent complexity. A more holistic view can be provided by a relative or relational reframing by permitting increasing levels of multiplicity and inter-/intra-connectivity to explain phenomena. Such switching has been shown in the field of physics when studying macro- and microscales of the universe (e.g., theory of general or special relativity and relational quantum mechanics). Conversely, relative and relational framings can become overly complex and need to be capped, consolidated, and reduced for knowledge to be made practical (e.g., rules of thumb for ecological stewardship).

measurable, founded on precision, replicability, and reliability of clearly and systematically delineated entities, properties, and processes.[64] This knowledge system seeks objective, measurable, and systematic parameters.

Through the realist lens (Figures 1, 1), enhanced understanding comes from improving observations, instrumentations, and/or analysis by breaking the problem down into component parts (e.g., as is used for Newtonian mechanics, molecular biology, nuclear energy, surgical medicine).[61] Deconstruction and reductionism permit each component part to be researched, governed, or enacted upon in isolation before reassembling knowledge for improved system comprehension.[65] Research seeks to define and describe properties of entities and point-for-point relationships between each of the disparate entities of the system such that targets, actors, and actions can be identified.[65] Policy seeks to govern based on choosing targets, actors, and actions that are assumed to have predictable and/or controllable interactions. Implementation seeks to enhance in-

terventions by acting on objective measures and improving the precision, resolution, and/or instrumentation of actions to increase efficiency of outputs.[1]

Looking at a conservation example, realist framings would include language and concepts that are measurable and defined. Research could focus on the distribution and viability of species, the threats that are causing declines, and the likely abatement of those threats based on empirical evidence from field surveys. Policy could propose the areas and locations needing management to stop extinctions by 2030.[66] Implementation could involve area-based conservation actions to reach global targets.[67,68]

Relativist framing
In the relativist frame, assumptions are commonly applied to compare elements within or between different systems that can be described as multiple realities (Figure 1, 2) (e.g., as applied in economics, anthropology, geography). One of the

main assumptions of relative framing is that reality presents itself subjectively, such that empirical data are dependent on the frame of reference or perspective of the observer.[69] For example, fluid concepts like gender, sexuality, the value of money, the desirability of a consumer product, wilderness, or remoteness comprise observer-relative features, which depend on the observer or experiencer for their assumed properties.[70] This onto-epistemological positioning acknowledges differences within those concepts (e.g., differences in gendered/cultural requirements to be a particular body shape) that make definitions, measures, and experiences between realities subjective.[38] In national environmental policy, for instance, the relative value bestowed upon wildlife can have different but very real effects. In Australia, policies provide native wildlife (e.g., Tasmanian devil, *Sarcophilus harrisii)* with funding for protection, while non-native wildlife (e.g., red fox, *Vulpes vulpe*s) may have funding allocated for their elimination.[34] In the United States, it is a federal offense to kill its national bird, the bald eagle (*Haliaeetus leucocephalus*), but legal to fell the national tree (the oak, genus *Quercus*). Due to relative framing being adept at dealing with a subjective lens, it is useful when seeking to compare and contrast physical objects, as well as socially constructed experience (e.g., color as a physically produced experience determined by cones and rods in the eye or color as a linguistic experience whereby English distinguishes the color green as separate from the color blue, unlike in Japanese, where the color is blue-green). System knowledge(s) through a relative lens is gained comparatively with an emphasis placed on the subjective nature of reality.

Through the relative lens (Figure 1, 2), enhanced understanding comes from comparing observations, instrumentations, and analysis by component parts with one another by changing reference frames. Comparison permits research, governance, and interventions to be informed as, and by, points of reference. Research seeks to differentiate targets, actors, and actions, to permit meaningful comparisons to be made among them. Policy seeks to prioritize between targets, actors, and actions on the basis of their relative differences and subjective importance. Implementation seeks to direct measures differentially to increase efficiency of different objectives.

Returning to the conservation example, relativist framings would compare particular entities and interactions between systems. Research could focus on the benefits of conserving a particular area relative to another. Policy could propose a distribution of resources to abate threats to species proportional to their impact. Implementation could involve relative investment, such as distribution of resources based on a project's relative size, location, importance, and area.

Relational framing

In the relational frame, assumptions are commonly applied to (un)empirical data, using equations and patterns, to further understand systems that involve complex, dynamic, and interactive processes of systems that can be described as multiple, intersubjective, realities (Figure 1, 3) (e.g., as applied in biogeography, thermodynamics, political ecology, socio-ecological custodianship). The main focus is performative rather than observational, mainly because reality is assumed to emerge as an intersubjective product of inter- and intra-actions.[45] Here,

there is no observer per se because all entities are actors and participate, thereby becoming responsible for the emergence of properties and relationships in their own right.[7] For example, to understand the behavior of a species, a relational framing would not permit the species to be "observed" or studied in isolation from the ecosystem(s) it inhabits (e.g., a laboratory) because the ecosystem itself is considered to be formative of not only species behavior but the individual organism—and vice versa. This assumption lies at the heart of a relational framing that asserts humans are a part of nature and that social and ecological environments cannot be considered as separate or distinct entities and must be considered as one.[12,41,42,47,71,72] Rather, a relational framing is encompassed by a focus on continuous and reciprocal interactions.[47,72,73] For instance, species co-evolve on the basis of dynamic geographic conditions that form ecosystems[74]; thermal dynamics is understood by giving attention to the interplay between temperature, energy, and material properties[75]; and political ecology is influenced by inter- and intra-actions between and within social and physical elements that in turn embody power relations that feedback into the system, thereby shaping it.[11] System knowledges are based on probability and incompleteness because complex interactivity that produces reality is dynamic and emergent.[69,76]

Through the relational framing (Figure 1, 3), understanding develops via emergence, having the potential to become more than the sum of its parts due to the inherent complexity that arises from non-linear, non-causal, interrelated, and dynamic phenomena. Research seeks context-dependent variables, or agents, that influence actions and relations. Policy seeks new ways to account for and prepare for emergent conditions based on synergies and incompatibilities between targets, actors, and actions.[36,66] Implementation processes seek to enable multidimensional actions with precautionary objectives,[59] inherently limiting expressions of precision and predictability in favor of holistic, dynamic, and comprehensive types of interventions and forms of evaluation to increase efficiency of impact and respond to the unexpected.[62,65,77]

Recalling the conservation example, relational framings would characterize inter- and intra-actions between multiple, intersubjective, systems. Research could seek to investigate how biodiversity loss relates to socio-economic drivers. Policy could propose that international conservation projects must be accountable to place-based mechanisms created by, or with, local actors. Implementation may be enacted with the intention to improve human-nature connection by enabling, or discouraging, particular forms of access, use, and activities.

HOW ASSUMPTIONS FRAME RESEARCH, POLICY, AND PRACTICE

We explained how onto-epistemological assumptions play a fundamental role in framing realities and now go further to show onto-epistemological assumptions and research, policy, and implementation as visually distinct from one another (Figure 2). Importantly, frames, like research, policy, and implementation, are not mutually exclusive of one another in either theoretical or practical terms and have the potential for dynamic interplay, creating unique and diverse overlaps and interfaces. For example, species prioritization as a topic of research, policy,
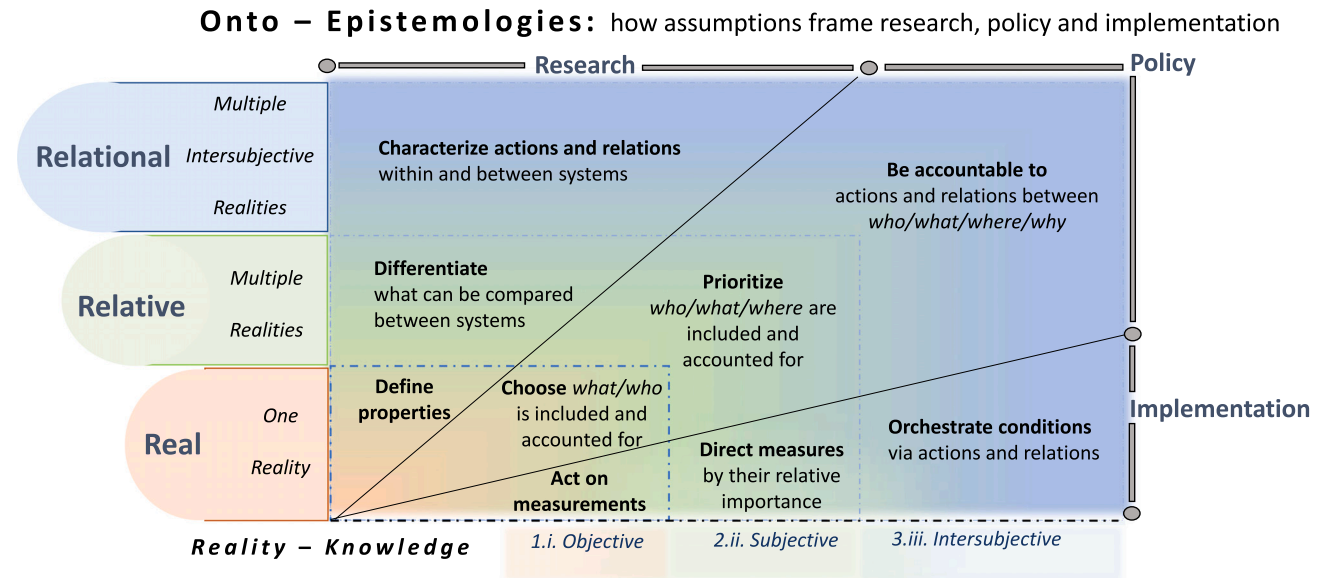
Figure 2. Onto-epistemologies: How assumptions frame research, policy, and implementation
Real, relative, and relational frames influence the intent and function of research (to define, differentiate, and characterize), policy (to choose, prioritize, and be accountable to), and implementation (to act, direct, and orchestrate). In the case of addressing biodiversity conservation for example, real, relative, and relational frames influence the focus of biodiversity research (genetics, species, ecosystems), policy (availability, access, conduct), and implementation (insurance, management, care). Recognizing the different but often complementary natures of onto-epistemologies can assist in situating different knowledges to enable their consideration across research, policy, and implementation. For example, to situate realist assumptions (1, i), a number of questions can be asked. What has been observed, measured, and defined (e.g., genomes, species, ecosystem types)? What is the consensus regarding how observations are made, measured, and defined, and who decides (e.g., to what extent does addressing biodiversity loss using gene-, species-, and ecosystem-specific knowledge resonate)? What objectively measurable actions can be taken to maximize output efficiency (e.g., what forms of data, methods, or analysis are lacking)? To situate relative assumptions (2, ii), one could ask what is being compared and how is/are they being differentiated (e.g., diversity, richness, extinction risk)? What is the consensus regarding how prioritizations are being made and measures justified (e.g., is a focus on diversity, richness, risk disputed)? What measures can be made on what/whom and to what scale for effective outcomes (e.g., do resources need to be allocated elsewhere or in different ways)? To situate relational assumptions (3, iii), one could ask what actions and relations (i.e., factors) are emphasized as influential to conditions and are called to be reexamined (e.g., human-nature, socio-economic, socio-political relations)? What is the consensus regarding the nature of interactions and relationships that require attention and engagement, and why are they important? (e.g., What are the relationships being debated and called to change? What suite of actions can be orchestrated to enable, evaluate, and adapt to emergent conditions? What forms of conduct are necessary to transform the socio-ecological environment?)

and/or implementation can draw upon objective measures of species distribution, relative measures of what to prioritize, and relational measures to account for the requirements of bio-cultural relations in different combinations at any given time. This "messiness" becomes compounded once inconsistencies and divergences of interest, resources, and values are factored in. In other words, the jostling of onto-epistemological framings within and across research, policy, and implementation occur through a continuous contestation of power.

ONTO-EPISTEMOLOGIES: ASSUMPTIONS AND POWER

With such different onto-epistemologies in mind, imagine being involved in the task of co-developing policies and targets and having to make decisions about what actions need to be taken. Whose worldviews, knowledge systems, and values should factor in? When, how, and why? And which onto-epistemological assumptions will be engaged, aligned, misaligned, or dismissed in the process? And who decides? Although different onto-epistemologies exist, it does not mean they are all fairly or equally recognized or included in decision-making processes.

The scholarship on power and responsibility is substantial, due to the importance that power dynamics has in determining whose onto-epistemological realities and values are legitimized, vali-

dated, persecuted, or exterminated.[11,19–31,33–37,39–42,78–80] We include a brief overview of the topic, acknowledging the nuances of politics pertaining to onto-epistemology. Contemporary scholarship focuses on, but is not limited to, ontological hybridization, sovereignty, decolonization, critical race theory, feminism, political ecology, and more.[11,18–31,33–37,39–42,78–86] To keep within a scope appropriate for a general audience, we offer a brief introduction on matters of onto-epistemology in the context of power. Importantly, we note that when we refer to Indigenous peoples or local communities or aspects of Indigenous onto-epistemologies, we do so in plural terms to reflect their diversity and multiplicity and do not mean to imply that they are singular or homogeneous across First Nations Peoples or cultural groups.[42] We also would like to acknowledge and strive to be respectful of the important case that Indigenous scholars have made showing that Indigenous onto-epistemologies are alive, performative, intricate, and representative of legal orders through which Indigenous peoples throughout the world are fighting for self-determination and sovereignty.[31,39,41,51,72,87–90]

In this section, we examine how power dynamics can affect onto-epistemological assumptions themselves, as well as broader social processes that inform the political landscape in which assumptions are negotiated.[11,19–22,30,31,53,91] The political landscape influences the extent to which onto-epistemologies

can, and are, expressed, ranging from acceptance toward diverse worldviews, knowledge systems, and values to genocide.[19,20,53,92] Here, we build the case demonstrating why consideration of power dynamics is vital to address for biodiversity conservation and beyond.

Power within onto-epistemologies

Onto-epistemologies are imbued with power, in how they are developed and how they are practiced. This power influences not only the onto-epistemology itself but also what properties, actions, or relations frame practices, decision-making, and problem-solving.[15,22,23,27,30,51,60,91,93–96] For example, factors involved with decision-making, like what or who has agency, can be an issue of onto-epistemological origin. For instance, in many Indigenous onto-epistemologies, Nature itself, as the land, sea, plants, animals, and spirits, is given authority and agency as part of decision-making processes. To illustrate, Aboriginal practices are interrelated with "Country," which is imbued with the power to determine when specific practices or acts can take place. To elaborate this in the context of cultural burning:

> Poppy showed me a second test where you run the grass through your hand to feel if it is ready. If the feeling of warm and dry runs through your hand then it is ready to burn. If it is cold and moist, then basically it is too early to burn. The trees tell us roughly what time we burn and then the grass indicates the exact right time. If there is no grass where there is supposed to be grass, then you need to rely on the soil and the trees … If you don't know the trees then you will never know how to apply fire the way Aboriginal people have done to look after the land." (Steffensen, 2020, p. 61, 64)[97]

In another example, consider the onto-epistemological assumption that water is assumed to exist only as a material resource, or H_2O, that can be abstracted from its social context or "rendered technical."[98,99] Under an onto-epistemological assumption of water as a resource, it is possible to understand water as inanimate (i.e., disempowered) and existing for human use, management, or manipulation.[41,99] In contrast to onto-epistemologies of water as a resource, onto-epistemologies of water as lifeblood lead to an understanding of water as living, interconnected, and autonomous, connecting diverse beings and foregrounding water's health and vitality.[42,100] Under such a framing, water as lifeblood is inextricably (and relationally) linked to human bodily health, eliminating any notions of separation between the water and human beings.[39] As Cree elders know it, "We are the water, and the water is us."[41,101]

Differences in onto-epistemological assumptions can also influence the extent to which individuals and groups would be willing, or even able, to engage in problem-solving processes. For instance, processes that represent colonial rule and practice might be challenging for First Nations people to engage in because of the way in which decision-making powers are limited (e.g., to one deity or human).[88,102,103] In addition, some Indigenous ontologies are in many cases lived through, sustained by, and accessible only via their respective language and place-based concepts. To illustrate, framing a sacred relationship in a different, at times more restricted, language or in the wrong place

(e.g., a capital city or administrative hub) may subvert the onto-epistemological meaning and spirit of the relationship itself, extinguishing it to invisibility or non-existence.[88,104] Further, not every individual member of a community has the right to access all forms of knowledge, such that knowledge is decentralized, shared, and equitably distributed across members within a group (e.g., men, women, elders).[104] Ultimately, the power associated with any onto-epistemologies can come to determine what or who is empowered to exist and how and the rules that underpin forms and sharing of knowledge.[19,20,25–28,30,31]

Power across onto-epistemologies

When broader social and policy practices and processes fail to consider, and respond to, the roles and influences of different onto-epistemologies, efforts for collective action can become ineffective because of incommensurable, misaligned, absent, and/or unknown assumptions. For example, authority might be ascribed to certain forms of knowledge, such as numerical data from surveys, written reports, or traditional ecological knowledge, which is shared orally and contains information through story-telling and metaphor.[104–108] Such authority can compound power inequalities and reinforce questions of legitimacy. For example, notions of legitimacy can constrain the development of frameworks (e.g., biodiversity conservation agendas) because of different onto-epistemological positions about what biodiversity change matters most and why or how to respond to species loss.[109] Prioritization can be different based on onto-epistemological premises where a species can be representative of onto-epistemological assumptions that make it sacred, invasive, critically endangered, all of the aforementioned, or none of the aforementioned (i.e., species blindness)[110–113] or a wicked combination.[74,76] In sum, broader social processes can run into issues of onto-epistemological representation, where over-, under-, a lack of, or misrepresentation of particular assumptions, and the people or cultures who hold them, can reinforce problematic distributions of power.[19,31,53] Unequal power dynamics may then lead to systemic forms of onto-epistemological homogenization, degradation, and marginalization.

Homogenization via hybridization and globalization of onto-epistemologies contributes to the deterioration and destruction of entire worlds of realities, knowledge systems, and values, let alone human and more-than-human lives (i.e., biological and biocultural diversity). To elaborate what homogenized onto-epistemological dominance might look like at the science-policy interface, one of the main findings of the IPBES Values Assessment found that the majority of scenario studies (94%) are driven by one form of valuation (instrumental), which privileges the hierarchical power structures that are possible in real and relative onto-epistemological framings over the flat or decentralized power structures prevalent in relational framings.[3,4,7,12,21,40,53,56,73,82,114–116] Similarly, the globalized application of realist framings may reject relative and relational approaches, citing the impracticality of subjectivity and emergent complexity. A clear example is the systemic dismissal of more-than-human actors in formal legal mechanisms from being recognized as having agency and autonomy,[60,85,117] where a disproportionate abundance of human rights laws or rights granted only to some taxa or species demonstrates the lack of codified rights and legal protections granted to "all life forms."[27,88,95] If research, policies, and implementation

schemes are developed in the absence or misappropriation of onto-epistemological diversity, such as without Indigenous Peoples and/or local communities, the potential to exacerbate inequality increases and can act as a form of "epistemic violence" contributing to unsustainable and unjust practices.[30,58]

It thus becomes critical to consider the power dynamics that determine which onto-epistemologies are represented, when they are represented, how they are represented, and by whom. Returning to the example of water in the context of governance, an onto-epistemological imbalance is revealed by governance structures that only recognize assumptions of water as a resource, where it is treated as a commodity or technical instrument that can be owned, traded, polluted, bought, sold, and geopolitically defined (e.g., watershed, national to council-based jurisdictions).[95–97] Such an approach to water ignores the perspective of many Indigenous Peoples and local communities, where water as lifeblood would mean that acts that objectify or pollute water would be akin to objectifying or polluting one's self and others.[42] Further, the dominant approach to water governance currently applies the onto-epistemological frame of water as a resource. This frame separates water from its social context, is associated with colonial-settler practices, and is considered to be a root cause of contemporary water crises.[21,42,58,99,118] Consequently, calls to decolonize water are fundamentally about "exposing the ontological violence" authorized by domineering onto-epistemologies and changing processes to be respectful toward onto-epistemological realities defining water as lifeblood.[41,119,120]

UNEARTHING ONTO-EPISTEMOLOGICAL ASSUMPTIONS AND POWER

Let us first acknowledge here that we, the authors, do not identify as Indigenous and are each in different positions of power. Rather than be absolved of responsibility, our positions demand that we take responsibility for our roles in practices that homogenize, marginalize, and violate onto-epistemological sovereignty. Our different positions of power, within our different roles and socially ascribed identities (e.g., gender, education), require that we share this responsibility differentially, in relation to the extent to which we can influence others and processes. A failure to do so would be to contribute to the loss of diverse worldviews, knowledge systems, and values. Whether we hold positions in research, policy, and/or implementation, we must each remain responsible, adaptable, and humble to diverse onto-epistemologies as they emerge and as power dynamics underpinning them change. We must begin or continue on our own journeys to unsettle and disrupt onto-epistemological dominance by pursuing processes that seek to decentralize power and redistribute imbalances.[57,96,121] Rather than reinforce analytical tensions by generating a rigid typology or authoritative categorizations of diverse onto-epistemological approaches to framing problem-solving,[122] we propose five principles to help navigate the challenges that come with problem-solving the complexities we face in "real" life.

Seeking greater onto-epistemological plurality within and across research, policy, and implementation in principle means (1) situating assumptions, (2) addressing power dynamics, (3) respecting (in)commensurabilities, and (4) reframing with the intent to create space—all of which takes (5) practice. Situating onto-epistemological assumptions and addressing power dynamics using these principles can help foster a more plural and equitable approach for complex problem-solving across worldviews, knowledge systems, and values.[3,6,11,27,123–126] This effort means familiarizing oneself with what onto-epistemologies are, acknowledging their importance in shaping society, and committing to critically analyzing them to bring to the forefront issues of inequity and injustice that often occur while attempting to solve complex social problems, like biodiversity loss and conservation[127] (e.g., wilderness protection targets, policies, and interventions that disengage and disempower Indigenous Peoples and local communities, blocking their onto-epistemologically based principles of stewardship from becoming meaningfully operationalized[128]). Tensions between different onto-epistemological approaches are likely to surface during efforts to improve the inclusivity, equitability, and plurality of problem-solving endeavors, especially for complex problems of a global scale. When conflict inevitably presents itself at individual, institutional, and societal levels, we must all, individually and collectively, practice taking time to be analytical about the onto-epistemological assumptions being made using the principles outlined below.

Situate onto-epistemological assumptions

Situating onto-epistemological assumptions, their diverse functions and their differences, and the power dynamics that influences their respective representation and operational freedom begins with the self. The composition and situation of onto-epistemological approaches can be revealed through language, content, actors, and scalability and, if used reflexively, can show changes over time (if and when time is a relevant construct).[129–132] It is important that we keep an eye out for onto-epistemological dominance that excludes alternative ways of thinking-doing-being.[7,34,36,53] Onto-epistemological dominance can result in some forms of knowledge being given priority in decision-making, while others are "made to fit" the dominant onto-epistemology or are ignored completely because they cannot fit within the problem-solution frame.[6,34,36] It is therefore important to avoid placing any onto-epistemological frame and problem-solving approach as dominant, better, or privileged but rather highlight the relationships between and within different onto-epistemological assumptions and examine any (in)commensurabilities. The process is not linear or sequential, and we encourage supplementing the practice of situating oneself onto-epistemologically with techniques like positionality, reflexivity, and diffractive practices.[46,54,131]

Situating onto-epistemological assumptions invites opportunities for reframing to enable more plural, equitable, and inclusive practices. It does so by revealing complementarities and synergies as well as gaps, asymmetries, and misalignments, assisting in resolving a number of conflicts between worldviews, knowledge systems, and values. These conflicts can be at the heart of what limits the efficacy of solving the complex problems we face, such as that of biodiversity loss.[6] To illustrate, research, policy, and implementation efforts designed to protect genetic diversity[133] represent a set of onto-epistemological assumptions (i.e., realist framing) that are different from efforts seeking to

protect human rights of equal access to biodiversity[134] (i.e., relativist framing), which are again different from efforts to protect biocultural diversity as a right[135] (i.e., relational framing).[36] Therefore, communicating about genetic resources, species, and ecosystems may be functional for some peoples and across some knowledge communities but may not translate readily to others, and vice versa for a number of reasons (e.g., linguistically, conceptually, and/or ethically). Asking what pieces of the problem-solving puzzle might be absent, over-represented, or mis-represented within and across research, policy, and implementation and can improve the equitability of practices seeking greater levels of plurality (see Figure 2). Onto-epistemological assumptions can be assembled in a multiscaled way, such that justification of each framing is complementary to multiple interpretations, as far as is practicable.[133]

Address power dynamics

Effectively synthesizing knowledge to improve our collective ability to understand and solve problems requires a commitment to examine underlying onto-epistemological assumptions and how they interrelate both theoretically and politically.[11,15] To be more effective, one must slow down approaches to knowledge production and value evaluation by taking time to examine the onto-epistemological assumptions being made and situate them in the context of power.[22,123] To assess power dynamics in formal and informal settings, one can start by asking what/who decides on language? Has a voice? Has authority to make decisions, and what responsibilities come with this? Decides is capable of and/or entitled to make decisions, and why? Where and when are decisions being made, and why? How can time and effort be equitably afforded toward diverse onto-epistemologies? How can processes be improved when there is disagreement about language, voice, place, authority, responsibility? How can power be exercised in a way that does not disenfranchise? In the case of power in knowledge production, Our Knowledge Our Way, an Indigenous led and co-authored manual for best practices of knowledge co-production, describes the importance of taking steps early and often to foster an environment of inclusion from the outset and by continuously "(re)setting" the knowledge production "table."[90] In a similar vein, greater onto-epistemological plurality, inclusivity, and equitability also mean confronting the structural relations of power that enabled power imbalances to occur in the first place.[27] It is therefore important to keep in mind that the ways in which we navigate power dynamics, conflicts, and politics are multiple.[18,27,30,36,123]

Respect (in)commensurability

Attention must be given to (in)commensurabilities as they arise and caution paid to how onto-epistemological assumptions might be erroneously interpreted, translated, or negotiated. For example, real, relative, and relational framings may be commensurable under a scientific methodology but not necessarily under an Indigenous methodology, where relational complexity can be theoretically reduced to accommodate a relative and realist frame of reality but not practically reduced. In addition, some groups (e.g., Indigenous Peoples) may actively resist efforts to directly compare values to maintain the validity of their knowledge system.[5] It becomes important then to remain aware of the theoretical and practical limitations of interpretation and

reverse translation, including consent, when aiming to (re)frame the onto-epistemological assumptions underpinning approaches to realities and knowledge.[90,136] One could, for instance, consider incomparable or incompatible assumptions in parallel, as recommended by the IPBES Values Assessment (IPBES, 2022)[137] to avoid watering down, co-opting, or appropriating less dominant onto-epistemological frames to the benefit of those in more powerful positions. Under incommensurable conditions, an "ethic of incommensurability" can also serve to implicate and unsettle everyone[18] into a new setting and dialogue by disrupting prior negotiations and contestations of power. One could also consider the extent to which assumptions "partially overlap" when they are (in)commensurable in that they share similarities and differences to varying degrees.[138] Importantly, it is in the negotiation between (in)commensurable onto-epistemological differences where opportunity for transformative and imaginative thinking is at its highest potential, if practiced sensitively with empathy, humility, and respect.

(Re)frame with the intent to create space for inclusion

Best practices for more respectful problem-solving necessitates empathy, flexibility, and iterative inquiry to conscientiously approach diverse approaches that are underpinned by different assumptions.[35,139] An empathic approach to engaging with onto-epistemological assumptions is one that invites opportunities for collaboration and innovation while acknowledging (in)commensurabilities. For instance, biodiversity may be interpretable by most forms of real, relative, and relational assumptions but not all relational assumptions, which requires attention. To illustrate, deeply embedded relational assumptions regarding biodiversity mean it cannot be regarded as a resource to manage or exploit but as an integral part of human society and culture, whereby biodiversity in all its forms is experienced as a gift to be responsibly cared for and cultivated as relationships of kinship and belonging.[12,41,119] This (re)frame of assumptions cannot be underestimated. Differentiating and (re)framing assumptions are evident by the evolution of language across international environmental conservation frameworks (e.g., post-2020 GBF) and assessments (e.g., IPBES Values Assessment evaluating diverse worldviews, knowledge systems, and values). The evolution is demonstrated in that the aims of the CBD now promote conservation done with and led by, instead of being done for, Indigenous Peoples and local communities.[2,12,27,34,71] For example, the language of the Convention's frameworks historically maintained people and nature as separate entities, where nature was an object. Over time, it has been proposed that the language of the frameworks change from humans living in harmony with nature (i.e., realist and relative framing) to humans living as Nature (i.e., relational framing), where humans and nature become equally entitled as one and the same.[12,34,71] In addition to acknowledging the role of relational values of Nature, the significance of this change is that the onto-epistemologies of many Indigenous Peoples and local communities are given more space to relationally reframe biodiversity conservation to be more relatable toward their worldviews and knowledge systems.

Practice onto-epistemological analytics carefully

Analytical onto-epistemological (re)framing is not arbitrary; rather, it is learned and reinforced through ongoing practice.[34,36]

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Engaging and situating diverse framings will thus need to be iterative, with a focus on the interactive processes that enable and disable ways of framing problems and solutions rather than focus solely on the substances, structures, or actors that might produce them.[130] Over time, the practice of recognizing and situating assumptions for the purposes of (re)framing can result in social learning and streamline deliberation, consensus-seeking, and conflict resolution.[3,34,36,129] As such, an analytical process of (re)framing onto-epistemological assumptions, while being cognizant and sensitive of underlying power dynamics, is a crucial component for cross-/inter-/translingual, -cultural, and -disciplinary collaborations to be more successful across scales.[3,140]

Practicing the analytical process of (re)framing through recognition and understanding of onto-epistemological assumptions, as expressed through worldviews and knowledge systems within and across biodiversity conservation research, policy, and implementation, is vital. What (re)framing has the potential to do is generate space for innovation that can emerge from onto-epistemological (re)positioning and analytic inquiry. For instance, an example of innovative (re)framing affecting research, policy, and implementation is where Nature has been ascribed legal rights and personhood such has been granted to rivers[119,141]; "common property" (e.g., species) proclaimed as kin[96]; or that it is Country that determines law/lore.[94] This transformative and pluralist jurisprudence can be attributed to the enabling of the "othered" people and "alternative" voices, in most cases Indigenous Peoples and local communities, whose onto-epistemologies regard Nature as a being, made of beings, in its/their own right(s).[53,89,94,121] To enable transformative potential for a more pluralist and just society, one must continuously (re)search to recognize and celebrate new and old differences and similarities, (re)frame political ordering and cycles, and empower Indigenous Peoples and local communities worldviews, knowledges, and values to imagine new ways of living and being in the world.[20,27,30,34,36,53,57,89,94,142]

CONCLUSIONS

In this perspective, we argued that analytically (re)framing real, relative, and relational onto-epistemological assumptions across research, policy, and implementation could improve our chances for more pluralist, equitable, and inclusive solutions to the complex problem we face, such as biodiversity loss and climate change.[33] The proposed actions in this perspective are to iteratively, systematically, and collectively examine onto-epistemological assumptions while applying five principles as a catalyst for more respectful engagement of diverse worldviews and knowledge systems across problem-solving practices.[143] We offer frameworks in an effort to provide language that clarifies the taxonomy of assumptions, indicates ways in which they are privileged, and explore opportunities for change against the state of play. We provide these frameworks so that we can be more specific with each other and more willing to give voice and press for acts of change by engaging the assumptions underpinning worldviews and knowledge systems directly.[18] These onto-epistemological analytical frameworks can be applied to evaluate not only the representational composition and upstream-downstream alignment of assumptions of existing

research, policy, and implementation but could also be used to critically evaluate the assumptions being made and represented across future research proposals and policy-development and action-planning schemes. The five guiding principles serve to support transdisciplinary knowledge integration and innovation, stakeholder engagement, cross-cultural projects, and more. Although our arguments highlight the complementarity and (in) commensurability of onto-epistemological framings, we do not fully engage with wider issues of (in)commensurability, power dynamics, and conflict, including those that may not be onto-epistemologically generated but rather socially, institutionally, politically, or culturally reinforced. More work is needed to investigate how unearthing assumptions and power, such as those presented here, can be integrated and upscaled into research, policy, and implementation processes while expanding on unresolved tensions that inhibit inclusive, equitable, and plural outcomes.[144]

AUTHOR CONTRIBUTIONS

Conceptualization, K.-V.P.-H. and K.M.; visualization, K.-V.P.-H. and K.M.; writing – original draft, K.-V.P.-H., K.M., and H.P.P.; writing – review & editing, K.-V.P.-H., K.M., and H.P.P.; supervision, K.M. and H.P.P.

DECLARATION OF INTERESTS

The authors declare no competing interests.

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