Philosophy of Ethnobiology:

Understanding Knowledge Integration and Its Limitations

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Ethnobiology has become increasingly concerned with applied and normative issues such as climate change adaptation, forest management, and sustainable agriculture. Applied ethnobiology emphasizes the practical importance of local and traditional knowledge in tackling these issues but thereby also raises complex theoretical questions about the integration of heterogeneous knowledge systems. The aim of this article is to develop a framework for addressing questions of integration through four core domains of philosophy - epistemology, ontology, value theory, and political theory. In each of these dimensions, we argue for a model of "partial overlaps" that acknowledges both substantial similarities and differences between knowledge systems. While overlaps can ground successful collaboration, their partiality requires reflectivity about the limitations of collaboration and co-creation. By outlining such a general and programmatic framework, the article aims to contribute to developing "philosophy of ethnobiology" as a field of interdisciplinary exchange that provides new resources for addressing foundational issues in ethnobiology and also expands the agenda of philosophy of biology.

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Ethnobiology has become widely concerned with questions of knowledge integration in complex multi-stakeholder settings. While ethnobiologists document biological knowledge of local communities, they also increasingly emphasize the practical relevance of this knowledge for addressing socio-ecological challenges from health and food security to labor conditions and the preservation of biocultural heritage (Cuerrier et al. 2015; Wolverton 2013; Wyndham et al. 2011). This emphasis on the local expertise of non-academic actors has put ethnobiologists at the center of wider collaborative developments in the life sciences that aim for "co-creation", "co-leadership", "co-management", "multi-stakeholder approaches", "participatory action research", "participatory design", "upstream engagement", "transdisciplinarity", and so on (Davidson-Hunt et al. 2012; Gavin et al. 2015; Saslis and Lagoudakis 2013; Wolverton et al. 2014a).

While ethnobiological contributions to such multi-stakeholder interactions have been reflected in a turn towards "applied ethnobiology" (Armstrong and Veteto 2015; Silitoe 2006; Wolverton 2013; Whyte 2018), it would be a mistake to assume that they reduce the need for careful theoretical reflection. On the contrary, applied and especially collaborative perspectives in ethnobiology raise complex philosophical questions about the prospects and limitations of integrating knowledge systems of heterogeneous stakeholders. First, there is the *epistemological challenge* (Marlor 2010; Wilson 2008) that traditional communities and academically trained scientists often rely on very different methods for producing and validating knowledge, from spiritual norms of ecological engagement to computational modelling of ecological dynamics. Second, there is the *ontological challenge* (Ellen 2016; Ludwig 2018b) of collaborating in the light of very different assumptions about reality as reflected in anthropological accounts of issues such as the mental life of plants and forests (Kohn 2013) or the status of rivers as persons (Hutchison 2014). Third, there is the *ethical challenge* (Anderson 1996; Whyte 2015; Wolverton et al. 2016) that epistemic and ontological assumptions are intertwined with different value systems such as contrasting ways of thinking about moral responsibilities between human and non-human agents. Finally, there is the *political challenge* (Ludwig 2016b; Nadasdy 2003) that stakeholders often hold very different positions of power to enforce their epistemological, ontological, and ethical perspectives in collaborative practice.

Despite the interdisciplinary orientation of ethnobiological research, none of these epistemological, ontological, and normative challenges have led to a sustained interaction between ethnobiology and academic philosophy. The aim of this article is to outline a framework for bringing ethnobiology together with philosophical research to address fundamental challenges of multi-stakeholder processes. The next section introduces a general framework of "partial overlaps" that contrasts with overly optimistic accounts of philosophical universalism and pessimistic perspectives on cross-cultural incommensurability. The following sections develop this framework in four philosophical core domains of ontology, epistemology, value theory, and political theory. The final section provides a synthesizing discussion about the role of philosophical reflectivity for ethnobiological research.

A Methodology of Partial Overlaps

Global challenges such as climate change (Wolverton et al 2014b), deforestation (Alves and Albuquerque 2012), and food security (Nolan and Pieroni 2014) have to be addressed through the inclusion of heterogeneous stakeholders. A crucial element in the development of multi-stakeholder processes is the recognition of local expertise about environments and sustainable practices (Byskov 2017; Whyte and Crease 2010). For example, Indigenous hunters will often be able to monitor endangered species, traditional farmers have rich expertise about sustainable agroforestry, and local fishers tend to be the first to notice changes in marine, estuarine and riverine ecosystems.

Ethnobiology can play an important role in spelling out this idea of local expertise by documenting the complexity of traditional knowledge beyond academic research. For example, Berlin and Berlin's (1996:3) classical account of *Medical Ethnobiology of the Highland Maya of Chiapas* does not only provide a detailed documentation of a specialized body of local knowledge but also explicitly argues "that the ethnobiological knowledge of traditional peoples conforms in many respects to basic scientific principles". Emphasizing both the complexity of traditional knowledge and its compatibility with modern science, ethnobiology appears to be an ideal resource for transdisciplinary knowledge integration that synthesizes the expertise of very different stakeholders in developing better responses to socio-ecological challenges (Albuquerque et al. 2017; Nabhan 2009, 2016).

While ethnobiology provides resources for knowledge integration, there has also been increased concern about the limitations and adverse effects of integration projects. For example, Nadasdy's (2003) influential critique of Traditional Ecological Knowledge (TEK) has emphasized that optimistic visions of knowledge integration often obscure differences between stakeholders and thereby reproduce hierarchies between scientists and local communities in the negotiation of practice and policy (Lertzman 2009). Often, holders of TEK need to prove the value of their knowledge by showing that it holds up to the methodological and epistemological criteria of academic researchers. As a consequence, TEK is required to be validated through academic criteria but academic research is not regarded in need of validation through compliance with TEK. This imbalance can create what philosophers have called "testimonial injustice" (Fricker 2007; Wanderer 2011; Anderson 2012) and contribute to practices that treat TEK as a resource for novel data while ignoring aspects of TEK that challenge the assumptions of academically trained scientists.

As Ludwig and Poliseli (2018) have argued, this situation can be described as a dilemma between assimilation and division. On the one hand, critics of overly optimistic integration ideals like Nadasdy are correct to point out the danger of downplaying differences between knowledge systems and therefore obscuring unique features of ethnobiological knowledge (see also El-Hani and Bandeira 2008). On the other hand, overly pessimistic accounts of incommensurable knowledge systems are equally problematic from both theoretical and political perspectives. First, philosophers have questioned whether the idea of entirely incommensurable knowledge systems is coherent in the first place (Davidson 1984; Putnam 1981). While anthropological discussions of the ontological turn (Holbraad and Pedersen 2017) often postulate a "radical alterity" of "different worlds" (Henare et al. 2007; Alberti et al 2011; cf. Graeber 2015), this literature does little in addressing theoretical worries about the coherence of incommensurability and radical metaphysical claims about different worlds often remain philosophically obscure. Furthermore, claims about incommensurable worlds also come with political risks as they seem to undermine the very possibility of productive interaction between heterogeneous stakeholders. As a result, an exclusive focus on difference returns to what Agrawal (1995) has famously criticized as the "divide between Indigenous and scientific knowledge" that creates not only artificial boundaries but can also contribute to marginalizing traditional knowledge in policy and practice through the assumption of insurmountable differences (Hunn 2014).

The aim of this article is to develop a nuanced framework for analyzing the relations between knowledge systems that avoids a biased focus on either differences or similarities through a framework of "partial overlaps". On the one hand, we propose to develop an analysis of overlaps that provide common ground for collaboration and mutual understanding. The following sections argue that such overlaps can be identified across core philosophical domains, including *ontological* assumptions about the biological world, *epistemological* strategies for achieving knowledge, say, about biota and environments, and *normative* reasoning about moral relations between human and non-human agents.

While an analysis of overlaps clarifies shared resources for collaboration, we propose a complementary analysis of the partiality of such overlaps. Although there may be substantial overlaps in fundamental assumptions of traditional and academic knowledge systems, there will often also remain substantial differences along ontological, epistemological, and value dimensions. For each of these dimensions, the relations between two knowledge systems K_1 and K_2 can be visualized through intersecting sets in which the intersection ($K_1 \cap K_2$) represents shared assumptions while the relative complements ($K_1 \setminus K_2 \wedge K_2 \setminus K_1$) represent (ontological, epistemological, and value) assumptions that are unique to knowledge systems (Figure 1).

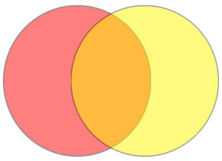

Figure 1: Simple representation of partially overlappig knowledge systems through intersecting sets that include shared ontological, epistemological, value resources (intersection) as well as unique elements (relative complements)

We argue that such an idea of partial overlaps can provide methodological tools for addressing relations between foundational assumptions between (ethno)biological knowledge systems. The following sections develop this idea of partial overlaps as a methodological tool through four philosophical core domains of ontology, epistemology, value theory, and political theory.

Application: While this article develops a theoretical and philosophical perspective, it also aims to provide an applicable framework for addressing foundational issues in ethnobiological practice. Each of the following sections is therefore supplemented by a short example of application from our own fieldwork in two fishing villages in the North shore of the state of Bahia, Brazil, situated in the estuary of a large river (Itapicuru): Siribinha (ca. 500 inhabitants) and Poças (ca. 600 inhabitants) (El-Hani et al. forthcoming). While fishing communities in the region are gradually disappearing due to the growth of the tourism industry and declining catches resulting from overfishing, pollution, and other environmental threats, in these villages we still find a living fishing culture (in the Brazilian shore an emergent cultural product from native Tupinamba and Portuguese influences, with some African contributions; Ott 1944), with young people learning the traditional fishing practices and subsisting from their product (despite also earning their living from tourism), and knowledge flowing across generations. These communities use at least a dozen different fishing techniques and show a wealth of ethnobiological knowledge, not only about the animals they capture (fishes, crustaceans, mollusks), but also about medicinal plants and the local environments. Understandably, it has previously attracted the attention of ethnobiologists (e.g., Costa-Neto 2000; Costa-Neto and Marques 2000).

In each of these cases, we argue that a framework of partial overlaps allows more nuanced analyses of foundational issues in ethnobiology that avoid shortcomings of universalism and relativism.

Partial Overlaps in Ontologies

Ontology is one of the core domains of philosophy and is concerned with the question of what exists (Quine 1948, Chalmers 2011, Sider 2011). As debates about the “ontological turn” have moved to the center of anthropological theory (Holbraad and Pedersen 2017), ethnobiologists have also become increasingly concerned with cross-cultural relations among ontological assumptions (Daly et al. 2016). In current anthropological theory, emphasis on difference tends to dominate recognition of similarity and many influential anthropologists focus on cases of radical alterity such as ontological commitments to shamanic transformations (Viveiros de Castro 2014) or thinking forests (Kohn 2013).

Ludwig (2016b) has suggested that ethnotaxonomic research provides a different but complementary angle for investigating cross-cultural relations among ontologies. Ethnotaxonomy provides a “bottom-up” strategy that starts with small-scale ontological differences, for instance concerning categories of animals and plants, rather than the more common anthropological “top-down” strategy that proceeds from the most salient cases of deep ontological difference (Ellen 2006, Hunn 2014). By putting ontological relations under the “microscope of ethnotaxonomy”, the methodology of partial overlaps can be articulated more clearly. On the one hand, there are many salient cases of ontological convergence as illustrated by cross-cultural agreement on the boundaries of many biological species. These cases of ontological convergence play an important role in ethnotaxonomy and are especially prominent in Berlin’s (1992) universalist program. Furthermore, Berlin also provides a metaphysical justification of these convergences by appealing to "discrete, discontinuous chunks of biological reality" (1992:81) that can be further specified through philosophical accounts of natural kinds and their grounding in causal networks and property clusters (Khalidi 2013; Slater 2015; see Ludwig 2018a; 2018b for application to ethnobiology).

While there is need for substantial philosophical discussion of cross-cultural similarities between categories, ethnobiologists have increasingly qualified claims of cross-cultural convergence. Nabhan (2016:27) clearly expresses wider developments of the field when arguing for a focus on "the anomalies, the unique cultural expressions, and the collisions of dissonant taxonomic structures". Looking at such dissonant taxonomic structures provides a microcosmos of ontological difference as culturally unique concerns and local environmental factors influence what distinctions between animals and plants are being drawn. At the same time, the very fact that dissonant taxonomic structures can often be qualified as "anomalies" illustrates that widespread convergence is also found among ethnotaxonomies.

Addressing both cross-cultural similarities and differences in the categorization of animals and plants provides an important application of the wider idea of partial overlaps. Indeed, there are cross-cultural ontological similarities that provide the basis for collaborative ethnobiological practices which would often not be possible without joint recognition of the same biological species. However, there are also ontological differences that matter because they often reflect different priorities and concerns about biological and ecological properties (Ludwig 2018b). Rather than pushing for a universalist emphasis on cross-cultural similarities or a relativist emphasis on differences, a model of partial overlaps suggests a more nuanced picture of the relations among ontologies.

Can this picture of partial overlaps be extended from categories of animals and plants to wider ontological issues as commonly debated by anthropologists in the context of the "ontological turn"? It can indeed be fruitful to explore the framework of partial ontological overlaps in the context of these wider issues. Much of the anthropological literature has focused on salient cases of ontological difference but it would be a mistake to assume that there are no substantial overlaps. For example, consider Kohn's influential discussion of *How Forests Think* (2013). In part, fascination with Kohn's discussion comes from the ontological difference between the Runa of Ecuador's upper Amazon who take forests to be thinking agents and Western scholars who often reserve "thinking" for a much narrower set of organisms such as humans and some other mammals. In part, however, fascination with Kohn's account also comes from sufficient ontological overlap. The idea of thinking forests is not so alien that Kohn's descriptions become unintelligible to (non-Runa) readers. On the contrary, part of the fascination with thinking forests is that they do appear as a genuine ontological option that many readers can at least partly relate to. Indeed, radical expansions of the realm of cognition are very much part of the Western intellectual heritage and are also reflected in current controversies about plant cognition (Adams 2018; Segundo-Ortin and Calvo 2018).

Of course, this does not mean that ontological assumptions can always be integrated and proponents of the "ontological turn" in anthropology often emphasize deep cross-cultural differences. For example, Viveiros de Castro's (2014) discussion of shamanic transformation aims at fundamentally different metaphysical perspectives on the relations between human and non-human that challenge optimistic accounts of ontological integration. Again, accounts of ontological overlaps need to be complemented with analyses of their partiality that leave room for deep cross-cultural disagreement about ontological matters.

To sum up, the idea of partial overlaps provides a useful guide for thinking about ontological relationships from fine-grained questions about the boundaries of plants and animals to general ontological issues such as animism and the boundaries of "cognition". It therefore constitutes an alternative to the one-sided focus on ontological similarity that has dominated large parts of the Berlinian tradition of ethnotaxonomy and the focus on ontological difference that dominates large parts of current anthropological theory. As such, it provides ethnobiologists with a sharper and more nuanced framework for addressing ontological relationships in multi-stakeholder processes.

Application: Partially overlapping ontologies can be found in our field study in traditional fishing villages in Brazil. Consider, for instance, the ethnobiology of *Buteogallus aequinoctialis* (locally known as Gacici, in English Rufous crab-hawk, a near threatened species, https://www.iucnredlist.org/species/22695808/131937283). Cross-cultural taxonomic convergence is clear: fishing communities and academic zoologists uncontroversially refer to the same species, despite having different knowledge about it. Ethnobiological research leads to new insights about Gacici, as there is almost nothing published on the biology of the species. It is from traditional knowledge that we learn, for example, that this hawk calls when the tide turns: their calls are used by the fishermen as indication that the tide will be low after some time and they need to retrieve the captured fishes. This is a clear inference from traditional knowledge, even expressed in a local saying, *Gacici cantou, a maré vazou*, free translation: Gacici sang, the tide turned. Other insights derive from academic research rather than traditional knowledge. For example, the presence of the species in the mangroves, as a specialist top predator, is a bioindicator of how well-conserved the mangroves are, despite use by the villagers, which thus may be sustainable at least to some extent. Epistemic productivity of knowledge integration can also be shown, due both to the sum of unique inferences from each knowledge system and to novel inferences using insights from both systems. For instance, one may conjecture that Gacici calls when the tide turns to signal for a conspecific with which it hunts together the availability of crabs for foraging (perhaps the calls are used as signals shared by a couple, as some raptors are known to form lasting couples and hunt together). This is at least a hypothesis worth testing. Our field studies also show, however, the partiality of overlaps in taxonomy. If we consider, for instance, the two local species of sandpipers (small and large sandpipers – maçaricos pequeno and grande), we will be able to see a correspondence between two ethnospecies and at least eleven scientific species. Small sandpipers include, for instance, *Actitis macularis*, *Arenaria interpres*, *Calidris alba*, *Calidris pusilla*, *Charadrius collaris*, *Charadrius semipalmatus*, while large sandpipers include *Numenius hudsonicus*, *Tringa melanoleuca*, *Tringa semipalmata*, *Pluvialis squatarola*, *Limnodromus griseus*.

Partial Overlaps in Epistemology

It has become widely argued in contemporary philosophy of science that "the scientific method" in singular does not exist (Laudan 1983; Andersen and Hepburn 2015). Of course, there are common characteristics of scientific practices such as experimentation, modeling and mathematization, but none of them provide necessary and sufficient conditions of science that are applicable from cultural anthropology to quantum physics. While the lack of a simple demarcation criterion for science is hardly a new philosophical insight, it has important implications for thinking about epistemic relations between traditional and academic knowledge in ethnobiology.

Under the assumption of a general demarcation criterion, one could aim to investigate whether local ethnobiological knowledge systems meet the essential criterion for science. Without a clear demarcation criterion, comparisons of knowledge systems lead to more ambiguous diagnoses as traditional knowledge shares some but not all epistemic features with academic biological knowledge. Given an expansion of the idea of "partial overlaps" from ontology to epistemology, this is not a surprising outcome. On the one hand, ethnobiological research often presupposes a substantial overlap in epistemic resources. For example, consider an ethnobiologist going into the field with a traditional expert to learn about local plants and their cultural significance. Such practices would simply not be possible without substantial overlap in epistemic resources, such as joint reliance on observation or similar ways of reasoning about ecological relations. As classics in epistemology from Wittgenstein (1953) to Davidson (1984) have stressed, disagreement can only be intelligible on the basis of substantial agreement. Collaborative practices in ethnobiology provide vivid illustrations of this point, as joint engagement with biocultural diversity would simply not be possible without substantial agreement in observing and reasoning about biota and environments.

Even if collaborative approaches in ethnobiology presuppose shared epistemic resources, they are also often confronted with deep and unexpected differences. For example, consider Marlor's (2010) study of tensions between Canadian biologists from the Department of Fisheries and Oceans (DFO) and commercial clam diggers of the Kwakwaka'wakw First Nation. As Marlor describes in detail, tensions were at least in part grounded in different methodological standards. For example, DFO biologists assessed clam abundance through randomly selected sample areas of the beach that were standardized through straight perimeters and assessed through an equally standardized procedure of digging clams. In contrast, Kwakwaka’wakw assessed clam abundance through harvest outcomes that were not standardized but affected by different individual styles and contexts of clam digging. Marlor is careful in providing a nuanced picture of the epistemic virtues and vices (Ludwig 2017) of both strategies. For example, the standardized DFO method had drawbacks such as being inapplicable to certain areas (e.g., high clam abundance near rock walls that did not allow the required straight perimeters) and excluding individual expertise of experienced clam diggers, but also had epistemic virtues that were important for DFO researchers such as transparency and replicability of methods.

An adequate account of epistemic relations among heterogeneous stakeholders requires acknowledgement of similarities in epistemic resources as well as differences that limit collaboration and co-creation. A starting point for such an account of partially overlapping epistemologies has been recently developed in philosophy of ecology by Poliseli (2018). Poliseli’s account of explanation and understanding in ecology avoids the specification of one general methodology of ecological research but instead develops the idea of toolboxes of context-sensitive heuristics that allow researchers to grasp complex ecological dynamics. As Ludwig and Poliseli (2018) have argued, this metaphor of toolboxes of heuristics can be used to develop a more nuanced account of the epistemic relations between traditional and academic ecological knowledge: it would be a mistake to think that stakeholders always operate with identical or entirely distinct epistemic tools. Instead, some tools will be largely identical. Some will be related but noticeably different. And some tools will only be found in one of the toolboxes.

In spelling out this metaphor of toolboxes, it is helpful to start with salient cases of similarity and difference. When looking for similarities between epistemic tools, the most obvious examples come from general cognitive abilities such as visual perception and inductive reasoning. For example, consider a local hunter and an academically trained ornithologist trying to assess the status of a local bird population. Both of them will rely on observations of birds and inductive generalizations from these observations. Indeed, these very general cognitive abilities are universally shared among human agents and it is hard to even imagine any biological knowledge that is not grounded in some of these shared basic epistemic tools.

When looking for differences, it is helpful to start with more high-level epistemic traditions that have been shaped by epistemic communities over the course of several generations. In the context of European science, for example, one of the most important epistemic traditions is mathematization (Dijksterhuis 1961) with a long history from the mathematical roots of the scientific revolution to current methods of computational modelling. Considering the highly specialized character of mathematical methods in current scientific practices and their increased reliance on digital technologies, it is indeed not difficult to identify salient contrasts with knowledge production in Indigenous and other local communities. Furthermore, differences can also be approached from another direction by looking for epistemic traditions of local communities that are often the result of hundreds of years of adaptation and co-evolution with local environments (Albuquerque et al. 2015; Berkes 2018).

To sum up, the metaphor of toolboxes avoids a simple dichotomy between universally shared epistemic resources and incommensurable epistemologies by treating them as endpoints on a gradual spectrum. In fact, these endpoints are usually no more than idealizations as it is typically not difficult to locate *some* similarities and *some* differences between the epistemic tools of stakeholders. For example, general cognitive capacities like visual perception and inductive reasoning may be the best candidates for universally shared epistemic resources but also interact with their local socio-ecological embedding (Atran and Medin 2008). Indeed, the "theory-ladenness of observation" (Brewer and Lambert 2001; Bogen 2009) has been widely discussed in philosophy of science, as observing certain phenomena through scientific instruments such as microscopes or telescopes often requires careful theoretical training.

Similar experiences are familiar in ethnobiological research as ethnobiologists often have to acquire intimate familiarity with local knowledge systems in order to understand what a local farmer is seeing in the field or to understand what an Indigenous hunter is hearing in the forest.

Just as cross-culturally shared epistemic resources such as visual perception involve some differences in practice, highly specialized epistemic tools will usually still involve some cross-cultural similarities. For example, it is true that current scientific methods of mathematical modelling in ecology are the product of an epistemic tradition that contrasts with the ecological reasoning of many Indigenous communities. However, numerical cognition does not only play a role in Western science but is also a part of Indigenous accounts of environments, as one can see, for instance, in estimates of population sizes or population trends (Gordon 2004). The idea of overlapping epistemologies should therefore not be misunderstood as suggesting a neat division between tools that are essentially the same and tools that are essentially incommensurable. On the contrary, relations between epistemic tools tend to be more complex and involve both opportunities and limitations that need to be carefully addressed in ethnobiological practice.

Application: Partial overlaps in epistemology can be found in our studies of epistemological practices in the traditional fishing village of Siribinha. The villagers use epistemic tools such as causal explanations, just as academic researchers: for instance, they explain the regular disappearance of a bivalve (locally called Massunim, scientific name *Anomalocardia brasiliana*) due to the causal effect of freshwater that kills it and periodically enters the estuary due to heavy rains upstream. They also explain that the Massunim reappears because it remains buried until freshwater is "washed away" by the highest sea tides. They also seem to identify mechanisms to explain phenomena: for instance, they explain the high availability of snooks (local name Robalo, scientific name *Centropomus* sp.) in some periods due to factors like freshwater coming down the river and displacing the juveniles growing in the mangroves, and the muddy waters that make the nets harder for the fishes to see, even though floodlit by bioluminescence from what they call jellyfishes (from a scientific perspective, probably *Noctiluca* sp.). They mention several components causally interacting with one another, organized in space and time, as in a scientific mechanistic model. But there are also divergences between traditional and scientific epistemic tools, showing the partiality of epistemological overlaps. For instance, our fieldwork data illustrate how general cognitive abilities such as inductive reasoning from observation are sensitive to socio-ecological and cultural circumstances: while academic researchers strive for multiple, replicable tests that allow to weigh evidence for and against a claim, a fisher may need one single, crucial test to be convinced to accept a new fishing artefact or technique. As a local fisherman (called Zé) told us, if he tests a net and successfully captures fishes, he will not doubt the net when it seems to fail, because this simply means that there are no fishes, not that the net is faulty. This difference may be grounded in the distinct outcomes sought by a fisher and an academic researcher. A fisher may be in the position to accept one crucial test because he or she deals with quite concrete outcomes, say, whether fishes are captured or not by a net, while a researcher, worrying about how well his or her methods provide reliable evidence on rather abstract things like an underlying causal structure, is more likely to feel that more tests are generally needed.

Partial Overlaps in Value Systems

Sustainability has become a dominant concept at the intersection of normative and empirical concerns about socio-ecological dynamics. While some sustainability-related ideas can be traced back to early modern (Caradonna 2014) or even ancient philosophy (Gomis et al. 2011), the rise of the term "sustainability" is a product of the late 20th century and has been most commonly associated with the Brundtland report *Our Common Future*, published by the World Commission on Environment and Development in 1987. For example, Hansson (2010: 274) suggests that “it was in the 1987 report *Our Common Future* [...] that sustainability became a central concept in environmental policies. The importance of this report in late 20th century environmental policies cannot be overstated.”

While explicit theorizing on sustainability is a relatively recent phenomenon, it has become common to appeal to Indigenous and traditional practices as inspirations and models for sustainable practices. In fact, the Brundtland report already argued that tribal and Indigenous “lifestyles can offer modern societies many lessons in the management of resources in complex forest, mountain and dryland ecosystems” (WCED 1987:12). Furthermore, it is by no means a coincidence that academic debates about Traditional Ecological Knowledge (TEK) became institutionalized in the same time period (Johannes 1989), providing a bridge between ethnobiological research on local biological knowledge and applied concerns about sustainability in conservation management and wider policy debates.

The co-evolution of discourses about sustainability and TEK can motivate an optimistic vision of co-creation on the basis of converging reasoning about moral responsibilities towards environments. The sustainability concept moves academic research beyond traditional visions of “value-free science” (Douglas 2009; Kincaid 2006; Ludwig 2016a) and fosters transdisciplinary practices in which moral responsibilities and wider value questions are integrated with empirical research. As such, sustainability also promises to move academic research closer to TEK, which never employed a clear dichotomy between “facts” and “values” and always treated knowledge about environments as a fundamentally moral issue. Furthermore, such an account of convergence also seems to support meaningful co-creation that recognizes holders of TEK as experts who can teach scientists how to weave moral responsibility and environmental stewardship into biological and ecological research.

There is certainly some truth to this optimistic vision, which has played an important role in creating awareness for Indigenous and traditional values in conservation practices and environmental policy (Kealiikanakaoleohaililani and Giardina 2016; Johnson et al. 2016). At the same time, stories about complementarity in sustainability can be misleading and outright harmful if they contribute to a neglect of tensions between heterogeneous value systems (Whyte 2015). First, environmental practices of local and traditional communities are highly diverse and blanket characterizations of TEK as sustainable can mislead about this complexity through a simplistic and romanticized picture of sustainable TEK. Second, characterizations of TEK as sustainable also require critical reflectivity about how different value systems can lead to different understandings and operationalizations of "sustainability."

For example, consider what Holden et al. (2014) describe as the four primary dimensions of sustainable development in the Brundtland Report: "safeguarding long-term ecological sustainability, satisfying basic human needs, and promoting intragenerational and intergenerational equity." As much as these dimensions suggest overlaps with value systems of TEK, there are also salient differences. One difference is that TEK often assumes a complex web of mutual responsibilities between human and non-human actors (Lewis-Jones 2016; Rose 2002) that is not adequately reflected in satisfying basic human needs or human-focused equity concerns. If non-human actors are incorporated into the values of TEK with both responsibilities and rights, normative reasoning about environmental issues will often depart from Western discourses about sustainable development. Second, sustainability discourses tend to be geared to sustainable growth that remains compatible with long-term ecological sustainability and intergenerational equity. While it has become widely reflected that TEK is far from static and adapted to constant change (Fernández-Llamazares and Reyes-García 2016), accounts of change in TEK tend to be very different from sustainability debates that often aim for balancing economic growth with socio-ecological concerns (Elkington 2013).

Expanding the overall methodology of partial overlaps towards value systems in ethnobiology provides a helpful starting point for avoiding both horns of the dilemma of division and assimilation. On the one hand, the assumption of overlaps avoids a simplistic divide between Indigenous and Western values. Postulating an incommensurable divide is often factually incorrect in ethnobiology where local communities and academic researchers share substantive concerns such as improving of local livelihoods or preservation of biocultural heritage. Furthermore, neglect of overlaps in value systems can also further the marginalization of TEK by rejecting any common ground for meaningful collaboration in the negotiation of practice and policy. On the other hand, the partiality of such overlaps needs to be addressed carefully to avoid illusions of co-creation that are in fact an assimilation of TEK into normative agendas of external researchers and conservation managers. Taking transdisciplinary collaboration seriously requires that ethnobiologists navigate this complex web of relations among values that can provide resources for joint action, but also deep normative tensions that need to be taken seriously.

Application: Partial overlaps in value systems can also be found in traditional Brazilian fishing villages, even in cases of radical alterity. Consider, for instance, the *Caipora*, an entity from Tupi-Guarani mythology still important in the Brazilian culture, but certainly not a part of scientific ontologies. This ontological divergence does not seem to matter much, however, when a conservation scientist finds a convergence between her values and the value systems of a traditional fishing community that relies on *Caipora* and other alike entities to maintain a sustainable extraction model (Almeida 2013). In several fishing villages where we worked along the years, including Siribinha and Poças, we heard the stories that when a fisherman or fisherwoman misbehaves in the mangroves, that is, his or her actions diverge from what are acceptable practices to the community, it may be the case that *Caipora* appears and makes him or her lose the way in the mangroves for days or even weeks. In the Boipeba community (also in Bahia, Brazil), where one of the authors worked in the beginning of the 1990s, this was said to happen when a fisherman extracted too much of the red mangrove bark used to dye the boat sails (local name Mangue-vermelho, scientific name *Rhizophora mangle*), threatening the tree survival. A conservation scientist will also be content enough with the idea that *Caipora* needs territories in order to create animals that are offered to hunters or gatherers, since it will echo her ideas on protected areas (Almeida 2013). In these cases, we can see how local and academic communities share values regarding ecosystem conservation that may make scientists value *Caipora* as biocultural heritage that sets norms against unsustainable practices, as illustrated by an excessive collection of Mangue-vermelho bark, despite the fact that this entity is not part of her ontology. But differences are all too clear, showing both the partiality of value systems overlap and the intertwining of ontologies and values, because the values underlying the norms against unsustainable practice put to use by the traditional community have little to do with Western notions of sustainability and the value of biodiversity. Rather, they concern a different moral order in which there should be a right kind of balance between humans, mangroves, and mythical creatures like *Caipora*. Partly because she is not committed to that moral order, the conservation scientist will probably not show in the field the same engagement with situations of fear and fright that are for the local communities signs of the presence of *Caipora*. She would not report, say, the same feelings a fisherwoman would describe to us when telling about how she listened to some voice in the mangroves that might be the *Caipora* calling.

Towards a Political Philosophy of Knowledge Integration

The aim of the previous sections has been to spell out the general idea of partial overlaps through three core domains of philosophy: ontology, epistemology, and value theory. This section adds political philosophy as a fourth dimension by showing how an analysis of partial overlaps can lead to better understanding of political dynamics among stakeholders who often hold very different positions of power to enforce their ontological, epistemological and value perspectives in collaborative practice.

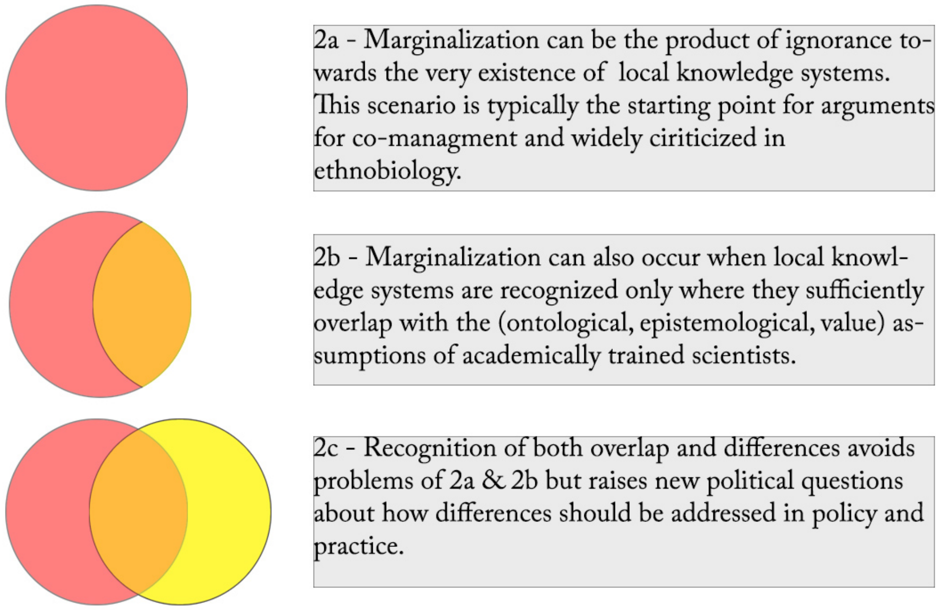

Figure 2 uses the idea of partial (ontological, epistemic, value) overlaps between knowledge systems to distinguish three modes of marginalization of local knowledge. Mode 2a illustrates the case of marginalization through disregard of the very existence of local knowledge systems. This scenario has been widely discussed and criticized in the anthropological literature on failed modernization. For example, consider Scott's (1998) famous discussion of the Ujamaa villagization campaign in Tanzania that forced local communities to practice "scientific agriculture", but ended up leading to soil erosion and dysfunctional village structures. Or think of Lansing's (1991) discussion of the negative effects of the "Green Revolution" in Bali that was driven by the goal to increase yields of rice farming through scientifically-based practices, but had catastrophic effects on local farmers through water shortages and pest spread. In both cases, the adverse and unintended consequences for local farmers were a product of ignorance towards local knowledge systems. For example, Scott (1998:226) emphasizes the "complete faith in what officials took for 'scientific agriculture' on one hand and a nearly total skepticism about the actual agricultural practices of Africans on the other. As a provincial agricultural officer in the Shire (Tchiri) Valley put it, 'The African has neither the training, skill, nor equipment to diagnose his soil erosion troubles nor can he plan the remedial measures, which are based on scientific knowledge, and this is where I think we rightly come in'". Lansing documented similar attitudes in Bali that led to the suppression of traditional water management through a system of connected water temples: "The answer to pests was pesticide, not the prayers of priests. Or as one frustrated American irrigation engineer said to me, 'These people don't need a high priest, they need a hydrologist!'" (Lansing 1991:115).

Ignorance towards local knowledge in the sense of 2a has become widely criticized across the biological sciences and is in many ways the starting point of the very project of ethnobiology. In contrast, mode 2b illustrates a more elusive danger of partial recognition that acknowledges local knowledge only insofar as it fits with the (ontological, epistemic, value) assumptions of academic researchers. This scenario has been the target of Nadasdy's (2003) influential critique of knowledge integration and is reflected in Kimmerer's (2012:322) concern about knowledge mining: "Knowledge mining or the extraction of useful facts from the body of knowledge, without exploration of the cultural context in which they belong, can do a disservice to the information as well as to the culture. Just as gold mining degrades a large area of land for the extraction of what is perceived as valuable 'ore' and leave a wasteland in its place, extraction of valuable data from traditional knowledge without consideration of its cultural context can also be damaging."

Both Nadasdy and Kimmerer focus on the risks of an overly optimistic vision of harmonious co-creation in which different stakeholders bring their diverse resources together and jointly solve socio-ecological challenges. In many cases of co-management of local environments, such a picture is indeed tempting, as local communities possess a wealth of expertise about local environments that can complement the knowledge of academically-trained ecologists and conservation managers. However, this integration of local knowledge can reproduce and consolidate unequal power relations if academically-trained scientists have the power to decide when to incorporate the local knowledge in research and conservation management.

Moving beyond the limitations of 2b requires recognition of local ontologies, epistemologies, and values even when they differ substantially from academic research. Mode 2c represents this situation in which the intersection provides resources for co-creation and collaboration while the partiality of the overlap leaves room for acknowledging various sources of tension that suggest different actions in concrete contexts. While 2c provides a more comprehensive picture that detects both common ground and tensions, it does not in itself provide an answer to the question of how tensions should be addressed. On the contrary, the acknowledgement of different resources emphasizes the possibility of different answers to socio-ecological challenges and the political character of choosing between them when negotiating practices and policies.

In this context, one core philosophical task is to move from a merely theoretical discussion of epistemology and ontology towards an explicitly normative discussion of political epistemology and political ontology of ethnobiology. The question is not merely whether local communities have different methods for knowledge creation and validation or different ontological categories, but rather what role these epistemologies and ontologies should have in negotiations of practice and policy. Following Viveiros de Castro (2014), Ludwig (2016) suggests "ontological self-determination" as a starting point for addressing these questions. The idea of self-determination of local communities provides a helpful contrast to the opportunistic use of local knowledge that is suggested by mode 2b. Rather than integrating local knowledge only where it is relevant for academic researchers, the idea of self-determination inverts this relation by asking when exogenous epistemic and ontological resources become relevant for the concerns of local communities.

While the idea of epistemological and ontological self-determination provides a useful starting point, it clearly requires further specification and qualification. In political philosophy, articulations of self-determination are often tied to the assumption that policies and practices should be determined by the affected stakeholders themselves (Fraser 2007). In many socio-ecological processes, however, it is far from clear how the group of affected stakeholders should be determined. For example, should adequate frameworks for the preservation of a forest be determined exclusively by local communities that directly interact with the forest? Or even more narrowly only those who live in the forest? Or should everyone be considered a relevant stakeholder in forest conservation as it is a crucial requirement for mitigating global climate change? Addressing such questions requires serious engagement with current political philosophy and debates about adequate “scales of justice” (Fraser 2009).

Conclusion

While ethnobiology has grown into a vibrant interdisciplinary field, it also often remains insufficiently connected with wider theoretical debates (Ludwig 2018c). Lepofsky and Wolverton (2018:454), for instance, note that “the reach of ethnobiology remains limited in scope” and argue for the need to increase its “visibility in and relevance to global social-ecological discussions”. Although one may be inclined to think of developments towards “applied ethnobiology” as further diminishing the role of wider theoretical reflection, this article has argued that multi-stakeholder processes raise complex questions that require interaction with core areas of philosophy, from ontology and epistemology to value theory and political philosophy. Developing philosophy of ethnobiology as an interdisciplinary field can overcome this lack of institutionalized exchange and contribute to the development of new intellectual tools for addressing these questions.

The point is not simply to add philosophers to the already heterogenous community (Latulippe 2015; Wyndham et al. 2011) of ethnobiologists, which includes scholars from anthropology, archeology, botany, cognitive science, cultural geography, ecology, Indigenous studies, sociology, and so on. Rather than leading to further fragmentation of the field, philosophy of ethnobiology can play a synthesizing role that connects underlying issues of knowledge diversity that cut across various disciplines of ethnobiological research. For example, a comprehensive account of partial ontological overlaps will require careful attention to relations between taxonomies, as developed in the *biological sciences*, and relations between more general metaphysical principles, as discussed in the *cultural anthropology* of the ontological turn. An analysis of overlapping epistemic toolboxes requires attention to experimental evidence from *cognitive science* as much as in-depth qualitative narratives from *Indigenous studies.* Developing philosophy of ethnobiology can therefore contribute to building bridges between heterogeneous disciplinary traditions in ethnobiology and to addressing knowledge integration through self-reflective procedures that do not shy away from fundamental questions regarding knowledge diversity in biology.

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