COMMON PROPERTY AND COSMOLOGY: CONSERVATION INCENTIVES AMONG THE MISKITU OF NICARAGUA

by

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ABSTRACT

Sustainability problems can often be characterized as social dilemmas because the "rational" strategy for an individual's short-term self-interest is suboptimal if everyone follows the same strategy. Such dilemmas may be overcome through social institutions (e.g., common property regimes) and cosmological beliefs (e.g., belief in punitive spirit guardians of nature) that alter the costs and benefits, or at least the perception of costs and benefits. In this dissertation I examine the efficacy of common property institutions and cosmological beliefs for regulating natural resource use among the Miskitu people of an indigenous territory located within the Bosawas Biosphere Reserve, Nicaragua. Using mixed methods and an interdisciplinary approach, I focus on the relationship between individual incentives and prosustainability behavior in a series of studies. First, I analyze de facto enforcement of the local common property regime, concluding that it is weak due to rules that are inherently difficult to enforce and too few individual incentives for enforcers to do so. Second, I test whether individuals who perceive greater resource scarcity or who perceive greater severity or certainty of civic punishment for violating the rules are more likely to comply with them; they are not. Third, I test whether individuals who expect supernatural punishment for overharvesting take less wildlife; they do, but this result is not robust against outlier exclusion. However, since individuals with an inclusive moral circle may weigh the costs and benefits of their actions to nonhumans, I also examine the relationship between wildlife harvests and beliefs in nonhuman

personhood (without reference to punishment) and the interconnectedness of humans and the rest of nature. Results show that individuals, especially men, who hold more of these beliefs harvested less wildlife biomass. This suggests that morally inclusive and relational beliefs about nonhumans may alter the way that costs and benefits are tacitly, even if not explicitly, perceived. In light of these results – and in consideration of each study's limitations – several directions for future research are recommended.

In loving memory of my father,
who set me upon a journey of the mind and spirit.

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CHAPTER 1

INTRODUCTION

Humanity is not living in a sustainable way. If the rapid rates of biodiversity loss, deforestation, resource depletion, and pollution were not problematic enough, global environmental change caused by human activities now threatens to "push the Earth system outside the stable environmental state of the Holocene, with consequences that are detrimental or even catastrophic for large parts of the world" (Rockström et al., 2009, p. 472). It is therefore of utmost importance that we understand what factors lead to more sustainable behavior. Fortunately, we at least understand the root of why people so often do *not* behave sustainably: it is so often not in their self-interest to do so (Ridley & Low, 1993). However, common property institutions can alter the material costs and benefits of sustainable behavior – and supernatural beliefs and cosmologies of human and nature interconnectedness can alter perceptions of costs and benefits of sustainable behavior.

In this dissertation I examine the efficacy of not only common property institutions but also cosmological beliefs for regulating natural resource use among the Miskitu people of Nicaragua. In particular, I am interested in understanding why some people behave more sustainably than others. Presumably those who perceive greater costs or benefits to certain behaviors will act accordingly. I take a mixed methods and interdisciplinary approach by using both quantitative and qualitative data and drawing on

ideas from economics, political science, psychology, and anthropology. Although a case study, it is largely driven by hypothetico-deductive reasoning that could be applied to other contexts. In the next sections I raise several theoretical considerations that frame the research, and I provide a brief overview of each chapter.

Theoretical overview

Sustainability: a social dilemma

In thinking about what factors contribute to sustainable behavior, it is useful to think about what things might limit it. It is easy to see very quickly that there are at least two major limitations. First, an individual may have a constrained set of behavioral options. For example, if there is no public transit, a person will not be able to use it. However, he or she might still have a choice between driving a car, bicycling, or walking to the destination. Clearly the decision among these options would be affected by the distance to be traveled. This brings us to the second major limit on sustainable behavior: the costs to an individual. Indeed, at its core, the problem of sustainability is a *social dilemma* because while our air quality would be better if everyone walked or biked to work, each of us might prefer the personal convenience of driving. According to Ostrom (1998), "Social dilemmas occur whenever individuals in interdependent situations face choices in which the maximization of short-term self-interest yields outcomes leaving all participants worse off than feasible alternatives" (p. 1). Social dilemmas are everywhere, and they are at the heart of environmental problems involving common-pool resources – such as forests, pastures, or fisheries – which are "resources for which exclusion is difficult and joint use involves subtractability" (Borgerhoff Mulder & Coppolillo, 2005,

p. 130).

Solutions to the dilemma

Yet many human societies have overcome social dilemmas (a.k.a., collective action problems) in order to manage their common-pool natural resources sustainably. Although Hardin (1968) argued that the only solutions to the "tragedy of the commons" were individual privatization or state control, a great deal of empirical evidence has accumulated showing that common property is a viable alternative (e.g., Agrawal, 2001; Feeny et al., 1990; Ostrom, 1990). Successful common property regimes are characterized by natural resource management rules that are not only well-suited to the local context but are also designed and enforced by those to whom they apply (Ostrom, 1990). Enforcement of the rules is fundamentally important (Gibson et al., 2005; Keane et al., 2008), but this presents a second-order collective action problem: who will incur the costs of monitoring and sanctioning? Communities have come up with various ways of compensating enforcers or otherwise sharing the costs of enforcement (e.g., McKean, 1992). However, common property is no panacea; its success is highly contingent upon many factors, such as how well enforcement is conducted (Acheson, 2006; Berkes, 2004).

Communities are made up of individuals

Its success also is facilitated by the extent to which community members' interests align. The community-based conservation and common property literature has not always paid enough attention to intracommunity tensions (Agrawal & Gibson, 1999;

Mansuri & Rao, 2004). However, by understanding the divergent interests within communities, we can better understand not only why some communities manage their resources well and others do not, but also why individuals cooperate with or, in the parlance of game theory, defect from the common property institutions. Social phenomena are, after all, the result of individual decisions and actions, even as these decisions and actions are affected by institutional arrangements. Thus, rather than viewing communities as homogeneous, we should recognize the diversity of actors, each with a unique perspective on the situation.

The role of cognition

Indeed, one general area of study that has not yet received much attention by common property researchers is cognition. Although social institutions – "the rules of the game" (North, 1990, p. 3) – are often studied at the community level (e.g., presence/absence of institutions), how people think about, feel towards, and respond to these institutions probably varies. For example, knowledge of the rules (Keane et al., 2011), expectations of sanctions (Nagin, 1998), and perceptions of legitimacy (Madrigal-Ballestero et al., 2013) all are likely to vary among individuals – and they are all likely to affect compliance with common property institutions. However, these cognitions are presumably related to the social reality of which an individual is a part (e.g., Do knowledgeable community members educate others about the rules? Are there individuals in the community who actually do sanction transgressors? Were the rules established through an inclusive, participatory process?). In other words, humans possess individual beliefs and agency, but they are also embedded in a social milieu and are

affected by what other people do.

Human-nonhuman relationships

What if that social milieu includes *nonhuman persons?* Common property theory, which is based on Western dualisms between people (subject/active) and resources (object/passive), does not incorporate the idea that the "resource units" themselves can be active agents that determine who has rights to access and use them (Schmidt & Dowsley, 2010). Yet, from the Inuit perspective, a polar bear has the "right to decide who may hunt it and when" (i.e., by presenting itself to a hunter) – and humans would be wise to respect the bear's authority in these matters (Schmidt & Dowsley, 2010, p. 384). Failure to show adequate respect to a bear could make it angry and retaliatory (Schmidt & Dowsley, 2010). In this case, then, enforcement of the "rules" of resource withdrawal is performed by a nonhuman person, the bear. Although the Inuit believe that resource scarcity is due to an improper relationship with bears, not overhunting per se (Schmidt & Dowsley, 2010), in other indigenous cultures people believe that overharvesting will be punished by supernatural guardians or owners of animals (Dennis, 2004; Reichel-Dolmatoff, 1976). If such beliefs affect behavior they could function similarly to sanctions delivered by humans.

Moreover, in many indigenous cosmologies, humans and nonhumans are bound together through kinship and the interconnectedness of all of nature. As Descola (2005) described for the Achuar of Ecuador, human-nonhuman relationships can be thought of as *social* relationships:

> Far from being considered prosaic stores of calories and proteins, the forest and the swiddens are seen as the theater of a subtle sociability wherein, day after day,

> one has to tame, seduce and coerce a host of leafy, furry, or feathery beings, that only differ from humans by the variety of their appearances and by their lack of articulated language. Whether they are treated as consanguines or as affines, natural beings do not appear as mere objects of the food quest but as legitimate social partners (p. 23).

Salmón (2000) described the Rarámuri concept of *iwígara* as "kincentric ecology" (p. 1328). He argued that *iwígara* guided Rarámuri land management towards sustainable practices based on reciprocal relationships with nature (Salmón, 2000). Other scholars have made similar arguments that indigenous cosmologies of interconnectedness, kinship, and nonhuman personhood promote sustainability (e.g., Chernela, 1987; Pierotti & Wildcat, 2000). However, human behavioral ecologists in particular have been skeptical that cosmological beliefs *cause* people to show restraint in wildlife harvests. Their skepticism arises due to theoretical reasons such as the underlying collective action problem discussed above, but also due to the empirical observation that hunters tend to hunt in ways consistent with predictions of optimal foraging theory rather than conservation (Alvard 1993, 1994, 1995).

Dissertation overview

This dissertation examines the issues raised in the preceding sections by focusing on costs and benefits to actors pursuing a prosustainability course of action. The study was conducted from February 2010 to January 2011 in Kipla Sait Tasbaika, one of six indigenous territories in the Bosawas Biosphere Reserve of north-central Nicaragua. Two focal Miskitu villages were selected because of their relatively small size and proximity to a larger village that was the seat of territorial governance. This proximity allowed for regular visits to the larger village to interview territorial-level leaders and to keep abreast

of issues related to governance for the territory. Importantly, Kipla Sait Tasbaika has a common property regime with written natural resource management rules that were developed through a participatory process, facilitated by nongovernmental organizations, during the 1990s. Moreover, according to the ethnographic literature (e.g., Cox, 1998; Dennis, 2004; Fagoth et al., 1998; Jamieson, 2009), the Miskitu people believe in punitive spirit guardians of certain natural entities. Thus, this field site presented an opportunity to examine the efficacy of both common property institutions and cosmological beliefs for regulating natural resource use.

In Chapter 2, I analyze the barriers to the efficacy of Kipla Sait Tasbaika's common property regime. I argue that de facto enforcement is weak because many of the natural resource management rules are logistically difficult to enforce and there are few individual incentives for people to enforce them. Partly as a consequence of these challenges, the ways in which the rules are enforced are perceived by some villagers as ineffective and unfair. Moreover, some question the very legitimacy of the rules. I suggest that through a participatory revision of the rules and enforcement system – perhaps facilitated by external actors – the costs of enforcement could be reduced, which should improve the functionality of the natural resource management system.

Chapter 3 extends the analysis in Chapter 2 by focusing on several cognitive variables that are hypothesized to relate to people's compliance with the natural resource management rules. Specifically, using statistical methods, I test whether people's perceptions of resource scarcity, knowledge of the natural resource management rules, or expectations of punishment (in terms of severity and certainty) affect the likelihood that they violated the natural resource management rules.

Chapter 4 turns to the relationship that people perceive they have with nonhuman persons. As with the previous chapters, I examine the role of sanctions – except here I am interested in people's expectations of punishment by spirit guardians of nature. Using quantitative methods, I test for a relationship between cosmological beliefs – about supernatural punishment, interconnectedness with nature, and nonhuman personhood – and measurements of actual wildlife biomass harvested. I also qualitatively analyze participants' rich commentaries about their cosmological beliefs in order to validate the measures used in the quantitative analysis and to appreciate the subtleties of people's perspectives.

Finally, in Chapter 5 I summarize the main findings, limitations, and implications. I conclude with several suggestions for future research directions.

CHAPTER 2

BARRIERS TO INSTITUTIONAL EFFICACY IN A COMMON PROPERTY REGIME: A CASE STUDY FROM NICARAGUA'S BOSAWAS RESERVE

Introduction

Common property institutions for the management and conservation of common-pool natural resources (i.e., resources characterized by problems of excludability and subtractability) do not always function well (Acheson, 2006; Barrett et al., 2001; Campbell et al., 2001; Dietz et al., 2003). Although common property institutions are supposed to structure human interactions and create incentives for cooperation, they are not necessarily well-designed (Barrett et al., 2001). Getting common property institutions right is difficult both because there are dozens of variables that may affect their success (Agrawal, 2001) and because institutions must be responsive to changing social and ecological circumstances: "successful commons governance requires that rules evolve" (Dietz et al., 2003, p. 1908). The intent of this paper is not to critique common property as a route to natural resource management but rather to highlight some of its vulnerabilities so that steps can be taken to build institutional efficacy and resilience. To this end, this paper takes a case study approach that will allow for a more nuanced understanding of the implementation difficulties faced by communities with recently

created common property institutions.

The present study is one of two related studies concerning the functionality of common property institutions in Kipla Sait Tasbaika, an indigenous territory in the Bosawas Biosphere Reserve, Nicaragua. In this paper, I argue that de facto enforcement is weak and institutional functionality is low because many of the natural resource management rules are difficult to enforce and there are few individual incentives for leaders and forest guards – many of whom lack adequate training and equipment – to do so. Moreover, even though the natural resource management rules were created through participatory processes, some villagers perceive them – and/or the way that they are enforced – as unfair, illegitimate, and unjust. These perceptions pose a barrier to compliance and thus to sustainable resource use. I further argue that these barriers to institutional efficacy – the logistical difficulties of enforcement, the lack of incentives for enforcers, and the perceptions of injustice – could be overcome through the financial and capacity-building support of external actors who facilitate participatory revisions of the rules and enforcement system. I make some specific recommendations, and I conclude with some general lessons for building institutional efficacy and resilience.

Theoretical background

Following Garrett Hardin's (1968) seminal essay on the inevitability of "the tragedy of the commons," many people, including policymakers, thought that the only options for protecting common-pool resources from over-exploitation were individual private property or state control (van Laerhoven & Berge, 2011). This view was challenged by empirical studies showing that communities can in fact manage their

common-pool resources successfully without individual privatization or state control (e.g., McKean, 1992; Ostrom, 1990; Tang, 1991). They do so through common property institutions. In contrast to open access, common property is a form of private property that is shared among a group of people who have rights of access and use as well as duties of natural resource management (Bromley & Cernea, 1989; McKean, 2000). Common property regimes are more successful if the resource boundaries are well-defined; rules are well-designed for the local context, self-imposed, and self-monitored; sanctions are graduated (meaning punishments become harsher with repeat offenses); and mechanisms are in place for the resolution of conflicts (Ostrom, 1990). These insights were accompanied by a shift in policy away from market- or government-based approaches to community-based approaches – and the "community" was hailed as a more effective and equitable route to natural resource management and conservation than privatization or state control (Mansuri & Rao, 2004).

Despite the new emphasis on community, it was no panacea; community-based conservation did not always succeed in protecting the environment and local livelihoods (Acheson, 2006; Berkes, 2004). Agrawal and Gibson (1999) critiqued the way that *community* was conceptualized by researchers and policymakers. Too often communities were assumed to be "small, territorially contained groups" that were homogeneous (in terms of language, ethnicity, religion, etc.) and bound together by common interests and shared norms (Agrawal & Gibson, 1999, pp. 634-635). They recommended that "research and policy move away from universalist claims either for or against community" and move toward more nuanced perspectives focused on the multiple actors and interests within communities and the processes and institutions that characterize and structure

interpersonal relationships (Agrawal & Gibson, 1999, p. 630). The value of recognizing intracommunity conflicts of interest is evident in studies of *elite capture* (i.e., when local elites dominate "participatory" processes and/or "capture" the benefits of community projects; Berkes, 2007; Mansuri & Rao, 2004; Platteau, 2004).

Following Agrawal and Gibson's (1999) suggestion, we see that individuals within a community do not all face the same costs and benefits for cooperating with common property institutions. In addition to important strength, status, and power asymmetries that can affect who is willing to punish whom (von Rueden & Gurven, 2012), sometimes a subset of community members is tasked with the responsibility of monitoring and sanctioning those who commit violations.[1] Without some form of material benefits these enforcers would be *altruistic punishers*. Experimental evidence and formal models show that, under certain conditions, people will incur costs to punish free riders (Fehr & Gächter, 2002; Gintis et al., 2003; Ostrom et al., 1992). However, it is one thing to incur small material costs to sanction an anonymous stranger in a low-stakes laboratory game; it is quite another to sanction one's neighbor or relative in the real-world where there is danger of a broken social tie, revenge, or even a feud (Adams & Mullen, 2012; Wiessner, 2005, 2012). Indeed, lab-based experiments show that when retaliation is an option, altruistic punishment declines (Nikiforakis, 2008; Nikiforakis & Engelmann, 2011).

In order to incentivize enforcers under these conditions, some form of

[1] Sometimes communities hire guards from outside the community, but poor, remote communities often do not have the funds to hire outsiders. In such cases, the community might compensate (not necessarily economically) those members that take on the role of detective or guard – or their rules might stipulate that every community member must serve in the role of enforcer on a rotating basis (see Agrawal 1994 and McKean 1992). Or, as will be discussed for the communities of the present study, voluntary service is expected of only a few select individuals.

compensation is necessary. However, if such compensation is not institutionalized, then enforcement becomes less likely (uncoordinated costly punishment is rare "in the wild," [Guala, 2012a, 2012b]) and the entire system of common property institutions is vulnerable to failure. Many communities have institutionalized incentives for enforcers in clever ways, such as by allowing enforcers to keep the fines they charge transgressors (McKean, 1992). Unfortunately, compensating enforcers does not guarantee that they will enforce in a manner that is procedurally just. For example, if the rules do not specify precisely how much will be charged for each kind of infraction, enforcers that are allowed to keep the fines they charge might be tempted to charge different fines of their allies and enemies. Clear rules and sanctions increase transparency and reduce opportunities for abuse of authority (McKean, 1992); they also help to legitimize the punishment and thus reduce the likelihood of counter-punishment (Guala, 2012b). Furthermore, notions of fairness, justice, and legitimacy affect people's willingness to comply with the law (Eggert & Lokina, 2010; Jenny et al., 2006; Kuperan & Sutinen, 1998; Madrigal-Ballestero et al., 2013).

Since the enforcement of natural resource management rules is critical for successful common property institutions (e.g., Chhatre & Agrawal, 2008; Gibson et al., 2005; Rustagi et al., 2010), it is important to understand barriers to institutional efficacy in general and enforcement in particular. The present study examines such barriers in the context of recently designed institutions for common property management in Nicaragua's Bosawas Reserve. The next section provides details concerning the creation of Bosawas, the indigenous territories, and the territorial natural resource management plans (including how they are to be enforced). Although the process that created Bosawas

was not participatory, the process that resulted in the management plans was. This historical perspective helps contextualize the subsequent analysis.

Case study background

The creation of Bosawas and the struggle for indigenous land titles

A presidential decree by Violeta Barrios de Chamorro in 1991 created the Bosawas[2] National Natural Resource Reserve out of 8,000 km^2 (subsequently found to be only 7,400 km^2 when actually measured) of mostly humid tropical broadleaf forest in north-central Nicaragua (Kaimowitz et al., 2003). Although this area was from the beginning described as a "core zone" surrounded by a "buffer zone" – and later it was declared a World Biosphere Reserve by UNESCO – it did not properly constitute a "core zone" as is generally meant in the terminology of biosphere reserves because there were indigenous groups living in the core zone that made their living by hunting, fishing, and farming (Stocks et al., 1998); the core zone was not an area of strict conservation. It was, however, an area that had been largely depopulated during the Contra war of the 1980s as inhabitants either joined armed groups in the fight or became refugees in other parts of the country or Honduras (Kaimowitz et al., 2003; Stocks, 2003). When people returned to their homeland in 1991, they "found themselves in a declared natural resource reserve that was not demarcated, had little government presence, and was under very active agricultural and pastoral invasion" (Stocks, 2003, p. 348). This invasion was encouraged by the government's decision to resettle many former enlisted men and officers in the frontier areas around the core zone (Kaimowitz et al., 2003; Stocks, 2003).

[2] "Bosawas" – or in Spanish, "Bosawás" – is often used in lieu of the acronym "BOSAWAS," which was formed by taking the first letters of local place names: the Bocay River, the Saslaya Mountain, and the Waspuk River (Kaimowitz et al. 2003; Stocks 2003).

Rather than accept this invasion, the indigenous residents chose to organize to protect their homelands. Isolated from the Pacific mestizo population for centuries, the indigenous communities of the Atlantic Coast and Coco River had never been fully controlled by the national government (Hale, 1994; Kaimowitz et al., 2003). The Miskitu in particular possessed a "militant ethnic consciousness" (Kaimowitz et al., 2003, p. 7; see also Bourgois, 1986). Many Miskitu had taken up arms against the Sandinistas to defend what they perceived as an affront to their autonomy and way of life (Hale, 1994) – and after the war, the Miskitu people maintained a pro-active approach to defending their land rights. In 1993, a meeting of various stakeholders – including government representatives, the United States Agency for International Development (USAID), The Nature Conservancy (TNC), representatives of indigenous groups in Bosawas, and others – was convened in Managua to discuss a provisional map of land claims (Stocks, 2003; Stocks et al., 1998). The discussion set off a series of events and collaborations between indigenous groups and NGOs, most notably TNC and Centro Humboldt, that involved a major participatory mapping project and demarcation of territorial boundaries for six indigenous territories (for a fuller description of the mapping and demarcation process, see Stocks, 2003, and Stocks et al., 1998). These efforts culminated, after many years of political struggle against a reticent national government, with the granting of territorial land titles in 2005 (Stocks et al., 2007).

The creation of the *normas ecológicas* for natural resource management

Throughout this process the Nicaraguan Ministry of Environment and Natural Resources (MARENA) sought to maintain the image of a ministry with some control

over Bosawas, particularly through the creation of the Technical Secretariat of Bosawas (SETAB) – but as Kaimowitz et al. (2003) pointed out, the Nicaraguan government has never had meaningful governance of the area. This is due in no small part to the lack of roads and basic infrastructure in Bosawas; it is simply extremely difficult and costly to maintain a government presence. Given the on-the-ground reality of limited government presence, TNC was acutely aware that the best route to conservation was through indigenous common property institutions:

> Land titling is a fundamental step for halting the advance of the agricultural frontier, the main threat to the reserve. Poorly funded and trained institutions in the area and limited enforcement of regulations create a situation of open access, with devastating effects for the reserve's ecosystems. It is very important to define clear rights to the natural resources in order to limit this open access. *The rationale behind giving communal land titles to indigenous groups is that the indigenous way of living is environmentally compatible with the reserve's goals.* (emphasis added; The Nature Conservancy, 2007, p. 5).

In many respects this rationale is valid. Satellite imagery data show that forest cover is preserved better in the indigenous territories of Bosawas than in the surrounding areas colonized by mestizos (Hayes, 2007a; Stocks et al., 2007). Research suggests that the local indigenous peoples' common property institutions – including a system of forest guards created with the support of NGOs (see Stocks et al., 1998) – are an important reason for limiting mestizo settlement on indigenous lands and protecting the forest's well-being (Hayes, 2007b).

On the other hand, there is some evidence of potentially unsustainable practices below the canopy. For example, tapirs, white-lipped peccaries, and spider monkeys are less abundant near indigenous people's settlements in Kipla Sait Tasbaika, a territory within Bosawas, indicating these species may be locally overhunted (Williams-Guillén et al., 2006). Subsistence hunting when human population densities are low can be

sustainable, but as human populations rise, overhunting becomes more likely. Similarly, as "traditional" practices give way to "modern" practices, some conservationists (e.g., Terborgh, 2000) worry that indigenous populations will have an impact no different than nonindigenous populations. This concern has led to the argument that indigenous peoples have a right to their ancestral lands regardless of their land use practices (see Stearman 1994). However, although this right may be true in a moral or theoretical sense, in practice there has been a long history of forced evictions of local people deemed hazardous to biodiversity (Dowie, 2005; West et al., 2006).

TNC, instrumental as it was for the territorial titling process, never lost sight of the importance of natural resource management rules for the local Miskitu and Mayangna communities within Bosawas (The Nature Conservancy, 2007). In particular, TNC was concerned that, given the decade of displacement during which many Miskitu and Mayangna depended on humanitarian organizations and observed mestizo practices, much traditional ecological knowledge had been lost and new ways of interacting with the land had been acquired (e.g., cattle ranching; The Nature Conservancy, 2007). Therefore, following the mapping effort, TNC worked with each indigenous territory to develop a set of natural resource management rules and enforcement mechanisms known as *normas ecológicas* (ecological norms). In contrast to many stories of top-down decision-making and imposition, the development of these *normas* for the indigenous territories of Bosawas stands apart as an exceptionally participatory process that fostered a feeling among indigenous groups that these rules were legitimate (Hayes, 2007b).

From 1994 to 1998, TNC also supported the creation of civil society organizations to represent each territory (Stocks, 2003; The Nature Conservancy, 2007).

As these indigenous associations gained recognition and received support from various NGOs for travel to participate in negotiations with the government, they became part of the governance structure for the area (Stocks, 2003). The right of indigenous peoples of the Caribbean Coast to self-govern and title their communal lands is codified in Nicaraguan law, namely the Autonomy Law passed in 1987 and Law 445 passed in 2003. Nonetheless, emerging indigenous associations do not necessarily have the experience to navigate the globalized web of government ministries, NGOs, and foreign donors (see Chapin, 2000).

Since the present study took place in only one of the six indigenous territories of Bosawas, the following discussion is limited to that territory. Of the six territories, Kipla Sait Tasbaika presents a particularly good location to focus on the efficacy of local natural resource management rules rather than boundary defense against encroaching mestizo populations because it does not border with the buffer zone like the other territories do. To the north is the Coco River – the border with Honduras – and to the east, west, and south are other indigenous territories. However, this is not to say that there are no issues of encroachment in KST, only that the presence of indigenous neighboring territories affords some protection.[3]

[3] For example, the press has reported significant problems of illegal settlement and deforestation in the indigenous territories of Mayangna Sauni Bu and Mayangna Sauni As, located to the southwest and southeast, respectively, of Kipla Sait Tasbaika (see "Indígenas piden expulsar a colonos de Bosawás," 2014, and Rogers, 2013).

Kipla Sait Tasbaika

Kipla Sait Tasbaika (KST) consists of 1,136 km^2 (Kipla Sait Tasbaika, 2001) and 16 communities, most of which are Miskitu.[4] The indigenous association that emerged from the process described above called itself the *Asociación para el Desarrollo del Sector Raudales* (KUNASPAWA). A booklet published in 2001 in Spanish, Miskitu, and Mayangna, and distributed widely throughout KST contained the *normas ecológicas de manejo* (Kipla Sait Tasbaika, 2001).[5] These *normas* outlined in plain terms who had rights of access and use as well as what should and should not be done by those with rights in order to maintain a healthy environment and sustainable subsistence system. In general, people of the indigenous communities within KST were allowed to hunt, fish, extract timber for houses or boats for personal use, and plant subsistence crops. Activities were restricted according to zones of use based on traditional land use patterns. These zones included: agriculture; hunting, fishing, and collection of plants; protection of springs and streams; gold panning; historical sites; and conservation. Some rules applied across all zones. For example, certain fishing technologies were prohibited (e.g., dynamite and plant toxins), the sale of timber to nonresidents of KST was regulated, and the clearing of virgin forest was discouraged.

[4] Based on population sizes given by two Nicaraguan ministries, CEDAPRODE and CONADETI (and reported in Williams-Guillén et al., 2006, and Acosta, 2010, respectively), the population of Kipla Sait Tasbaika grew from 4,500 in 2004 to 5,164 in 2009, which corresponds to a population growth rate of approximately 15%.

[5] These *normas* were originally published in 1998. According to the title page of the second edition (see Kipla Sait Tasbaika [2001]), the publication was made possible through financial support from USAID. The back cover also listed TNC, SETAB, the Center for Environmental Anthropology, Idaho State University, the *Centro de Derecho Ambiental y Promoción para el Desarrollo* (CEDAPRODE), and Alistar Nicaragua, indicating their involvement in some way.

Enforcement of the *normas ecológicas*

According to Kipla Sait Tasbaika (2001), the promotion and enforcement of this management plan is the responsibility of the *síndicos* of the territory, KUNASPAWA, and community leaders. A *síndico* is officially responsible "to represent the community in all matters concerning communal land and he is the overseer of that land, as well as the guardian of the land title documents" (Henriksen & Kindblad, 2011, p. 203). These groups were also charged with organizing and soliciting support for the maintenance and patrol of the territorial boundary, which are 3 m wide cleared paths through the forest that physically demarcate the border. Two forest guards from each community must clear these paths once every year as well as patrol them once a month and submit a written report of their findings to the *síndicos* and KUNASPAWA. If someone from outside of the territory is caught violating the rules, he or she will be brought before the appropriate authorities (unspecified) and charged a fine (unspecified). If someone from within the territory is caught, an appropriate sanction will be decided upon at a community meeting. Modification of the *normas ecológicas* can only occur through a territorial assembly at which all KST communities are represented (Kipla Sait Tasbaika, 2001). A decade later, at the time of field research for this study, these *normas* were still the de jure law – whether they were also the de facto law was a basic question under investigation in this study.

Methodology

This study draws on information acquired through structured and semistructured interviews as well as participant observation during fieldwork carried out from February

2010 to January 2011. Two small, neighboring villages (approximately 321 residents) were the focal communities of this study, but since a third, much larger neighboring community was the headquarters of territorial governance, I made regular visits there to keep abreast of broader territorial issues. I also conducted a few semistructured interviews with key leaders from this larger community. Research permission was first obtained from territorial-level leaders and then from the two focal villages during community meetings. Informed consent was obtained from individual participants. People received monetary compensation for their participation in the structured and semi-structured interviews.

In structured interviews with 122 participants, participants were asked about their perceptions of resource scarcity, expectations of sanctions for violations of the *normas*, and knowledge of the *normas ecológicas* (assessed through a "quiz"). Expectations of sanctions were determined by a set of questions following three vignettes. In one vignette, a fisher violated the fishing quota using an illegal technology (a diving mask). In another vignette, a hunter violated the law by killing three tapir when only one per trip is permitted. In yet another vignette, the character built and sold a boat to an outsider without first obtaining permission from KUNASPAWA (i.e., territorial-level permission). Although the vignette did not specify whether the sale was *for need* or *for business* – a distinction that, according to the de jure rules about the sale of wood, affects whether permission must be obtained at the communal or territorial level – most people thought that the character violated the law (Chapter 3). Further details about these methods, including the text of the vignettes, can be found in Chapter 3. To acquire a better understanding of people's overall perceptions of the *normas*, I followed the quiz with

some open-ended questions asking participants what they thought about these laws – were they good or bad? Did they think that they should be changed? Why?

Semistructured interviews were also conducted with village forest guards, village employees of government ministries, and local leaders. These interviews were topically focused, respectively, on forest guard training, activities, and support; community development projects, many of which had a direct impact on subsistence practices; and natural resource management rules, governance, and community issues more generally. Because levels of Spanish fluency varied widely across participants, I worked with Spanish-Miskitu interpreters as necessary. Interviews were not audio-recorded; rather, extensive notes were taken during and following the interviews. Information from informal conversations and my own observations also informed the analyses below.

De facto enforcement

I analyzed people's responses about whether they thought the *normas ecológicas* were good or bad – and whether they should be changed. Of 121 respondents, 48.8% expressed general satisfaction with the *normas* (at least as they understood them in the quiz). Most other respondents were somewhat less pleased. Of these, only 3 explicitly said that they wanted a "softer" law, although several of those who said they were fine with the current law said that it was *suave* (soft) – and they preferred it that way. Rolins[6] was perhaps the most honest about his reasoning: he preferred a soft law because sometimes he encounters and kills many animals while hunting – and with a strong law he might be thrown in jail. More common, however, were those who thought that there was a need for a stronger or better-enforced law. For example, Antonella noted that the

[6] All participant names are pseudonyms.

laws were good but there were problems too because people were always violating them by not respecting the trees, streams, and animals. Kiara wanted stronger laws and, pointing at her one-year-old baby, asked rhetorically, "what are the children that come going to eat?" Others expressed similar concern for the future generations. Some participants thought that either the certainty or severity of punishment was too low to serve as an effective deterrent. Jerónimo mused that "the people know the laws – but without punishment, they do their normal behaviors."

A consequence of doing "normal behaviors" seems to be increased resource scarcity. As is shown in Chapter 3, (1) many people used prohibited fishing tools and (2) many people perceived more fish and game scarcity than before[7] – yet few people violated the harvest quotas. This combination of facts suggests that local fish and wildlife populations have been depleted due to overharvesting. Certainly the connection between human foraging behavior and increased resource scarcity was salient for many villagers: 91% of 115 respondents thought wildlife was less abundant now (Chapter 3). Of the 105 respondents who thought that wildlife populations had declined, all identified human-related causes (i.e., overhunting, overfishing, new technologies like the diving mask, or increased human populations). In a few cases the participant thought that wildlife was less abundant but not in an absolute sense; the animals and fish were simply hiding or had run far away because of human activities. However, most people were quite aware that

[7] For example, Luana recalled how her father used to go fishing for just a little while and return with many fish, but "now you have to fish all day only to have fish for one time [meal]." Similarly, Iker remembered the period after returning from refugee camps in the early 1990s as a time of abundant wildlife. He described how easy agoutis were to catch because the dogs would chase them into the river where the women washing clothes would kill them with their hands and rocks – and a man could catch a large fish in the time it took his wife to cook *banano* (about 20 minutes). Iker also reflected on the increased vulnerability they now faced when he explained how he and his wife had survived on *wabul* (a drinkable banana mash) and fish during the 2005 plague of rats that destroyed the rice and bean harvest – "but now if there's no harvest, the people won't be able to survive because there are no fish."

animal numbers had declined and a typical explanation was "lots of people, and lots of hunting." For example, Thiago explained that "after the war there had been an abundance of fish because during the war there were no people. So the fish and animals multiplied. But as the population of people has grown a lot, the population of animals has fallen." Sulan, wearing the figurative hat of culture critic, said that the Miskitu "have the custom of *basala* [plant toxin used for fishing] – and all fish, from big to small, are killed – and now there are no fish in the streams."

Thus, the limited functioning of the *normas* system was widely perceived, and many people had opinions about why this was the case. Montserrat said, "the law is fine but the leaders don't do their part." This was a recurring complaint, and by "not doing their part" people generally meant that the leaders and/or forestguards did not enforce the law adequately. Alma quipped: "the leaders need new batteries because they are sleeping." Others pointed out that the leaders simply did not know what was going on in the communities. Simón explained that although the laws were good, the leaders did not observe the activities of hunters and fishers – so people were not afraid to violate the law. Josefina observed that "the leaders don't know what people do because they don't walk in the community and they don't observe – and furthermore the forest guards don't do their job. People walk free." However, she added that things were better now than before because "now there are law [*sic*] and forest guards." This latter point raises the possibility that perhaps some of the respondents who said they were content with the current laws were just glad that there is *some* form of natural resource management law – while others might be glad that the laws are poorly enforced. In his own analysis of community sentiment, Jorge thought people aligned mostly with this latter perspective:

> If I could, these laws that we have, I would set laws [that are] a bit more harsh. But as I am not leader, I can't change anything. But the majority of people think that a soft law is good. They don't want punishments. If we carry on with this soft law, we are going to terminate the natural resources.

Validating the criticisms made by some villagers, Ignacio, a territory-level leader, described the *normas ecológicas* sanctioning system by saying "this is a weakness." He explained that when a transgression is brought to the attention of the leaders, all the leaders are supposed to show up together at a meeting – but this does not actually happen. Usually only a few people show up for the meeting, and they do not want to bear the sole brunt of the transgressor's wrath. Nevertheless, he was able to recount an example of enforcement. People from a nearby village had complained about two young men who had overfished with prohibited fishing technology. They were put in jail for 3 days in addition to being required to do community service and pay a fine to the village making the complaint – but, he said, the prisoners had escaped and had yet to pay the fine. My own observations were that few people received sanctions for violations – and if a sanction was given it usually consisted of *consejo* (advice/good talking to).

Finally, de facto enforcement of the *normas ecológicas* was primarily carried out – and expected to be carried out – by the forest guards and communal and territorial judges; the *síndico* did not play a prominent role in this regard.[8] If a transgression involved outsiders illegally extracting resources, the police or military was expected to provide enforcement support – although the nearest outpost was approximately 3 hours away by motorized canoe.

[8] If there was a dispute among villagers concerning who had the right to plant on a certain swath of land, then the *síndico* would mediate.

Barriers to enforcement and compliance

There are several reasons why de facto enforcement was weak. First, the *normas ecológicas* include many different kinds of rules (see Chapter 3) – and some are easier to enforce than others. Some rules do not specify a concrete limit (e.g., chemical pesticides may be used, "but not in an extensive or intensive way" [my translation; Kipla Sait Tasbaika, 2001, n. pag.]) and therefore would be difficult to enforce in a fair and consistent way. Other rules specify a concrete limit, but whether someone had violated that limit would be difficult to know without very close monitoring – and perhaps the use of technology not readily available to the forest guards (e.g., each family can harvest no more than 10 lbs of fish each week). Other rules are expressed as community *values* more than as specific restrictions on behavior (e.g., wild animals that inhabit the agricultural zone like the nine-banded armadillo, agouti, and paca should be valued and preserved). Contrast the specificity of the rule stating that "you cannot cultivate or work within fifty (50) meters of the banks of small streams" with the rule, "you cannot make a latrine near a stream" (my translation; Kipla Sait Tasbaika, 2001, n. pag.). However, setting aside the problem of deciding what counts as "near a stream," it is at least easy to notice a latrine. Other violations are considerably more difficult to observe, especially if transgressors are intent on concealing them.

Indeed, some participants pointed out the ease with which the characters in the vignettes could conceal their illegal actions. Ariana said of the hunter who killed too many tapir, "well, since he was hunting alone, no one will know what he did. Therefore he won't be punished. But if someone does report him to authorities, he'll receive *consejo*." Gilberto thought that Jorge, the character who built and sold a boat to an

outsider without permission from KUNASPAWA, would be punished but the others would not be because "all the people are going to know that Jorge violated the law, but the fishers and hunters can catch a lot but nobody is going to know it." He went on to say that perhaps the hunter would tell his wife, but since he knows he's violating the law, he's not going to want to tell others about it. On the other hand, Martina thought that fishers *cannot* conceal their catches well because "they have to walk in the village with the fish to sell them. So the leaders are going to know." She then recounted how her brother, originally from the village but now living elsewhere, had fished often with a diving mask and the leaders told him that he needed to stop fishing like that here or else they would call the police (this would be an example of *consejo*). She said that now he does not fish here anymore.

Second, although enforcing the *normas ecológicas* within one's home village did not necessarily require much – if any – special equipment, there was little motivation for unpaid guards to incur the social cost of sanctioning their own family and friends. As Ignacio said, people feared the wrath of the transgressor. Although technically the guards might not need to confront somebody because they could write a report to the communal or territorial judge, in practice not all guards were literate. The training and general capabilities of the people who had taken on forest guard duties were major issues discussed at a territory-wide meeting of forest guards held in December 2010. According to one territorial-level leader, the delays that had plagued this meeting were due to delays in funding from an international donor that refused to release the funds because two other already-funded projects – one dealing with agriculture, the other sewing machines – had not yet submitted any reports. Although I was not able to verify this specific claim, the

lack of financial and institutional support for the forest guards was quite evident, and the link between funding of the forest guards and functioning of the formal natural resource management system was explicitly noted by Lorenzo, who observed that "in 2008 and 2009 the laws functioned better because the forest guards did their jobs. But since they don't receive pay, now they don't work."[9]

Although the focus of this paper is on enforcement of natural resource management rules among legal residents of the territory, the duties of the forest guards extended further and entailed additional costs. Enforcement of the territorial boundaries did not carry the same social risks, but the threat of violent retaliation was greater because in a confrontation with outsiders there were no kin or social ties to inhibit escalation. Fortunately, in practice the guards were not expected to patrol and clear the brush from the boundaries alone; it was a duty divided among the forest guards from the entire territory, and each subgroup was responsible for a segment of the border. These segments were long enough that they needed to be away for about 20 days. The forest guards with whom I spoke stressed the importance of having adequate equipment to fulfill these duties. They said they needed, among other things, machetes, hammocks, boots, raincoats, backpacks, flashlights, and uniforms. Moreover, they needed to get paid.

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[9] However, this is not to say that the only laws not enforced well were those that pertained to natural resource use. People complained of problems of theft and general disorderliness – but people were afraid to stand up to the criminals out of fear of retribution. Irene did not mince words about the matter: "Like the young men – like Daniel and Ian (pseudonyms) – [who] walk about like kings, always robbing people and not receiving sanctions. So you can say that the law does not work. There are many people who violate the law and do not receive sanctions." The problem of enforcement is one that small-scale societies with no police force must address. In fact, during the period of my fieldwork, there was a movement afoot in one of the villages to find a new community judge because the current one was ineffectual (and ultimately he resigned the position). A previous community judge explained to me that when *he* had been judge, he had been a strong one who could round up a group of young men with machetes and guns to track down and punish criminals. While such stories of past bravado must be taken with a grain of salt, I do not doubt that this particular individual's charisma contributed to his efficacy as judge, at least with respect to violations of the law that he thought warranted retribution.

In a subsistence economy, this kind of volunteer work leaves one – and one's family – vulnerable.

Perceived lack of legitimacy, fairness, and justice

According to Delfina, lighter violations are dealt with at the community level but more grave violations are dealt with by KUNASPAWA. The *normas* make this point implicitly because although a family *in need* can sell wood to people outside of the territory with permission granted by *community-level* leaders, wood cannot be sold *by contract* or *for business* without *territorial-level* permission. The distinction between selling *for need* versus selling *for business* seems to be a matter of judgment – a judgment loaded with ethical considerations and vulnerable to corruption.

Although I did not include a question explicitly about corruption in the formal interviews, people sometimes brought up the issue in conversation or in response to the general question about the *normas ecológicas*. Some participants thought that territorial leaders used money from fines for personal aggrandizement and ignored violations by their friends and relatives. Those concerned with the latter were in essence concerned with procedural justice. This notion was well-expressed by Diego who said:

> The law is good but [its] function is bad. The forest guards say that they are going to confiscate diving masks, but they don't do it. They talk but don't follow through – only once in a while they bother their enemies. Although one is poor, rich, Indian, or mestizo, over in Honduras the law applies because it is equal. But here, no. I give respect to a law if it is equal.

Given Diego's indictment of the forest guards, it is interesting to note that one of the forest guards also articulated the importance of treating people equally: "If we take the prohibited items from everyone, then no one can say they were the only person to have

their item taken. You have to be equal." To do this he thought it was necessary that the forest guards, community judges, and soldiers walk house to house to confiscate illegal tools *together*.

Another factor that likely affected perceptions of procedural justice was that specific guidelines for monitoring and sanctioning violations of the natural resource management rules had not been established. The *normas* simply stated that the community would decide what sanction to give on a case-by-case basis. Even if more specific guidelines were established, people would not necessarily know them; people did not have perfect knowledge of the rules as they were (Chapter 3). Yet, not being specific contributes to confusion. Responses to the questions about whether and how the characters in the vignettes would be sanctioned revealed that villagers had different opinions about what sanctions would be given for particular violations (Figure 1). Even though knowledge of the rules and expectations of punishment do not guarantee compliance (see Chapter 3), shared understandings of these institutions could help community members recognize procedural justice, which in turn could build people's trust and confidence in local institutions.[10] This is especially important in the local context where the natural resource management rules are viewed by some villagers as externally imposed and illegitimate despite the participatory design process.

For example, one day while talking with Diego and another man, Ricardo, the conversation turned to the topic of MARENA telling people what they can and cannot do.

[10] On the other hand, the *normas* specify that the community must gather together and collectively decide what sanctions to apply in particular cases. In theory this process should contribute to feelings of legitimacy, fairness, and justice. In the real world, however, the idealized potential of participatory processes is probably difficult to attain due to intracommunity alliances, conflicts of interest, fears of retaliation, and opportunity costs for attending meetings. Moreover, as discussed in this paper, people did not attribute failures of enforcement to failures of the *community* so much as to failures of *leadership*.

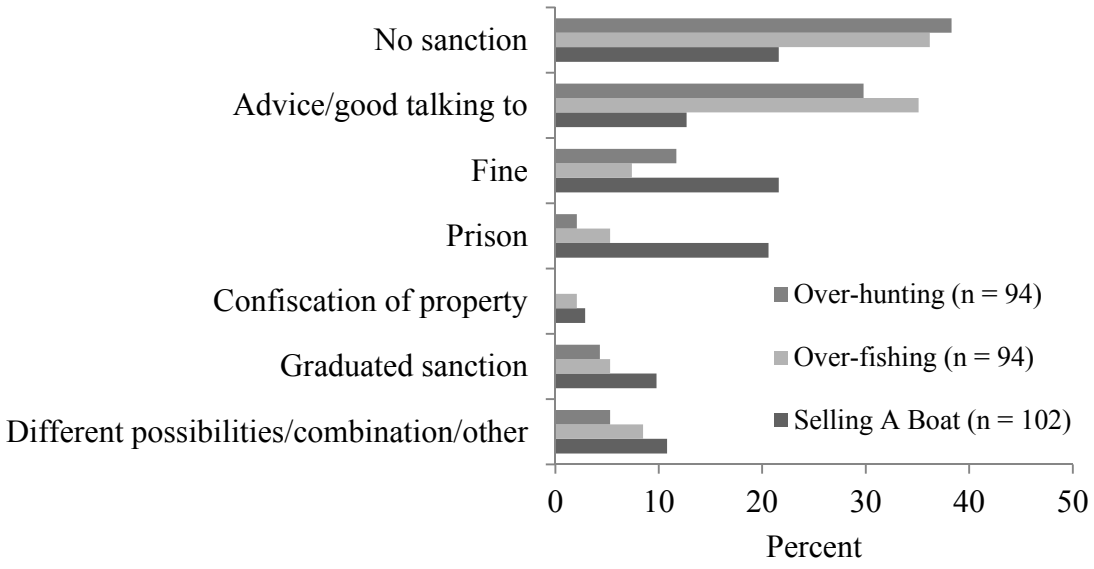

Figure 1. Expected sanctions for violations committed by characters in three vignettes. *Note*: *n*s in parentheses are the subset of respondents (out of 122) who thought that the character in the respective vignette had committed a violation of the natural resource management rules, and who therefore were asked whether the character would receive a sanction – and if so, what.

These two men were quite adamant that if the laws about selling boats or hunting were applied equally they would not have a problem with compliance – but as long as other people can do it without problems, they will continue to do as they like. Ricardo, evidently frustrated, queried the basic legitimacy of the rules themselves: "if MARENA says we can't hunt and fish, then what will the people eat? This is not for an external market that we kill, but for consumption. If we don't kill these animals, what will we eat?" In a separate conversation, Dante told me that perhaps the government did not want to eliminate poverty in his community because it feared that the people, if no longer poor, would buy chainsaws and clear more forest. He added that they might indeed clear the forest if they had more chainsaws, but that if the government did not want them to do so then it needed to send food supplies so that the people would not need to grow food. In support of his argument, Dante cited Nicaraguan Law 445 and said, "all indigenous peoples, we have the right to plant, to use the land."

This discourse of needs, rights, and justice pervaded the communities and was evident in people's reasoning about whether the characters in the vignettes would receive punishment. For example, Paula reasoned that the character in the boat vignette would escape punishment by explaining how he had violated the law out of necessity. Lola thought that although the characters had violated the law, they were unlikely to receive punishment "because animals are for eating" – and perhaps the fisher needed to take a lot out of necessity. "So," she explained, "for this reason they are going to receive light sanctions – because they too have the right." Winston, extending his analysis of justice to the global level, thought that the laws of KST (which explicitly recognize local people's resource use rights) should not be changed "because indigenous peoples have the right to

progress like those of other countries."

Discussion

Nearly half of the villagers surveyed in this study expressed some dissatisfaction with the functionality of the common property institutions in Kipla Sait Tasbaika. A common complaint was that the leaders and forest guards did not fulfill their enforcement duties. However, many of the rules were logistically difficult to enforce, and there were few, if any, individual-level incentives for these community members to bear the social and opportunity costs of enforcement. Furthermore, the perception that the rules and/or the way that they were enforced were illegitimate, unfair, and unjust served as a disincentive for compliance. In the following sections, I draw attention to specific areas where institutional efficacy could be improved, and I suggest a few ways this could be done. I conclude with a call for greater recognition by policymakers of a learning and adjustment period at the outset of any newly-created common property regime. Rather than prematurely labelling nascent institutions as "failures," further investment to allow for their constructive evaluation and modification to better suit local conditions, norms, and constraints is needed.

Improving institutional efficacy

The forest guards were not enthusiastic about monitoring and sanctioning their own family and friends – and most stories I heard of sanctions against *normas* transgressions were stories of territorial-level leaders imposing the sanction. The social distance between territorial leaders and local villagers may be a factor that contributed to

their willingness to confront rule violators. Indeed, there may be an optimal social distance for effective community-based enforcement (if the social distance is too great then the system ceases to be community-based and all the issues of external actors as enforcers apply). Explicit recognition of this could contribute to identifying which individuals should take on the roles of monitors and sanctioners.

However, there are other routes to improving enforcement efficacy. Recall that one of the forest guards suggested that the guards walk together with community judges and soldiers to confiscate all illegal tools from everyone at the same time. Doing this could transform the act of confiscation from a punitive one involving one person against another into a public demonstration of community solidarity – supported by the state – and an affirmation of the importance of a transparent and equal process. Given that some participants thought territorial leaders used money from fines for personal aggrandizement and ignored violations by friends and relatives, such a collective process would likely increase perceptions of procedural justice. This is a point worth emphasizing because some research has shown that sanctions *negatively* affect cooperation when the sanctioner's motives are perceived as selfish (Fehr & Rockenbach, 2003) – and in the present context, people's expectations of punishment were not associated with their compliance with the rules (Chapter 3). Procedural justice could also be improved through the clarification of sanctions. The codified rules do not specify what sanctions will be given for particular infractions, and there is no explicit mention of graduated sanctions even though some people expected sanctions to be lighter for first offenses (Figure 1). This lack of specificity opens the door for abuse (McKean, 1992), or at the very least, the perception of abuse since there will likely be discrepancies between expected and

received sanctions.

In the political context during which these rules were designed, it was extremely important to specify that the responsibility and authority to fulfill the *normas ecológicas* was in the hands of the indigenous communities rather than the Ministry of Environment and Natural Resources. Thus, the first steps toward successful common property management were the demarcation and securing of territorial boundaries, the receipt of legal land titles, and the recognition by the Nicaraguan government of local communities' rights to self-govern. Now that there is a degree of tenure security and autonomy – and many villagers perceive increasing resource scarcity and poor management of natural resources – it may be time for building local institutional efficacy through participatory revisions of the rules and clarification of the sanctions. Although such institutional change could happen informally, the *normas* specify that after no more than 3 years the management plan should be revised – and that such a revision requires a territorial assembly with representation from all of the communities. As I mentioned earlier, nearly 10 years later, no formal revisions had been made. However, there was evidence that the de facto institutions differed from the de jure ones in ways beyond poor implementation. For example, most participants thought that KUNASPAWA needed to grant permission to sell wood to people outside of the territory – even in the case of necessity, as was specified in a quiz question to assess people's knowledge of the natural resource management rules (see Chapter 3). This suggests that KUNASPAWA was expected to play a more prominent role in governance than was specified by the codified rules. One likely reason there had been no recent revisions to the rules is because bringing together representatives from 16 villages for a territory-wide assembly was costly. Often

institutional change occurs "only when relevant political actors perceive gains" (Agrawal, 2003, p. 245) – or perhaps when external funds are made available. The next section addresses the potential role for external actors in building institutional efficacy.

External actors as a source of institutional support

There is no blueprint for the role that external actors should have in community-based natural resource management; appropriate roles depend heavily on contextual details including local history and power asymmetries. Agrawal and Gibson (1999) argued that the funds for implementation of common property institutions should "be local, raised through contributions of users rather than granted by central governments" (p. 641). Their reasoning was that this was a way for local communities to gain authority and control to make their own conservation rules. (In the case of Kipla Sait Tasbaika, local communities already have self-governance authority and control, albeit limited due to the restrictions on activities within international biosphere reserves.) However, another argument based upon global justice could be made:

> Since the benefits of tropical-biodiversity conservation typically extend far beyond the communities of local resource users or the boundaries of their nations, a significant share of the costs of developing and maintaining the institutional capacity to internalize biodiversity externalities necessarily must fall on wealthy foreign individuals, organizations, and nations (Barrett et al., 2001, p. 501).

Recall Dante's suggestion that if MARENA did not want the Miskitu clearing more forest, then the government should supply them with food to eat. In essence, he was proposing a direct payment conservation strategy whereby people receive payments in return for biodiversity or habitat protection (Ferraro & Kiss, 2002). Advocates of "payment for ecosystem services" have been criticized for reducing nature to its

monetary and service value to humans (Sullivan, 2009) and for trying paradoxically to solve a problem created by markets with markets (Büscher, 2012). Viewed from another angle, however, there is a compelling case to be made for wealthy nations and people with large carbon footprints to offset the costs incurred by poor nations and people for protecting, as has been said of Bosawas, "the lungs of the world." In a more equal world, such exchanges would not be necessary.

Our world being as it is, there is not only an ethical but also a pragmatic argument for reflexive collaboration between local communities and external actors. Local institutions for common-pool resource management often are connected to a wide range of other players, including regional and national governments, civil society organizations, and international donors. Moreover, these connections are not necessarily stable, and new players enter and leave the system. For example, in 2008 a higher level of indigenous organization was established by presidential decree to bring together three indigenous territories, including KST, as the *Régimen Especial de Desarrollo* which would be administered by the *Gobierno Territorial Indígena*, the head of which would be rotated yearly among the presidents of each of the three territories. At the time of my field research, people seemed hopeful that this unification would strengthen the collective indigenous voice, particularly as concerned indigenous rights and access to opportunities for sustainable development, including through the direct solicitation of external assistance.

However, all external support is not equally helpful. Research has shown that unsolicited external support can "crowd-out" local adaptive initiatives, whereas external support solicited by local communities can increase them (Murtinho et al., 2013). Yet,

this is where things can get complicated. An immediate and very obvious solution to the weak enforcement in KST is to pay the forest guards for their work. Certainly this is a solution that the forest guards I spoke with expressed. Unfortunately, this does not resolve the deeper problems of rules that are inherently difficult to enforce and the costs incurred by other community members who are, according to the *normas*, supposed to participate in meetings to decide on appropriate sanctions for each offense. As one territorial leader observed, few people show up to these meetings because they do not want to receive the transgressor's wrath. In other words, the decision to show up at these meetings is itself a collective action problem. Thinking through how to solve these interconnected social dilemmas requires considerable effort, and there may be a role for external actors to provide financial and technical support for it.

General policy implications

There are compelling arguments for using dynamic feedback processes based on deliberate learning from experience to build institutional efficacy and robustness (Berkes, 2007; Ostrom et al., 2007). This learning could be largely "trial and error" – or it could be more directed and intentionally experimental, such as in *adaptive management* (Duncan & Wintle, 2008; Lee, 1999; Stankey et al., 2005). Certainly any management system should be expected to need revision as new technologies are adopted, new markets open up, people's aspirations change, and external support waxes and wanes. Moreover, given that many variables have been connected to the success of common property management (Agrawal, 2001), it is not realistic to expect a recently designed common property system to function perfectly from the outset. Rather than jumping to label nascent institutions as

"failures," researchers and policymakers should recognize not only that community institutions must be dynamic in a rapidly changing world, but also that there is most likely a necessary period of learning and adjustment. In other words, it takes time, effort, and very often funds, to design effective institutions. The key to long-term success is whether on-going evaluations of the system are used to make adjustments to improve it. In a globalized world, external actors (e.g., nongovernmental organizations) may have integral roles to play in facilitating this learning process and providing capacity-building and institutional support.

CHAPTER 3

THE COGNITION OF COMPLIANCE WITH COMMON PROPERTY INSTITUTIONS: A TEST OF FOUR HYPOTHESES

Introduction

Individual-level incentives play an important role in maintaining common-pool resources. A common-pool resource is a resource system where, like a private good, one person's extraction of a resource unit reduces the units available for others to extract, and like a public good, exclusion of users is difficult or costly (Andersson & Ostrom, 2008). This combination of private and public goods characteristics makes common-pool resources especially vulnerable to overexploitation. Aware of this vulnerability, Hardin (1968) argued that self-interested actors exploiting a resource open to all would result in a "tragedy of the commons." However, by focusing on open access scenarios – yet referring to them as "commons" – Hardin (1968) blurred the distinction between common-pool resource, common property, and open access (Cox, 1985; see also Bromley & Cernea, 1989). The distinction is not trivial. A common-pool resource is a type of resource (e.g., a pasture or forest), whereas common property and open access are types of property rights. A common property regime is essentially a "system of shared private property" (Johnson & Nelson, 2004, p. 707) through which a group of resource users share exclusive rights of resource appropriation and duties of resource management

(Bromley & Cernea,1989; McKean, 2000). Much research has shown that tragedies are far less likely under a common property regime than in an unregulated, open access, "free for all" scenario (e.g., Basurto, 2005; Berkes et al., 1989; Feeny et al., 1990; McKean, 1992; Ostrom, 1990).

However, even under a common property regime, the underlying problem remains: individuals could maximize their self-interest by taking more than the natural resource management (NRM) rules allow – that is, unless noncompliance results in penalties severe enough to produce a net cost to the actor. From a theoretical perspective, a rational egoist will respond in a self-interested manner to the costs and benefits associated with a particular course of action, including illegal behavior (see Becker, 1968). Consistent with this theory, a large body of field-based research suggests the importance of enforcement (i.e., monitoring and sanctioning) for successful management of common-pool resources (e.g., Chhatre & Agrawal, 2008; Gibson et al., 2005; Ostrom, 1990; Rustagi et al., 2010). These findings are corroborated by experimental studies showing the importance of punishment for preventing defection in social dilemmas (e.g., Fehr & Gächter, 2000; Shinada & Yamagishi, 2007).

Importantly, there is a cognitive aspect to a law's efficacy: awareness of the law, including the consequences of violating it, is generally considered a prerequisite for any deterrent effect (Keane et al., 2011; Ostrom, 2000; Robinson & Darley, 2004; Waldo & Chiricos, 1972). In support of this logic, some criminological studies of perceptual deterrence have found that those who perceive greater certainty and severity of punishment are less likely to break the law (Nagin, 1998; Wright et al., 2004). Given these cognitive considerations, it is perhaps unsurprising that successful common

property regimes are often established through participatory processes which not only ensure some local awareness of the rules but also increase the likelihood that the rules will be perceived as fair and legitimate, further contributing positively to compliance (Ostrom, 1990, 2000).

Participatory processes for conservation gained traction in the 1990s as an alternative to top-down approaches that neither respected local people's rights nor guaranteed conservation outcomes. Conservationists shifted away from the exclusionary fortress model of conservation and embraced community-based conservation and integrated conservation and development projects (Borgerhoff Mulder & Coppolillo, 2005). These people-oriented approaches are emblematic of sustainable development in that the goals of conservation and human well-being are viewed as simultaneously achievable if only the right strategies – which are fundamentally context-dependent – are used (Berkes, 2004; Ostrom et al., 2007).

However, even community-based conservation based upon participatory processes and local ecological knowledge, which is inherently context-specific, is not a panacea (Acheson, 2006; Berkes, 2004). In part this is because local ecological knowledge, while profoundly important for community-based conservation, is not necessarily integrated into the kinds of explicit social institutions associated with long-term, sustainable common property management systems (Lu, 2001). Indeed, much of the evidence of long-enduring, self-organized institutions for common-pool resource management comes from complex societies (e.g., intensive agriculturalists interested in regulating irrigation waters; see Ostrom, 1990), yet the areas of most interest to conservationists are areas of high biodiversity and low human population density. These

areas are often home to small-scale, indigenous societies that may not have experienced the resource scarcity necessary to motivate the development of an explicit set of natural resource management rules (Lu Holt, 2005; Lu, 2001; Smith & Wishnie, 2000). Lu (2001) argued that the notion of resource scarcity is a necessary condition for conservation because "natural abundance obviat[es] the need for conservation" (p. 442; see also Smith, 2001). The presumption that local ecological knowledge alone is sufficient for conservation can leave some communities without adequate institutional tools to live sustainably, especially as their populations grow and acquire more efficient extractive technologies. Where existing institutions are weak, institution-building may be necessary (Berkes, 2004; Chapin, 2000). This is not a task that can be completed quickly or cheaply; external financial and technical support may be necessary, especially in the context of the developing world where effective enforcement is severely limited by economic and infrastructure constraints (Keane et al., 2008).

The present study is one of two related studies (see also Chapter 2) that examine the efficacy of common property institutions in Miskitu communities of the indigenous territory, Kipla Sait Tasbaika, part of the Bosawas Biosphere Reserve, Nicaragua. Here, I test hypotheses about the role of four cognitive variables in people's compliance with local natural resource management rules. Specifically, individuals were hypothesized to be *less* likely to violate formal natural resource management rules if they perceived greater natural resource scarcity (hypothesis 1), possessed greater knowledge of the natural resource management rules (hypothesis 2), or expected more *severe* (hypothesis 3) or *certain* (hypothesis 4) punishment for violations. Kipla Sait Tasbaika presented a good location to test these hypotheses because of its codified common property regime

formed through participatory processes. Its codification allowed for the easy identification of de jure rules, and its formation through participatory processes meant that violations of rules would be more likely to be responses to individual-level, self-interested incentives than expressions of political resistance against an oppressive external authority (but see Chapter 2; see also Robbins et al., 2006).

Methods

Study site

Kipla Sait Tasbaika (KST) is 1,136 km^2 (Kipla Sait Tasbaika, 2001) and one of six indigenous territories of the Bosawas Biosphere Reserve in north-central Nicaragua. Although the Bosawas Reserve was created by presidential decree in 1991, the subsequent creation of these indigenous territories occurred through a participatory mapping process that resulted in the granting of communal land titles in 2005 (Chapter 2; see also Stocks, 2003, Stocks et al., 1998, and Stocks et al., 2007). The Nature Conservancy and other nongovernmental organizations provided capacity-building support during this process and contributed to the creation of indigenous civil society associations, including one for KST called the *Asociación para el Desarrollo del Sector Raudales* (KUNASPAWA; Stocks, 2003; The Nature Conservancy, 2007). The Nature Conservancy and other organizations subsequently worked with KUNASPAWA and the residents of KST to develop a set of rules for natural resource management.

This participatory process produced a set of *normas ecológicas de manejo* (see Kipla Sait Tasbaika, 2001), which were published in Spanish, Miskitu, and Mayangna,

and distributed widely throughout the territory.[11] As Chapter 2 described,

> These *normas* outlined in plain terms who had rights of access and use as well as what should and should not be done by those with rights in order to maintain a healthy environment and sustainable subsistence system. In general, people of the indigenous communities within KST were allowed to hunt, fish, extract timber for houses or boats for personal use, and plant subsistence crops. Activities were restricted according to zones of use based on traditional land use patterns. These zones included: agriculture; hunting, fishing, and collection of plants; protection of springs and streams; gold panning; historical sites; and conservation. Some rules applied across all zones. For example, certain fishing technologies were prohibited (e.g., dynamite and plant toxins), the sale of timber to nonresidents of KST was regulated, and the clearing of virgin forest was generally discouraged. (p. 19).

A selection of specific rules can be found in Table 1.

The two adjacent Miskitu villages selected for this study were chosen because of their proximity to a third, much larger, village that was the seat of territorial governance. This proximity allowed for regular visits and facilitated interviews with territorial leaders about the common property regime (see Chapter 2). The smaller sizes of the focal villages were better suited for building rapport and engaging in participant observation – particularly important when studying behavior that may be covert.

Data collection

Data were collected during fieldwork from February 2010 to January 2011. Permission to conduct research was granted by territorial leaders as well as the two focal communities during community meetings, and individual-level consent was obtained from each study participant. Participation, which was compensated monetarily, was open to all adults (18 years and older) residing in the two focal communities. Structured

[11] According to the title page, this publication was made possible through financial support from USAID. The back cover also listed The Nature Conservancy, *Secretaría Técnica de Bosawas* (SETAB), the Center for Environmental Anthropology, Idaho State University, the *Centro de Derecho Ambiental y Promoción para el Desarrollo* (CEDAPRODE), and Alistar Nicaragua, indicating their involvement in some way.

Table 1

Quiz questions to assess knowledge of natural resource management rules in Kipla Sait Tasbaika

	Question	Correct response	% Correct of sample in parentheses	% Equal to or below formal limit[a]	Evidence of informal rule
1	You cannot cultivate or work within 50 meters of the banks of small streams.	Yes	90.2 (122)	----	----
2	The conservation zone should be utilized frequently to hunt, fish, and cut trees.	No	55.7 (122)	----	----
3	In the case of necessity, a family can sell wood to people from outside the territory without written permission from the Board of Directors of KUNASPAWA.	Yes	23.1 (121)	----	strong
4	In January and February, or during the period of reproduction for fish, fishing is limited to the use of hooks only.	Yes	81.1 (122)	----	----
--	Which of the following technologies are completely prohibited within the territory?				
5	bow-and-arrow	No	60.0 (120)	----	----
6	fishing hook	No	95.1 (122)	----	----
7	*taralla* (type of fishing net)	Yes	47.9 (121)	----	----
8	*li pistalka* (complex fishing harpoon)	Yes	71.3 (122)	----	----
9	*máscara* and *varilla* (diving mask and simple fishing harpoon)[b]	Yes	76.2 (122)	----	----
10	poison for fishing	Yes	92.6 (122)	----	----

Table 1 continued

	Question	Correct response	% Correct of sample in parentheses	% Equal to or below formal limit[a]	Evidence of informal rule
11	According to the law, in the zone of frequent hunting and collection of plants, fishing and hunting is limited to how many trips per month per family?	2 trips	27.0 (122)	55.4 (121)	moderate
12	According to the law, fishing is limited to no more than how many pounds per week per family?	10 lbs	8.2 (122)	89.8 (118)	strong
13	According to the law, for nine-banded armadillo, paca, collard peccary, and white-lipped peccary, it is permitted to take no more than how many animals in one trip?	4 animals	2.5 (121)	98.3 (121)	very strong
14	According to the law, in the farthest zone of infrequent hunting and collection of plants, hunting and fishing is limited to how many visits per year per family?	4 trips	6.6 (122)	86.8 (121)	strong

[a] The sample sizes differ from the percent correct column because "don't know" responses were coded as incorrect for calculating the percent correct, but were excluded for calculating the percent below the formal limit.

[b] The Spanish version of the *normas ecológicas* only lists *máscara*, but the Miskitu version also lists *trisba*, which is a general term for dart or arrow but, as a forest guard explained to me, refers specifically to the *varilla*. Since in practice these technologies were used together (although the *máscara* was also used with the *li pistalka,* a less common tool than the *varilla*), I included them together much like the "bow-and-arrow" represent one method.

Note: For open-ended questions 11-14, if a range of values was given, if one number was given for small families and another for large families, and/or if the answer differed across species, the average was recorded. If the response was for a different period of time, the amount per relevant unit of time was calculated.

interview questions were translated and back-translated with the assistance of local Spanish-Miskitu interpreters.

Violations

Observational data on wildlife harvests were collected from early May through late December primarily by local field assistants whom I hired, trained, and provided with data forms and field equipment. The assistants monitored the comings and goings of villagers in order to conduct a brief interview and weigh catches of those returning from successful foraging trips. Since not all houses were visible simultaneously, the assistants conducted "rounds" through the communities from 6:00 AM to 7:00 PM, except on Sundays when assistants only worked from 6:00 AM to 8:00 AM. Sunday was considered the most important day for eating well (i.e., eating meat), but as a Christian day of rest, it was not considered a good day for hunting, although sometimes hunters would go late on Saturday night or early Sunday morning. That the assistants were locals greatly enhanced their capacity to keep track of people's activities – and often villagers would alert the assistants as to the whereabouts and activities of household members. In general the communities were quite cooperative and participants either waited for assistants to come by or actively sought them (or me) out. Sometimes parents would send their children to alert us that they had returned with a catch.

Aquatic and terrestrial faunas were weighed with a hanging digital scale, and the species (as determined by the assistant, often in consultation with others present), age (juvenile or adult), sex, and count were also recorded when possible. Other information recorded included: who went on the trip; what hunting or fishing technology was brought

by each person; and to whom the actual act of "the kill" or "the catch" was attributed. For example, often fishers and hunters would bring helpers who, in the case of fishers, might stand on the rocks protruding from the water and collect the fish tossed to them by a fisher using a diving mask and harpoon.

The information collected by these measurements and interviews allowed for the identification of violations of certain natural resource management rules. Specifically, the total number of times a participant took an illegal tool on a foraging trip; the number of times that a participant's fishing harvest contributed to his or her family's violation of the 10 lb weekly fishing limit; and the number of trips a participant took during which more than 4 pacas, nine-banded armadillos, collard peccaries, or white-lipped peccaries were killed (see rules 7-10, 12, and 13 in Table 1).

Cognitive variables

Perceptions of resource scarcity (hypothesis 1) were assessed through a set of simple, open-ended questions: "Do you think that now there are fewer wild animals and fish than before? Why?" To assess people's knowledge of the formal NRM rules (hypothesis 2), a quiz based on the published *normas ecológicas* was developed (Table 1). The questions were a combination of yes/no and open-ended formats. Answers were coded 0 = incorrect answer, 1 = correct answer. In practice, people sometimes seemed confused as to whether they were being asked about de jure or de facto laws (see below for further discussion of this issue), but I found that emphasizing that the task was a "quiz" helped clarify that I wanted to know their understanding of the de jure laws.

To assess people's expectations of punishment, three short vignettes were used in

which hypothetical scenarios described characters engaged in certain actions that violated the laws laid out in the *normas* (Table 2). Following each vignette, participants were asked whether they thought the imaginary characters had violated the law of KST, and if so, whether – and how – they would be punished (Table 3). *Severity* of punishment (hypothesis 3) refers to whether participants thought the characters would be punished harshly, lightly, or not at all (higher values = more severe); only participants that thought the character violated the law were included. *Certainty* of punishment (hypothesis 4) refers to a participant's degree of conviction (where 1 = not certain, 7 = very certain) that the character would indeed be punished; only participants that thought the character violated the law and would receive punishment were included. Because the vignette in which a character sold a boat without territorial-level permission (see the "Selling a Boat" vignette, Table 2) did not specify whether the sale was *for need* or *for business* – a distinction that the de jure law makes – responses to this vignette were excluded from the analyses below (inclusion does not qualitatively affect the results).

Control variables

Formal education was thought to be important to control for because people with greater education would likely be better able to read (and thus know) the codified laws, they would be more likely to have received environmental education in school, and they would be more likely to have jobs such as teaching in the local schools or working for a government ministry that would not only limit their time available for foraging but also allow them to purchase much of their food from local general stores or active foragers. Since the more foraging trips an individual took, the more likely it was that he or she

Table 2

Vignettes to assess expectations of punishment for noncompliance with natural resource management rules of Kipla Sait Tasbaika

	Vignette
Selling A Boat[a]	Jorge lives in Kipla Sait Tasbaika. Jorge made a large boat and sold it to a man from Li Lamni. Jorge did not receive permission from KUNASPAWA.
Over-Fishing	Mateo lives in Kipla Sait Tasbaika. Mateo is a good fisher. When the river is clear, he fishes almost every day. He uses a diving mask and harpoon. He always takes a lot of fish. In this week he caught more than 10 lbs of fish.
Over-Hunting	Julio lives in Kipla Sait Tasbaika. Julio is a good hunter. He hunts 2 or 3 times every week. One day he is hunting with a rifle in the bush and he encounters a group of tapir. He kills three tapir: 2 adult females and 1 adult male.

[a] Responses to this vignette were excluded from the measures of expected punishment for violating the natural resource management rules. See text for details.

Table 3

Responses to questions following noncompliance vignettes[a]

Question		**Response Summary**			
		Response Description	***Selling A Boat***	***Over-Fishing***	***Over-Hunting***
1	Do you think that [the character] violated the law of KST?	% yes	83.6 (122)	77.0 (122)	77.9 (122)
If respondent answered "yes" to the preceding question, then the following questions were also asked. Percentages given reflect only the relevant subsets of respondents.					
2	Do you think that [the character] is going to receive a sanction?	% yes	78.4 (102)	63.8 (94)	61.7 (94)
3	[If yes] What sanction?	% advice/good talking to	16.3	55.0	48.3
		% fine	27.5	11.7	19.0
		% prison	26.3	8.3	17.2
		% confiscation of tools/property	3.8	3.3	0.0
		% graduated sanction	12.5	8.3	6.9
		% combination of above, or other	13.8	13.3	8.6
			(80)	(60)	(58)
4	Do you think that this sanction is harsh or light?	% harsh	44.9 (78)	26.7 (60)	26.8 (56)
5	Do you think that it is very certain that [the character] is going to receive a sanction?	average degree of certainty based on Likert scale where 1 = very uncertain, 7 = very certain	5.3 ± 1.8 (76)	5.4 ± 1.6 (57)	5.4 ± 1.7 (56)

[a] Sample sizes given in parentheses.

would be observed committing a violation, the number of foraging trips was controlled for as well. The tally of foraging trips includes trips that were not focused exclusively on hunting or fishing (e.g., an animal was encountered and killed while participant was on the way home from weeding a garden), and it includes only *successful* trips (i.e., excursions during which wild fauna – including fish, mammals, birds, reptiles, crustaceans, and/or snails – were actually caught/collected by *anyone* in the foraging party). Although the NRM rules only prohibit certain fishing tools, it is plausible that a forager could have taken and used an illegal fishing tool unsuccessfully – but was able to make the most of the trip by collecting some river snails; thus, all successful faunal harvesting trips are included in the tally. Sex was also controlled for because Miskitu men and women engage in different subsistence activities (e.g., although both men and women fish, generally only men hunt), and use different tools (in particular, only men fish with diving masks). See Table 4 for definitions and summary statistics for the dependent and independent variables.

All statistical analyses were performed with R 3.1.0.

A word about scientific and ethical considerations

The foremost scientific difficulty in any study of illicit behavior is that individuals may be motivated to conceal their illicit behavior. To reduce the incentive for people to provide false or otherwise misleading information, researchers investigating illegal harvests of natural resources should avoid having ties to regulating agencies (Gavin et al., 2010) – and I did not have any, a fact that became generally appreciated by the villagers. Indeed, an important methodological advantage of extended participant-observation – a

Table 4

Definitions and summary statistics of variables

Variable		Definition	*n*	Mean	*SD*	Range
Dependent						
	Violations	Total number of times • Took an illegal fishing tool on foraging trip • Contributed to his/her family exceeding the limit of 10 lbs of fish per family per week • Participated in a foraging trip during which more than 4 pacas, nine-banded armadillos, collard peccaries, or white-lipped peccaries were taken	145	1.47	3.23	0-28
	Cooperator / violator	Classification as "cooperator" (0) or "violator" (1) based on above evidence	145	0.47	0.50	0-1
Explanatory						
(H1)	Perceived resource scarcity	Belief that there are fewer animals now than before (0 = no, 1 = yes)	115	0.91	0.28	0-1
(H2)	Knowledge of formal NRM rules	Score from NRM rule quiz (possible scores: 0-14)	117	7.36	1.74	3-10
(H3)	Perceived *severity* of civic punishment	Belief that characters in two formal rule vignettes would be punished harshly (2), lightly (1), or not at all (0)	82	1.63	1.28	0-4
(H4)	Perceived *certainty* of civic punishment	Conviction that characters in two formal rule vignettes would receive punishment (1 = very uncertain, 7 = very certain)	47	10.73	2.57	5-14
Control						
	Age	Age in years	142	33.5	14.9	18-78

Table 4 continued

Variable	Definition	*n*	Mean	*SD*	Range
Formal education	Maximum education of participant	143	6.59	3.73	0-13
Foraging trips	Number of trips during which someone in participant's foraging party harvested wild fauna	145	9.34	10.56	0-72

method which was noticeably absent from the recent review by Gavin et al. (2010) of methods for measuring illegal natural resource behavior – is that rapport, trust, and friendship develop between researcher and study participants. Moreover, as a participant-observer, one learns who is doing what through local gossip in addition to direct observations. For example, in a community with limited means of food storage, harvest quantities in excess of what the household can readily consume are usually gifted or sold; it is difficult to gift or sell large quantities of anything without this being common knowledge in the community. Thus, the noncompliance harvest data should be meaningful even if they are underestimates. The noncompliance tool use data are more susceptible to concealment because these data, while sometimes directly observed, were often self-reported during interviews. The issue of concealment will be revisited below.

The foremost ethical consideration in research on illicit behavior is that participants could face penalties if their illicit behaviors are exposed to authorities. In the case of indigenous communities – often marginalized and lacking secure land tenure – the risk is compounded if high rates of violations prompt governments to take punitive actions against entire communities. Therefore, any given study's risks to individuals and communities must be assessed on a case-by-case basis.[12] As described in Chapter 2, the existence of Nicaraguan laws that recognize indigenous rights, the granting of communal land titles to the indigenous territories of Bosawas in 2005, and the fact that the formal natural resource management rules of KST were created through participatory processes and do not require specific sanctions for violations (i.e., the community collectively decides for each case) all indicated that risks to study participants and communities were minimal. To my knowledge no participant received a sanction as a result of participation

[12] This research was approved by the Institutional Review Board of the University of Utah.

in this study.

Results

Sample

Approximately 321 people resided in the focal study villages, and 75 men and 70 women participated in the study. Although I sought to include all adult residents in all aspects of the study, due to people's comings and goings, not all information is available for all participants (see Table 4). The subject of NRM rules and expectations of punishment was covered in the second of two long interviews, with a subset of 122 participants. This subset includes at least one adult from each household (44 households at start of study; 49 at end of study).

Preliminary analyses

The results of Welch's t-tests indicated that mean values for knowledge of the NRM rules (i.e., quiz scores), severity of punishment, and certainty of punishment did not differ significantly among participants according to their sex or village of residence (alpha = .05). Although it is possible that people who took the knowledge quiz later might have heard about it from those who had already taken it – and therefore could have prepared for it – there was no correlation between quiz score and the order in which people were surveyed ($r = 0.06$, $p = .53$). The results of nonparametric Wilcoxon rank-sum tests showed that mean number of violations did not differ significantly between sexes ($W = 2421$, $p = .38$) or villages ($W = 1514$, $p = .18$). Therefore, the data for men and women and for the two villages were combined in all subsequent analyses to increase

sample size. None of the four cognitive variables were significantly associated with each other. Of the total 145 participants, 68 committed at least one violation of the formal natural resource management rules. Because over half of the participants did not commit any violation (or at least there is no evidence of their violations), and 91% committed fewer than 4 violations, the variable was dichotomized such that 0 = no evidence of violations and 1 = evidence of at least 1 violation.

Main analyses

In order to test whether the four cognitive variables were associated with transgressions of the *normas*, a series of binary logistic regression analyses were performed with status as either a "violator" (i.e., having committed at least one violation) or "cooperator" (i.e., having committed no violations) as the dependent variable.

H1: Perceived resource scarcity

Out of 115 respondents, 87% thought that there were fewer animals now than before, and another 3% thought that now there were fewer fish even though there was the same amount of terrestrial animals. Since there were too few cases of individuals who thought only fish had declined to analyze separately, I combined these two groups into one that perceived fewer resources now than before and compared it against those that did not perceive fewer resources to see if people who perceived resource scarcity were less likely to have committed at least 1 violation of the NRM rules; they were not (χ^2 (1, n = 115) = 0.39, p = .53). Controlling for total foraging trips, sex, and formal education in a binary logistic regression analysis also found no significant relationship between

perceived resource scarcity and violation of the NRM rules (Model 1, Table 5). Lumping the 4 participants who perceived scarcity in terms of fish but not land animals with those who did not perceive any scarcity did not qualitatively change these results.

H2: Knowledge of management rules

As shown in Table 1, responses to the open-ended quiz questions indicated that (1) most people did not know the exact limits specified in the *normas ecológicas*, and (2) most people thought that the codified limits were *below* what they actually were. To the extent that people's understanding of the rules affects their behavior, people should have been likely to comply with these quotas, and this is what the data show, at least for the two questions for which data were collected. Only 14 violations of the 10 lbs per family per week fishing limit occurred across 63 families over 33 weeks. Eight of these violations were committed by the same family. Only 1 individual violated the limit of no more than 4 nine-banded armadillos, pacas, collard peccaries, or white-lipped peccaries in one trip – and according to the data, he only violated this rule on two occasions. Thus, most violations had to do with taking a prohibited fishing tool on a foraging trip.

People with greater knowledge of the NRM rules were not more likely to have committed a violation than those with less knowledge after controlling for total foraging trips, sex, and formal education (Model 2, Table 5). However, since knowledge of the NRM rules was assessed through a quiz that included open-ended questions that most people got wrong because they gave responses that were *below* the formal limit, these answers – although technically incorrect – should be associated with fewer violations if people abided by the limits as they understood them. A logistic regression analysis with a

Table 5

Results of logistic regressions with violator/cooperator (1/0) as dependent variable

Variable		Model 1[a] (Scarcity)			Model 2[b] (Knowledge)			Model 3[c] (Severity)			Model 4[d] (Certainty)		
		B (*SE*)	OR	95% CI	*B* (*SE*)	OR	95% CI	*B* (*SE*)	OR	95% CI	*B* (*SE*)	OR	95% CI
(H1)	**Resource scarcity**	**0.79 (0.82)**	**2.21**	**0.48-12.73**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**
(H2)	**Knowledge of NRM rules**	**---**	**---**	**---**	**0.11 (0.13)**	**1.12**	**0.88-1.44**	**---**	**---**	**---**	**---**	**---**	**---**
(H3)	**Severity of punishment**	**---**	**---**	**---**	**---**	**---**	**---**	**0.05 (0.21)**	**1.05**	**0.69-1.61**	**---**	**---**	**---**
(H4)	**Certainty of punishment**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**---**	**0.11 (0.13)**	**1.11**	**0.86-1.47**
Foraging trips		0.17*** (0.04)	1.19	1.10-1.30	0.15*** (0.04)	1.16	1.09-1.26	0.17*** (0.05)	1.18	1.09-1.32	0.15* (0.06)	1.16	1.05-1.34
Sex (0 = female, 1 = male)		-0.08 (0.46)	0.92	0.37-2.27	-0.21 (0.46)	0.81	0.33-1.96	0.03 (0.55)	1.03	0.34-3.02	---	---	---
Formal education		0.20** (0.07)	1.22	1.07-1.40	0.17* (0.07)	1.18	1.04-1.35	0.22** (0.08)	1.24	1.06-1.48	0.21* (0.11)	1.24	1.02-1.56

[a] Model χ^2 (4) = 37.8, $p < .0001$, $n = 115$
[b] Model χ^2 (4) = 34.9, $p < .0001$, $n = 117$
[c] Model χ^2 (4) = 27.7, $p < .0001$, $n = 82$
[d] Model χ^2 (3) = 14.2, $p < .01$, $n = 47$
* $p < .05$, ** $p < .01$, *** $p < .001$

generous scoring of the quiz (i.e., scoring as "correct" all those responses to the open-ended questions that were below the formal limit) – and controlling for total foraging trips, sex, and formal education – found results similar to the harder version of the quiz (B = 0.19, SE = 0.13, OR = 1.20, 95% CI = 0.94-1.56, p = .14, n = 112).

H3: Perceived severity of punishment

Responses to the vignettes revealed that most people thought the characters had violated the law of Kipla Sait Tasbaika (Table 3). Of those participants who thought that the characters had violated the law, majorities thought that the characters would receive some kind of light punishment. However, people with greater perceived severity of punishment were not less likely to have committed a violation than those with lower perceived severity, after controlling for total foraging trips, sex, and formal education (Model 3, Table 5).

H4: Perceived certainty of punishment

Respondents were, on average, moderately certain (mean = 5.36 on 7-point Likert scale; see Table 4) that punishments would be received. Since sex was not associated with likelihood of being a violator of the NRM rules – and since data on certainty of punishment were available for only 47 respondents (see Table 3) – in order to increase degrees of freedom in the logistic regression with certainty of punishment, only total foraging trips and formal education were included as controls. As shown in Model 4 (Table 5), people who were more certain that punishment would be given for transgressions were not less likely to have committed a violation of the NRM rules.

Robustness analysis

To evaluate if these results were artifacts of model specification, each control variable was systematically excluded, and the effect of adding age to each model was examined. The inclusion or omission of foraging trips, sex, formal education, and age did not change the positive direction or statistical insignificance of the effects of the cognitive variables. However, adding age to the model with the generous scoring of the NRM rule quiz caused the log-odds ratio to increase from 0.20 to 0.29 and become borderline statistically significant ($B = 0.29$, $SE = 0.15$, $OR = 1.34$, 95% $CI = 1.01\text{-}1.81$, $p = .051$, $n = 111$). In other words, holding age, foraging trips, sex, and formal education at fixed values, every question a participant answered correctly on the NRM quiz *increased* the odds that he or she had committed at least 1 natural resource management violation by 34%.

Unsurprisingly, in all models individuals who had taken more foraging trips had higher odds of having committed a violation of the NRM rules than those who had taken fewer trips (Table 5).

Discussion

Contrary to expectations, individuals who perceived greater resource scarcity, had greater knowledge of natural resource management rules, expected more severe punishment, and were more certain of receipt of punishment were *not* less likely to have committed a violation of the NRM rules (see Table 5). These results seem unlikely to be due simply to small sample sizes since the direction of the relationships was positive – rather than negative as hypothesized – for all cognitive variables. The following

discussion offers some possible explanations and implications of these results, and suggests avenues for future research.

Perceptions of resource scarcity are probably best thought of as a necessary condition but poor incentive for conservation. The recognition of scarcity is a key first step, but the challenge is taking the next step of behavioral modification. Vickers (1994) described "nascent conservation" among the Siona-Secoya and concluded that, "One lesson to be drawn from this case is that 'conservation' is not a state of being. It is a response to people's perceptions about the state of their environment and its resources, *and a willingness to modify their behaviors* to adjust to new realities" (emphasis added, p. 331). Of course, it is not only willingness that matters but actual behavior. For example, Brooks (2010) found that mushroom harvesters in Bhutan who believed conservation was important because resources were scarce were, after controlling for other variables, 13.2 times more likely to be willing to reduce their harvests than those who did not perceive scarcity. However, Brooks (2010) did not measure actual behavior, only *willingness* to reduce one's harvest, so the caveat of "ideal versus real" must be made. Herein is the crux of the conservation problem: we can agree that we should use fewer resources, but actually using fewer resources is, as the global climate change crisis illustrates, very difficult. In fact, perceptions of dwindling resources could have the effect of inciting greater resource competition, possibly resulting in *intensification* of resource use as people scramble for a piece of the pie before it is gone (for research on the relationship between resource scarcity and violent conflict, see Durham, 1976, and Homer-Dixon, 1994).

Participants who possessed a greater understanding of the formal natural resource

management rules were not more likely to abide by them. This suggests that (1) having knowledge of the rules did not prompt participants to conceal their illegal behaviors, and (2) educating people about the rules is not enough to guarantee compliance. Like awareness of resource scarcity, knowledge of NRM rules may be best thought of as a necessary but insufficient condition for pro-environmental behavior. For NRM laws to matter, they must be enforced (Keane et al., 2008). Yet, in the present study, neither perceived severity nor certainty of punishment related to compliance. Moreover, the direction of the relationship with having committed at least one violation was positive (although not statistically significant; see Models 3 and 4, Table 5), suggesting that, if anything, people who expected punishment were more likely to have violated the rules.

One possible explanation for these latter results is that people's perceptions do not align with realities – or more precisely, perhaps my methods for ascertaining people's perceptions do not align with realities. Even though some people said that the characters in the vignettes would be punished, my own observations were that people were rarely punished – and usually punishment, when it did occur, consisted of "advice" only (Chapter 2). It is possible that some participants responded to the vignette questions with what they thought *should* happen rather than what they thought *actually* would happen. I used vignettes instead of asking participants to self-report the times that they had been sanctioned because I was concerned about asking such a personal question, but it is also possible that people think that *other* people are more or less likely to be punished than themselves. Methodological issues aside, another possible explanation for why the cognitive variables did not relate to compliance as expected is that most natural resource extraction by study participants was done to meet basic subsistence needs. Trading off

one's current consumption levels for future generations' consumption is more difficult for people living in poverty. The immediacy of basic needs such as food, water, and shelter tend to prevail over concerns about future generations. Thus perhaps people were willing to risk punishment in order to meet those needs.

Yet, it is important to recognize that by far most villagers complied with the harvest quotas; the majority of rule infractions involved the use of prohibited fishing technologies. Other technologies that were prohibited but never used during the study period included dynamite and hand grenades. A commonly used prohibited technology was the diving mask, which, when used with the *varilla* or *pistoeta* (*li pistalka*), is much more efficient than fishing by hook-and-line, mosquito net, bow-and-arrow, or lure (Koster, 2007). In other conservation contexts, the prohibition of new technologies has been criticized for being a form of "enforced primitivism" because local communities must maintain a "traditional lifestyle" – or else face eviction (Borgerhoff Mulder & Coppolillo, 2005, p. 189). The logic of managers is simple: more efficient technology will result in larger harvests. However, this logic rests on the assumption that with more efficient technology people will spend just as much time fishing as before rather than do something else. Questioning the requirement that only "traditional methods" be used in Paraguay's Mbaracayú Reserve, the local Aché people asked: "Our methods have changed radically over the twentieth century. Which of these are traditional, and who decides? Why are only traditional methods allowed? Isn't it important how many animals we kill, not how we kill them?" (Hill 1996, cited in Borgerhoff Mulder and Coppolillo, 2005, p. 189). These are good questions that challenge the ethics of conservation strategies based on enforced primitivism. In the case of Kipla Sait Tasbaika, however,

local people were involved in the design of the natural resource management rules, and in interviews many participants cited the use of diving masks for the decline in fish populations (Chapter 2). In contrast to the Paraguayan law, the *normas ecológicas* do not specify that the indigenous residents of Kipla Sait Tasbaika must use only "traditional methods." Instead, prohibited technologies are listed by name, thereby avoiding the tension and confusion created by pitting "traditional" against "modern."

That the *normas ecológicas* were created through participatory processes likely contributed to people's overwhelming compliance with the harvest quotas. There are stronger incentives to comply with formal rules when they coincide with community norms and values (and vice versa). On the other hand, people's compliance with the harvest quotas could be a consequence of resource scarcity rather than conscious decision-making – in other words, it could be a byproduct of past overharvesting. As Chapter 2 showed, most villagers thought human foraging practices were to blame for fewer fish and game now than before. Perhaps the awareness that past behaviors had caused the current resource scarcity was the reason that almost half of respondents indicated some displeasure with the current system of NRM rules. Importantly, most of this displeasure was not over the existence of NRM laws per se but over their lack of enforcement and general dysfunction. Enforcement of the *normas* was largely the purview of local leaders, including a voluntary group of local forest guards who not only lacked individual incentives for monitoring and sanctioning transgressors but also were unable to fulfill many of their duties due to limited funds and institutional support (Chapter 2).

Since previous research has shown the importance of enforcement for successful

common pool resource management, this study's results should be interpreted with caution – and its limitations should be kept in mind. First, participants may have concealed some or all of their illegal activities. Hiring local community members as field assistants rather than bringing in outsiders probably simultaneously decreased the ease with which participants could conceal their activities and increased their comfort with sharing them. I was initially worried that individuals with greater knowledge of the rules would be more likely to conceal their illegal behaviors, but since the results showed that knowledgeable individuals were more likely than others to have committed a violation, this is unlikely to have been the case. Second, people's compliance with *all* of the NRM rules was not evaluated; data are available to examine for only specific types of violations. For example, the behavioral data come from May through December, so the data do not permit an analysis of temporal restrictions on harvests in other months (e.g., each family is permitted to take only 1 male iguana per week in March). Third, Paternoster (1987) has argued that in order to distinguish between a deterrent effect and an experiential effect, the measurement of expectations of punishment should occur *prior* to the measurement of behavior. However, in the present study, there were other considerations that factored into the ordering of methods. Specifically, the quality of the data on actual violations was prioritized (asking people early in the study about their expectations of punishment seemed to me to be a recipe for prompting people to conceal their illegal behaviors), and waiting until later in the study to ask people about their beliefs about sanctions and the overall functioning of the NRM system meant that by then substantial rapport had developed which surely contributed to participants' willingness to express their honest opinions, observations, and criticisms (discussed in detail in Chapter

2). Fourth, there could be omitted variable bias. For example, it is possible that people with larger social networks are more likely to know the NRM rules (because they learn about them from others) and also more likely to violate them (because they must be more productive and efficient fishers in order to satisfy all their social obligations).

Finally, under conditions of weak enforcement, as Chapter 2 argued was the situation in the study villages, people may tacitly – even if not explicitly – understand that they will not be caught and/or punished for violations. Collecting systematic observational data on actual enforcement (not only rates of noncompliance) would allow for an assessment of people's perceptual accuracy. Additionally, the contested fairness, legitimacy, and justice of the sanctioning system may also help explain why expectations of punishment did not relate to violations (Chapter 2). Thus, future quantitative research examining the determinants of people's compliance with natural resource management rules in KST should refine the methods used to ascertain people's expectations of punishment and include measures of perceived fairness, legitimacy, and justice.

CHAPTER 4

THE EFFECT OF COSMOLOGY ON WILDLIFE HARVESTS: A STUDY OF INTRACULTURAL VARIATION AMONG THE MISKITU OF NICARAGUA

Introduction

An on-going discussion in the anthropological literature examines the role of traditional belief systems in determining indigenous peoples' comparatively small ecological impact. On the one hand, indigenous peoples possess intricate knowledge of ecological relationships (Hunn et al., 2003; Posey, 1985; Redford & Padoch, 1992; Turner et al., 2000), often accompanied by ontologies that do not draw sharp divisions between human beings and the rest of nature (Descola, 1996; Pierotti, 2011; Salmón, 2000; Willerslev, 2004). This perception of interconnectedness has been linked to behavior that not only shows respect for the natural environment but also promotes its sustainable use (Berkes, 2008; Salmón, 2000). Sometimes embedded within traditional cosmologies are beliefs about supernatural punishment for inappropriate environmental behavior (e.g., overharvesting) – and Reichel-Dolmatoff (1976), among others, suggested that such beliefs function to promote conservation. On the other hand, the tendency for humans to discount the future and the difficulty of overcoming collective action problems create barriers to conservation (Alvard, 1998; Borgerhoff Mulder & Coppolillo, 2005;

Smith & Wishnie, 2000). Moreover, detailed quantitative studies of human foraging populations have shown that hunters' behaviors generally correspond nicely with predictions from optimal foraging models (Alvard, 1993, 1995; Hawkes et al., 1982; Hill et al., 1987; but see Koster, 2008a). These latter theoretical considerations and lines of evidence suggest that the apparent sustainability of natural resource use by at least some indigenous peoples could be a byproduct of factors other than belief systems, such as low population density, inefficient extractive technology, and limited access to markets (Johnson, 1989; Low, 1996; Vickers, 1994).

The present study clarifies the relationship between indigenous cosmologies and environmental impact in three key ways. First, it focuses explicitly on the empirical relationship between belief and behavior at the individual level. Although this approach is common in environmental psychology research conducted among "WEIRD societies" (sensu Henrich et al., 2010: "Western, Educated, Industrialized, Rich, and Democratic," p. 61), few ethnographically-based studies among non-WEIRD populations utilize it (but see Zavaleta, 1999). However, such an individual-level analysis has certain advantages, namely that it clarifies the relationship between specific beliefs and specific behaviors, avoids essentialism by recognizing within-culture variation, and naturally controls for other factors that frequently vary across communities (e.g., proximity to markets). Second, rather than rely on self-reported behavior (as most environmental psychology studies do), the present study uses behavioral observations. Often the lack of systematic observational data has left previous ethnographic studies of the relationship between indigenous cosmologies and conservation vulnerable to the criticism that people's behaviors do not always match cultural ideals. Third, and related to the second point, the

present study does not rely on people's explanations for why they do things – which could simply be post-hoc rationalizations (or attempts to please the researcher). Instead, participants were asked about their beliefs irrespective of their own behaviors; it is through statistical analysis that a link between particular cosmological beliefs and particular behaviors is examined.

Specifically, I combine quantitative and qualitative data collected among Miskitu horticulturalists of Nicaragua to analyze the relationship between indigenous cosmology and environmental impact. I pair self-reported information about cosmological beliefs with observational data on fishing and hunting harvests to test whether individuals harvest less wildlife biomass if they hold cosmological beliefs of interconnectedness and nonhuman personhood (explained below) and/or if they expect supernatural punishment from spirit guardians for overharvesting. I then draw on participants' interview responses and commentaries to construct a qualitative understanding of people's cosmological thinking and provide a fuller context for the interpretation – and validation – of the quantitative analysis.

Indigenous cosmologies

Common beliefs in traditional cosmologies of indigenous peoples include beliefs that nonhumans have personhood (i.e., animism); all of nature, including humans, is interconnected; and humans and nonhumans are kindred. In essence, these cosmologies do not draw a clear ontological division between humans and the rest of nature (Descola, 2005). Animistic thinking attributes a spiritual essence – a "soul," "spirit," or "energy" – to nonhuman natural entities (Pedersen, 2002; Viveiros de Castro, 1998; Willerslev,

2004). Ethics, such as respect, tend not to be confined to the realm of human beings but are extended to the entire community, which in indigenous cosmologies frequently includes nonhuman others (Pierotti & Wildcat, 2000) – even to the extent that humans and nonhumans are thought to share a kind of kinship (Bird-David, 1990; Descola, 2005; Salmón, 2000). Empathy, likely facilitated by a belief in nonhuman personhood (or "other-than-human persons" [Hallowell, 1960]), is often a component of respect, as expressed by a Yup'ik man when discussing his feelings for geese: "They're trying to live, like us, right? But we still kill them, which is sad" (Zavaleta, 1999, p. 240). Often incorporated into indigenous ontologies of interconnectivity are beliefs that natural entities such as forests, bodies of water, and wildlife possess spirit "owners" or "guardians." For example, in the cosmology of the Amazonian Napo Runa, "each species is managed by a *dueño*, or owner, who is the spirit master. Animals do not come to hunters on their own accord; the *dueño* releases them for the hunter to kill" (Uzendoski, 2004, p. 887).

The case has been made that these kinds of cosmological beliefs – which I will refer to as cosmologies of interconnectedness and nonhuman personhood (and for brevity's sake, "INP" cosmologies) – contribute to sustainable resource use and conservation (e.g., Anderson, 1996; Berkes, 2008; Chernela, 1987; Grim, 2001; Pierotti & Wildcat 2000; Reichel-Dolmatoff, 1976; Salmón, 2000; Sponsel, 2012). However, although the outcome of such beliefs may be low environmental impact, that is not necessarily the conscious motive of an actor. Conversely, although an actor may express a conservation motive, the behavioral outcome may not differ from what would be expected from a self-interested actor pursuing the most efficient course of action.

Given these considerations, one class of cosmological beliefs – beliefs in supernatural punishment for inappropriate environmental behavior – warrants special attention because such beliefs could affect an individual's cost/benefit calculation in ways that reduce environmental impact. It may well be that without self-interested incentives conservation is unlikely; supernatural punishment may provide such an incentive. Previous research has demonstrated the efficacy of punishment for maintaining cooperation (Boyd et al., 2010; Fehr & Gächter, 2002), including in the context of common pool resource management (Gibson et al., 2005). Most of this research has focused on natural sources of punishment, but a growing body of evolutionarily-informed literature suggests that beliefs in moralizing and punishing supernatural agents can also promote cooperation (Atkinson & Bourrat 2011; Johnson & Krüger, 2004). Indeed, numerous ethnographers have noted informants' expressions of fear of supernatural sanctions for "taking too much" from nature (e.g., Beckerman & Valentine, 1996; Dennis, 2004). Although Low (1996), using the Standard Cross Cultural Sample, found that societies that expressed beliefs in sacred prohibitions were no less likely to have degraded their environment, other studies have documented that sacred sites are more likely to have been conserved (Byers et al., 2001; Salick et al., 2007), and some scholars have argued for the importance of species and habitat taboos for conservation (Colding & Folke, 2001; McDonald, 1977). For example, the highland Maya perceive the forest "as an active agent capable of taking revenge against disrespectful or careless humans who enter this realm to harvest resources such as wild animals or construction materials" (Brown & Emery, 2008, p. 302).

Interpreting behavior

Before proceeding further, it is important to recognize that assigning the label of "sustainable" or "conservation" to particular actions has proven to be challenging (and politically controversial) in part because multiple interpretations of the same behavior are possible. The following example illustrates this challenge. Salmón (2000), himself a Rarámuri, described the Rarámuri concept of *iwígara* as the "total interconnectedness and integration of all life in the Sierra Madres, physical and spiritual" (p. 1328). He recounted an example of a Rarámuri elder who went to a *rincón* to collect a particular species of plant. Along the way, the elder encountered the same species of plant but chose not to harvest it. When prompted for an explanation, the elder suggested to Salmón that the *iwígara* was weak there because there were only a few plants, whereas in the *rincón* there were many plants and collecting them there was good "because thinning them out actually helps the *iwígara* in the other plants to strengthen" (Salmón, 2000, p. 1330). Concluding that the elder understood the ecological danger of harvesting from threatened populations even though he articulated it in terms of *iwígara*, Salmón (2000) explained that "Rarámuri land management represents a tradition of conservation that relies on a reciprocal relationship with nature in which the idea of *iwígara* becomes an affirmation of caretaking responsibilities and an assurance of sustainable subsistence and harvesting" (p. 1330).

An alternative interpretation of the elder's behavior is that it reflects the most efficient course of action for him. From an efficiency standpoint, if a certain quantity of plants is desired, and the elder – who possesses local ecological knowledge – knows he will encounter more than this quantity in the *rincón*, pausing en route to collect a few

plants only means that he must carry these plants a greater distance since he still intends to walk to the *rincón* in order to obtain the total quantity he desires. Thus, at least three perspectives are represented in this Rarámuri example: an emic perspective of *iwígara*, an etic perspective of conservation, and an alternative etic perspective of efficiency. Attempting to establish which perspective is "correct" would likely irritate existing theoretical divisions among anthropologists more than it would illuminate Rarámuri behavior – and no doubt a great deal of the discussion would hinge upon definitions: what is meant by "conservation" and "sustainable"? Since these semantic and conceptual issues have been well-covered elsewhere (see Alvard, 1994, 1998; Hames, 2007; Hunn et al., 2003; Nadasdy, 2005; Redford & Stearman, 1993; Smith & Wishnie, 2000), I provide only a summary here.

The terms "conservation" and "sustainability" are often used interchangeably, but they have distinct connotations. *Sustainability* comes from the concept of maximum sustainable yield (MSY), which was developed for forestry and fishery management as a way to calculate the largest harvest sizes that could be taken over time without causing the stock to decline. It is possible to harvest resources at levels below MSY without having any explicit desire to do so (e.g., due to inefficient technology). This is sometimes called epiphenomenal conservation (sensu Hunn, 1982) because it is a byproduct of factors other than an explicit sustainability motive. *Conservation* implies an act – often *restraint* – that prevents environmental degradation and biodiversity loss. One of the most widely used definitions comes from Smith and Wishnie (2000): a conservation action or practice "should (*a*) prevent or mitigate resource depletion, species extirpation, or habitat degradation, and (*b*) be designed to do so" (p. 501). However, as Smith and

Wishnie (2000) noted, this definition raises not only the problem of how to define operationally *depletion* or *degradation*, but also how to determine that a practice is in fact *designed* for conservation (for further problematizing of these definitional issues, see Hunn et al., 2003, and Nadasdy, 2005).

The present study

In order to avoid some of these problems of interpretation, the present study does not purport to establish whether a particular indigenous people practice *sustainable* or *conservation* behavior per se. Rather, this paper tests for an association between an individual's cosmological beliefs and the quantity of wildlife biomass he or she harvests through hunting and fishing. The simple working assumption, then, is that the more wildlife a person harvests, the greater his or her environmental impact. In other words, the intracultural spectrum of both beliefs and behaviors is what is of interest. This approach follows from Snodgrass and Tiedje's (2008) call to transcend the binary thinking that has characterized much of the research on indigenous peoples and conservation.

Specifically, are individual differences in cosmological beliefs associated with individual differences in wildlife harvests? Using data collected among Miskitu horticulturalists in Nicaragua, three hypotheses were tested. First, people whose beliefs include notions of nonhuman personhood and interconnectedness with the natural world will harvest less wildlife biomass (hypothesis 1). Second, people who expect supernatural punishment from spirit guardians for overharvesting will harvest less wildlife biomass (hypothesis 2). Third, people who hold more "proconservation" cosmological beliefs

(operationalized here as beliefs in interconnectedness, nonhuman personhood, and punitive spirit guardians of nature – in other words, a combined measure of those used in each of the first two hypotheses) will harvest less wildlife biomass (hypothesis 3).

Study area and population

The study took place in the Bosawas Biosphere Reserve of Nicaragua in two Miskitu villages located adjacent to each other within the indigenous territory Kipla Sait Tasbaika (KST). The local indigenous Miskitu and Mayangna of the region were not consulted prior to the Reserve's creation (Kaimowitz et al., 2003), which was created in 1991 – just as the Miskitu and Mayangna were returning home after many years as refugees during the Contra war of the 1980s (Stocks, 2003). Consequently, in defense of their land rights, the Miskitu and Mayangna solicited the assistance of nongovernmental organizations for the purposes of demarcating and mapping six indigenous territories (Stocks et al., 1998). The indigenous people of each territory also developed a set of natural resource management rules that they themselves would be responsible for enforcing (Stocks et al., 1998). After many years of struggle, common property land titles were granted to the indigenous territories in 2005 by the Nicaraguan state (Stocks et al., 2007). Thus, the Miskitu are by no means naïve when it comes to the politics of natural resource management (see Chapter 2). However, the relationship between Miskitu cosmology and conservation has not (yet) been as extensively politicized as it has been for some other indigenous peoples.

In terms of subsistence, the Miskitu of KST are sedentary swidden horticulturalists who plant bananas, plantains, manioc, rice, corn, and beans as well as

tomatoes, avocados, pejibaye, and other supplemental fruits. Key fish and game species include machaca, guapote, nine-banded armadillos, pacas, and agoutis. Hunting technology includes machetes, dogs, rifles, and occasionally, axes or lances. Fishing technology includes hook-and-line, nets (often mosquito nets), diving masks and simple harpoons, bow-and-arrow, and plant toxins. Women rarely hunt, but both men and women fish. However, only men fish with diving masks and *varillas* (simple rubber-band harpoons), a particularly efficient method in clear waters that are characteristic of the dry season (Koster 2007). Research conducted in KST during 2003-2005 as part of the St. Louis Zoo's *Proyecto Biodiversidad* found that the two villages involved in the present study consumed 135.9 kg and 174.4 kg, respectively, of game biomass per household per year (Williams-Guillén et al., 2006), but animal husbandry of chickens, pigs, and cattle has been growing in importance due to government development projects. After studying the multipronged subsistence strategy of the inhabitants of KST, Cordón and Toledo (2008) concluded that the diverse collection of subsistence practices functioned as a kind of "autochthonous conservation mechanism" (p. 44). Other possible autochthonous conservation mechanisms include traditional Miskitu beliefs about nature and the supernatural.

Miskitu cosmology

Nietschmann (1973) described the Miskitu world as having "a number of spirits, beliefs, and cultural constraints controlling or limiting the daily availability of many food resources" (p. 112). Frequently mentioned in the ethnographic literature are spirit creatures generally referred to as *lasa* (pl. *lasa nani*). *Duhindu* (*duende*) is the spirit

"owner" or "master" (*dawanka*) of all the animals, although some plant and animal species – such as white-lipped peccaries and the Ceiba tree – have specific spirit owners (Conzemius, 1932; Cox, 1998; Jamieson, 2009). The owner of bodies of water and their inhabitants is *liwa* or *sirena*, a mermaid-like creature that seduces and drowns people (Cox, 1998, pp. 32-33; Dennis, 2004, pp. 212-213; Jamieson, 2009, p. 45; Wedel, 2009, p. 57). Indeed, *lasa* are to blame for much illness and death.

In Miskitu cosmology, illness is viewed as a result of breaking a balance with the natural world and thereby angering *lasa* who punish the offender (Cox, 1998; Dennis, 2004; Fagoth et al., 1998). In the Caribbean coastal areas where many Miskitu men are lobster divers, decompression sickness is understood as punishment by *liwa* for taking too many lobsters (Cupples, 2012, p. 18; Herlihy, 2012, p. 146; see also Dunford et al., 2002, p. 82). Similarly, because the *Sisin* (Ceiba) tree has a *dawanka*, cutting it is completely forbidden – and if you cut it you or your loved ones will be punished by sickness or death (Cox, 1998, p. 91). Fagoth et al. (1998) explicitly connected Miskitu cosmology, and in particular the belief in *lasa*, with living in harmony with nature: "If a person follows the basic rules of agreement with nature, it is certain he or she will carry on a healthy and happy life. Otherwise the **Lasas** or evil spirits will charge dearly for his or her habitual lawlessness"[13] (p. 19). Dennis (2004) recounts a compelling example of the conservation potential of traditional Miskitu beliefs in *lasa*: "the *swinta* is the owner of the deer. He herds them with his whip and punishes hunters who kill too many deer. Casey tells me he has seen the *swinta*'s light at night in the brush, when he was deer hunting, and then realized he was killing too many deer and should be careful" (p. 212).

[13] My translation of, "Si la persona sigue las reglas elementales de concordancia con la naturaleza, de seguro llevará una vida sana y feliz. De lo contrario los **Lasas** o malos espíritus cobrarán caro su desorden habitual" (emphasis in original; Fagoth et al., 1998, p. 19).

Miskitu beliefs in *lasa* have survived amidst contact with colonials, missionaries, foreign companies, the Nicaraguan government, and more recently, NGOs – but that is not to say that these beliefs have not changed as a result of contact. For example, *liwa mairin* (*mairin* means "woman" or "female") is also known on the coast as the Merry Maid. The similarity between *liwa mairin* and English buccaneer tales of mermaids is apparent, and Herlihy (2002, p. 278) suggested that contact during colonial times between the Miskitu and buccaneers may have given rise to the *liwa* folklore. Even though the Miskitu language is full of English and Spanish loan words; bedtime stories told to children about *Tibang*, the trickster rabbit, probably are of West African origin (Dennis, 2004, p. 276); and most Miskitu self-identify as Christian (especially Moravian), the Miskitu have not wholly abandoned their traditional beliefs, including beliefs in *lasa*: "The Christian concept of Satan and the indigenous belief in *lasas* are often equated today. Both words are used interchangeably in conversations, and both are considered to refer to real, animistic beings" (Helms, 1971, p. 187; see also Dennis, 2004, pp. 214-215, and Minks, 2007, p. 9).

Critical to this study, the Miskitu people's complex cultural history and tendency towards "cosmopolitanism" (Minks, 2007, 2010) have likely generated more intracultural variation in cosmological beliefs than would be found among more isolated groups. This within-culture variation is necessary for an analysis contingent upon individual differences in beliefs – and regardless of the origins of people's beliefs, the question of the relationship between a person's cosmological beliefs and his or her foraging behavior remains an interesting one and is the focus of this paper.

Methods

Data were collected during fieldwork in two adjacent villages (approximately 321 residents in total) in Kipla Sait Tasbaika from February 2010 through early January 2011. This study was conducted as part of a larger research project that also evaluated the efficacy of the local common property institutions (see Chapters 2 and 3), and the villages were selected primarily for their proximity to a third, much larger, village that was the seat of territorial governance. The process of informed consent involved gaining approval from local leaders and communities during community meetings in addition to individual-level consent. Monetary compensation was given for participation. All households participated in the study, and participants included adults (18 years and older) residing in the two study villages during the study period.

The study design included semistructured and structured interviews, measurement of wildlife harvests, and participant observation. The behavioral data used in the following analyses come from the period from early May 2010 through late December 2010. The survey data come from a survey carried out from mid-June through July, 2010, and another carried out from late November 2010 through early January 2011 (the cosmological questions were a part of this second survey). I worked with two Spanish-Miskitu interpreters from one of the villages. (Spanish is a second language for many of the villagers – but levels of fluency vary widely.) These interpreters were also key informants and their insights about Miskitu culture were immensely helpful in producing culturally intelligible questions. The profundity of the topics explored in this research does not lend itself to quick or easy "translation." Thus, the translation of some questions or concepts necessitated lengthy conversations among the three of us about the essential

meanings of the words used. As necessary, these conversations were expanded to include two bilingual, local Miskitu high school teachers (also participants in the study). The Miskitu translations were then taken to another highly educated Miskitu in a neighboring community who had lived in the Spanish-speaking Pacific side of Nicaragua for about 30 years. He back-translated the Miskitu into Spanish, and any needed changes were made to eliminate ambiguities and discrepancies as well as to achieve conceptual equivalence.

Wildlife harvests

To help monitor and measure wildlife harvests, I hired and trained several local Miskitu men and women from the villages to work as research assistants. I provided them with field equipment and data forms and for the most part they worked independently to monitor the comings and goings of villagers with the goal of conducting a brief interview and weighing any captured fish or game with a hanging digital scale.[14] The assistants would periodically visit each household throughout the course of a day (as not all houses were visible simultaneously) from 6:00 AM to 7:00 PM, Mondays through Saturdays, and from 6:00 AM to 8:00 AM on Sundays. Participants either waited for an assistant to come by to weigh the catch or actively sought out the assistants or me. The communities were very cooperative and assistants generally knew when participants went hunting or fishing and could closely monitor their return. Because Sunday was widely recognized in the communities as a day for going to church, participating in community meetings, resting, and socializing, very little hunting and fishing activity took place on Sundays. As

[14] The communities were quite familiar with this sort of work because a previous project conducted by the St. Louis Zoo in 2003-2004 also hired local field assistants to collect similar information (see Williams-Guillén et al., 2006; see also Koster, 2008b for similar methods used in nearby Miskitu and Mayangna communities).

such, the assistants only visited each household in the morning to weigh what had been caught the night before; the common practice of hunting on Saturdays in order to have meat on Sundays meant that hunters sometimes returned late at night (especially if hunting by flashlight). However, occasionally men would in fact go hunting on Sunday, and I would perform the interview and measurements.

For each trip during which fish or game were caught, the following variables were recorded: time of departure and return; purpose of the trip; who went on the trip; what hunting or fishing technology each person on the trip brought; the species and weights of animals caught; and to whom the actual act of "the kill" or "the catch" was attributed. For example, several men may go on a hunt together, but only one is usually recognized as "the killer" (i.e., the one who literally takes the life). Species identification was performed by the field assistant, often in collaboration with others present. In most cases the sex, age (juvenile or adult), and count were also recorded. In the case of some fish species, sex and age were difficult to discern, and in some harvests the fish were so small and the quantity so large that for the sake of not overburdening the study participants (patiently waiting to prepare the food), the *pescaditos* were weighed collectively.

Cosmological beliefs

To construct a set of questions (Table 6) to tap into indigenous cosmological beliefs of interconnectedness and nonhuman personhood, I drew on the ethnographic literature on indigenous cosmologies as well as the psychological literature on human-environment relationships. The Connectedness with Nature Scale (Mayer & Frantz, 2004), the Ecocentric, Anthropocentric, and Environmental Apathy Scale (Thompson &

Table 6

Measures of "pro-conservation" cosmological beliefs and participant responses (n = 122)

	Question	Yes (%)	Example comment
1	Do you think that plants and animals have as much right to exist as humans do?[a]	95.1	People have rights separate from animals and trees. (Maura)
2	Sometimes does it make you sad to see the virgin forest cleared for agriculture or pasture?[bc]	50.0	I clear forest because I have to plant food and survive, but part of me is sad to do so. (Cornelio)
3	Do animals seem almost human sometimes?[b]	40.2	Some animals have more sense than some people. (Camilo)
4	Do you think that plants and animals have some kinship with humans?[d]	51.6	I work with the *finca modelo* [model farming program run by an NGO], and they gave a workshop and told us that we should greet the plants in our fields. But I don't believe plants can hear because my parents never taught me this. (Tomás)
5	Do you believe that animals and trees have souls?	71.9[e]	Animals yes, but trees no. (Constanza, Gretal, Lily, Tamira)
6	Do you believe that some animals and some trees have owners that are spirits like *lasa* or *duhindu*?[c]	56.6	Old beliefs from before the Bible; now there is none of that. (Diego)
7	Do you feel sad when you see animals suffering?	86.1	One time I was with my husband hunting and saw a *guatusa* struggling to give birth and it was sad. (Plora)

[a] Adapted from the New Ecological Paradigm Scale (Dunlap et al., 2000).
[b] Adapted from the Ecocentric, Anthropocentric, and Environmental Apathy Scale (Thompson & Barton, 1994).
[c] To improve overall alpha for the index of cosmological beliefs in interconnectedness and nonhuman personhood, this item was dropped. See text for details.
[d] Adapted from the Connectedness with Nature Scale (Mayer & Frantz, 2004).
[e] n = 121

Barton, 1994), and the New Ecological Paradigm Scale (Dunlap et al., 2000) were especially helpful in this process. However, since these scales were designed for Western populations, only a few items were ultimately used (denoted in Table 6) – and these were slightly modified (e.g., to fit a "yes/no" response format). Also, whenever participants elaborated upon their yes/no response (as nearly half the respondents did during this portion of the interview) these comments were recorded.

To assess expectations of supernatural punishment, short vignettes (Table 7) were used. Participants were asked whether they thought an imaginary character would receive punishment from *lasa* for "taking too much" of species commonly believed by Miskitu to have spirit owners: the Ceiba tree (*Sisin*), white-lipped peccary (*wari*), and fish (*inska*). The specific punishment expected was also recorded. Prior to constructing these vignettes, semistructured interviews were conducted with local elders in order to get a sense of current, local beliefs about *lasa* and to ascertain whether the specific details of some of the examples given in the ethnographic literature were relevant in this context.

Control variables

In order to control for participants' absences from the community during which observational behavioral data were not collected, three sources of information were used to create a code for participants' degree of absenteeism (where higher values reflect greater absenteeism): a registry of trips away from the villages (kept beginning in late August), participant recalls of trips taken, and my general ethnographic observations throughout the fieldwork period.[15] Since the more mouths there are to feed, the more food

[15] Two participants turned 18 after the first survey but before the second. Thus, they began participating in the hunting and fishing interviews late compared to the others. Rather than exclude them from the data set,

Table 7

Measures of expectations of supernatural punishment for overharvesting (n = 122)

Vignettes	Question following each vignette	Punish (%)
Some people say that the tree called Ceiba has an owner that is a spirit or *lasa*. Alejandro cut a large Ceiba tree.	What is the spirit going to do to Alejandro/Henry/Rodolfo?	56.2[a]
Some people say that the white-lipped peccary has an owner that is a spirit. Henry is hunting when he encounters a bunch of white-lipped peccaries. He kills 10 white-lipped peccaries.		59.0
Some people say that the fish have an owner, *liwa mairin*. Rodolfo is a good fisher and always takes lots of fish. For example, he caught more than 50 lbs of fish in one day.		42.6

[a] n = 121

I coded their absenteeism as if they had been absent during this period in order to deal with their missing behavioral data in the multiple regression analyses.

is needed, I calculated the average number of consumers per meal in the household using data from weekly diaries kept by each household that recorded the number of people (above 2 years old) who ate each meal each day of the week (visitors eating in the household were included in this tally). Wealth was considered an important control variable because wealthier people might have less of a need to hunt and fish themselves (either because they can purchase fish and game or because they own more domesticated animals). Alternatively, wealthier individuals might simply be able to afford better hunting and fishing tools and thus wealth could have a positive effect on harvest sizes. Following Godoy et al. (2007), wealth was assessed by asking participants how many of 38 different durable items (e.g., livestock, tools, gadgets) they owned personally, multiplying the quantity of each item by its local price, and summing the products to create an estimate of individual wealth. Because these data were highly right-skewed, a square root transformation was used and the term "wealth" hereafter refers to this transformed variable. Finally, formal education, plausibly inversely related to supernatural beliefs, was coded such that higher values reflect greater education.

All statistical analyses were performed using R 3.1.0.

Results

Participants included 75 men and 70 women of whom the majority identified with the Moravian Church. Although a concerted effort was made to interview all adults from the two villages, inevitably some residents were not interviewed either for the first or second long interview due to absence from the community (e.g., visiting relatives) around the time of the interviews. Since the subject of cosmological beliefs was covered in the

second interview, the data analyzed in this paper include a subset of the 145 participants (i.e., $n = 122$). However, at least one adult from each household (total households at start of study = 44; total at end of study = 49) is included in this subset. The two villages did not significantly differ in INP cosmology or expectations of supernatural punishment, but a nonparametric Wilcoxon rank sum test showed that they did differ in the amount of wildlife biomass harvested ($W = 2251.5$, $p = .02$). Therefore, village was included as a control in the following regression analyses.

Quantitative analysis

Constructing the variables

Cosmological beliefs of interconnectedness and nonhuman personhood (INP cosmology)

Most of the time participants responded to the INP cosmological questions (Table 6) with a clear "yes" or "no" response (where yes = 1, no = 0), but occasionally their responses lay somewhere in-between (e.g., domesticated animals have a kinship with humans but wild animals do not; animals have souls but trees do not). For the purposes of the analyses here, these kinds of qualified responses were lumped with the "no" responses in order to best isolate those with very inclusive ontologies. With these data an initial index was constructed for INP cosmological beliefs by summing responses to the 7 items in Table 6 (Cronbach's alpha = 0.54). Dropping items 2 and 7 improved overall alpha (Cronbach's alpha = 0.63). Thus the responses to the remaining 5 items were summed to create a final index of INP cosmological beliefs (possible values = 0-5).[16]

[16] Although a Cronbach's alpha of 0.63 might be considered low for scale construction, the aim of the index was to tap into several related dimensions of cosmological beliefs about human and nonhuman

Descriptive statistics showed this index captured intracultural variation (see Table 8).

Expectations of supernatural punishment from spirit guardians

Following each vignette, I asked participants what they thought the spirit would do to the character in the vignette (see Table 7). The most common forms of expected punishment were that either the character or his family member would become sick, be taken or killed, or become lost (i.e., in the forest or water). Sometimes people thought the character would suffer some combination of the above – or perhaps one or the other of them. But for each of the three vignettes, 44%, 41%, and 57% respectively, thought that the character would receive *no* supernatural punishment. After coding responses to each vignette as 0 = no punishment and 1 = some form of punishment, I summed the three answers to create an index of expected supernatural punishment (possible values = 0-3; Cronbach's alpha = 0.82). Again, descriptive statistics showed this index captured intracultural variation (see Table 8).

Age was unrelated to INP cosmology, but older individuals were less likely to believe in supernatural punishment ($r = -0.36$, $p < .001$). Neither sex nor formal education was associated with INP cosmology or expectations of supernatural punishment.

Combined cosmological measure

These two indices – expectations of supernatural punishment and INP cosmological beliefs – were positively, but not strongly, correlated ($r = 0.25$, $p < .01$). To

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relationships rather than a very narrowly construed factor. Thus, the index trade-offs some internal consistency for greater content validity in terms of measuring "INP cosmology."

Table 8

Definitions and summary statistics of variables

Variable		Definition	*n*	Mean	*SD*	Range
Dependent						
	Wildlife biomass harvested	Total weighed biomass (kg) of mammals, fishes, birds, and reptiles harvested by participant from May 2 through December 23, 2010	145	8.90	20.49	0-173
	Harvests by men	see above	75	14.31	26.59	0-173
	Harvests by women	see above	70	3.10	7.23	0-54.92
Independent						
(H1)	Interconnectedness and nonhuman personhood (INP) cosmology	Sum of responses (0 = no, 1 = yes) to items 1, 3, 4, 5, and 7 in Table 1	121	3.44	1.32	0-5
(H2)	Supernatural punishment	Belief that character in 3 vignettes would receive supernatural punishment (0 = no, 1 = yes)	121	1.58	1.28	0-3
(H3)	Combined cosmological measure ("proconservation" cosmology)	Sum of standardized responses for INP cosmology and expected supernatural punishment	120	0.01	1.58	-3.85-2.3
Control						
	Village (dummy)		145	0.79	0.41	0-1
	Sex	0 = female, 1 = male	145	0.52	0.50	0-1
	Age	Age in years	142	33.47	14.90	18-78
	Absenteeism	Absence from community, where 0 = no absence, 1 = absent 1-15 days, 2 = absent 16-30 days, 3 = absent 31-60 days, 4 = absent more than 60 days	144	1.78	1.48	0-4

Table 8 continued

Variable	Definition	*n*	Mean	*SD*	Range
Wealth	Quantity of 38 durable items owned by participant, multiplied by each item's local price, and summed	137	8545	10589	8-57152
Formal education	Maximum formal education of participant	143	6.59	3.73	0-13
Number of consumers	Average number of consumers (>2 years old) per meal in participant's household	142	6.68	2.02	2.15-10.12

create a more holistic measure of "proconservation" cosmologies, I converted the two indices to z-scores and summed them.

Wildlife harvests

The simplifying assumption taken here is that the more wildlife biomass taken, the greater the environmental impact. Kilograms harvested of mammals, fishes, birds, and reptiles were summed across the study period for each participant to create a measure of total animal biomass harvested. Because these data were highly skewed to the right (see Table 8), I performed a log-transformation to improve normality prior to using parametric statistics. In analyses using the full sample in which the dependent variable contained zeroes, I first added 1 to avoid taking the log of 0. Inspection of residuals for the multiple regression analyses below indicated that this transformation improved normality of their distribution.

Descriptive statistics for all dependent and independent variables can be found in Table 8.

Main analyses

Taking the sample as a whole, multiple linear regression analyses showed that individuals with greater expectation of supernatural punishment as well as those with more "proconservation" cosmologies (i.e., the combined measure) harvested significantly less wildlife biomass, and there was a trend towards a similar negative effect for INP cosmology (Models 1, 2, and 3, Table 9). These regression analyses included village, sex, age, absenteeism, wealth, formal education, and the number of consumers as control

Table 9

Multiple regression results showing relationship between cosmology measures and log-transformed kg of wildlife biomass harvested (dependent variable) for the full sample

	Model 1 (n = 110)	Model 2 (*n* = 111)	Model 3 (*n* = 110)
	B (*SE*)	*B* (*SE*)	*B* (*SE*)
(H1) INP cosmology	**-0.18†** **(0.09)**	___	___
(H2) Expectations of supernatural punishment	___	**-0.19*** **(0.09)**	___
(H3) Combined measure of "proconservation" cosmology	___	___	**-0.17*** **(0.07)**
Village	-0.30 (0.28)	-0.33 (0.28)	-0.34 (0.28)
Sex (0 = female, 1 = male)	1.33*** (0.24)	1.25*** (0.23)	1.32*** (0.23)
Age	-0.02* (0.01)	-0.03** (0.01)	-0.03** (0.01)
Absenteeism	-0.13 (0.09)	-0.15† (0.09)	-0.14 (0.09)
Wealth	0.00† (0.00)	0.00 (0.00)	0.00† (0.00)
Formal education	-0.03 (0.04)	-0.06† (0.04)	-0.04 (0.04)
Number of consumers	0.00 (0.06)	0.02 (0.06)	0.01 (0.06)
(intercept)	2.41*** (-0.18)	2.63*** (0.68)	2.07**
Adjusted R^2	0.22	0.22	0.23
F	4.77	4.89	5.15

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

variables. Excluding individuals with standardized residuals greater than 2.5 eliminated the statistical significance (alpha = .05) of the relationship between harvest size (dependent variable) and expectations of supernatural punishment and the combined measure of "proconservation" cosmological beliefs (see Appendix). However, these outliers – 2 men and 1 woman (from different households) who had the highest harvest sizes for their sex – are arguably legitimate cases that should be included. These individuals did not believe in supernatural punishment, and they only held two out of five beliefs in interconnectedness and nonhuman personhood.

Significant results that were not contingent upon outlier inclusion were found when the analysis included only those participants who had harvest sizes greater than zero (i.e., 80% of 122 people). Among this subset, INP cosmology and the combined measure of "proconservation" cosmological beliefs – but not expectations of supernatural punishment – were significantly associated with harvest sizes. Specifically, those whose cosmologies reflected notions of nonhuman personhood and interconnectedness with nature harvested less wildlife biomass (Model 1, Table 10; Figure 2). Although there was a trend towards a negative relationship between expectations of supernatural punishment and harvest size, this relationship did not approach statistical significance (Model 2, Table 10; Figure 3). The combined measure also significantly related to harvest size such that those with more "proconservation" cosmologies harvested less wildlife (Model 3, Table 10; Figure 4). There was 1 individual (not the same as those mentioned above) with standardized residuals less than -2.5 in each of these models; excluding him increased the magnitude of the negative effect of the cosmological variables (and also eliminated the statistical significance of education).

Table 10

Multiple regression results showing relationship between cosmology measures and log-transformed kg of wildlife biomass harvested (dependent variable) for the subsample

	Model 1 (n = 90)	Model 2 (*n* = 91)	Model 3 (*n* = 90)
	B (*SE*)	*B* (*SE*)	*B* (*SE*)
(H1) INP cosmology	**-0.30*** **(0.13)**	___	___
(H2) Expectations of supernatural punishment	___	**-0.21** **(0.13)**	___
(H3) Combined measure of "proconservation" cosmology	___	___	**-0.24*** **(0.10)**
Village	-0.33 (0.37)	-0.39 (0.37)	-0.41 (0.37)
Sex (0 = female, 1 = male)	1.94*** (0.35)	1.79*** (0.34)	1.91*** (0.35)
Age	-0.01 (0.01)	-0.02 (0.02)	-0.02 (0.01)
Absenteeism	-0.32* (0.13)	-0.31* (0.13)	-0.32* (0.13)
Wealth	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Formal education	-0.09† (0.05)	-0.12* (0.05)	-0.10* (0.05)
Number of consumers	0.06 (0.08)	0.08 (0.08)	0.07 (0.07)
(intercept)	2.80** (0.91)	2.67** (0.94)	2.15* (0.84)
Adjusted R^2	0.26	0.24	0.27
F	4.98	4.52	5.02

† $p < .10$; * $p < .05$, ** $p < .01$, *** $p < .001$

Note: the subsample includes only those whose harvest sizes were greater than zero.

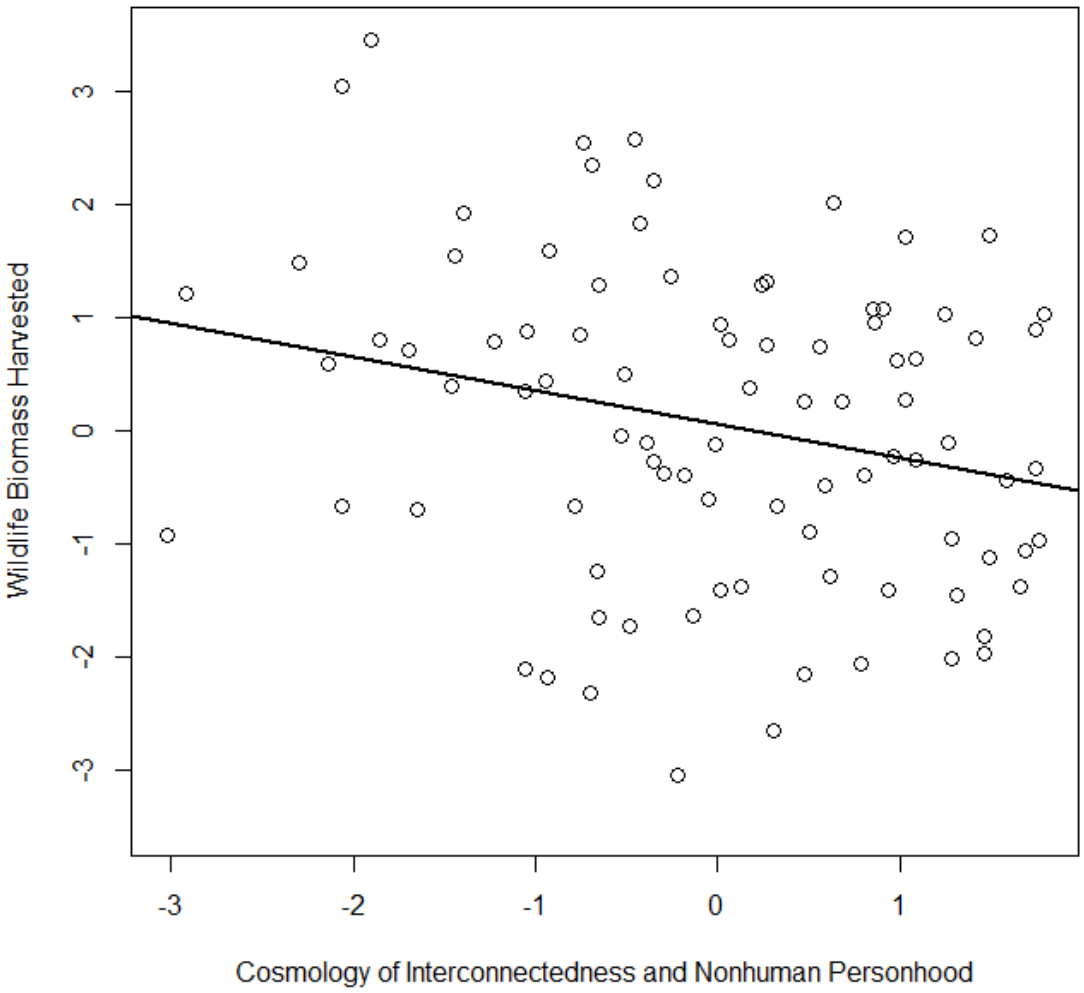

Figure 2. Partial residual plot showing the relationship between beliefs in interconnectedness and nonhuman personhood (INP cosmology) and wildlife biomass harvested (logarithmic scale), controlling for village, sex, age, absenteeism, wealth, formal education, and number of consumers, and including only people whose harvest size was greater than zero (n = 90).

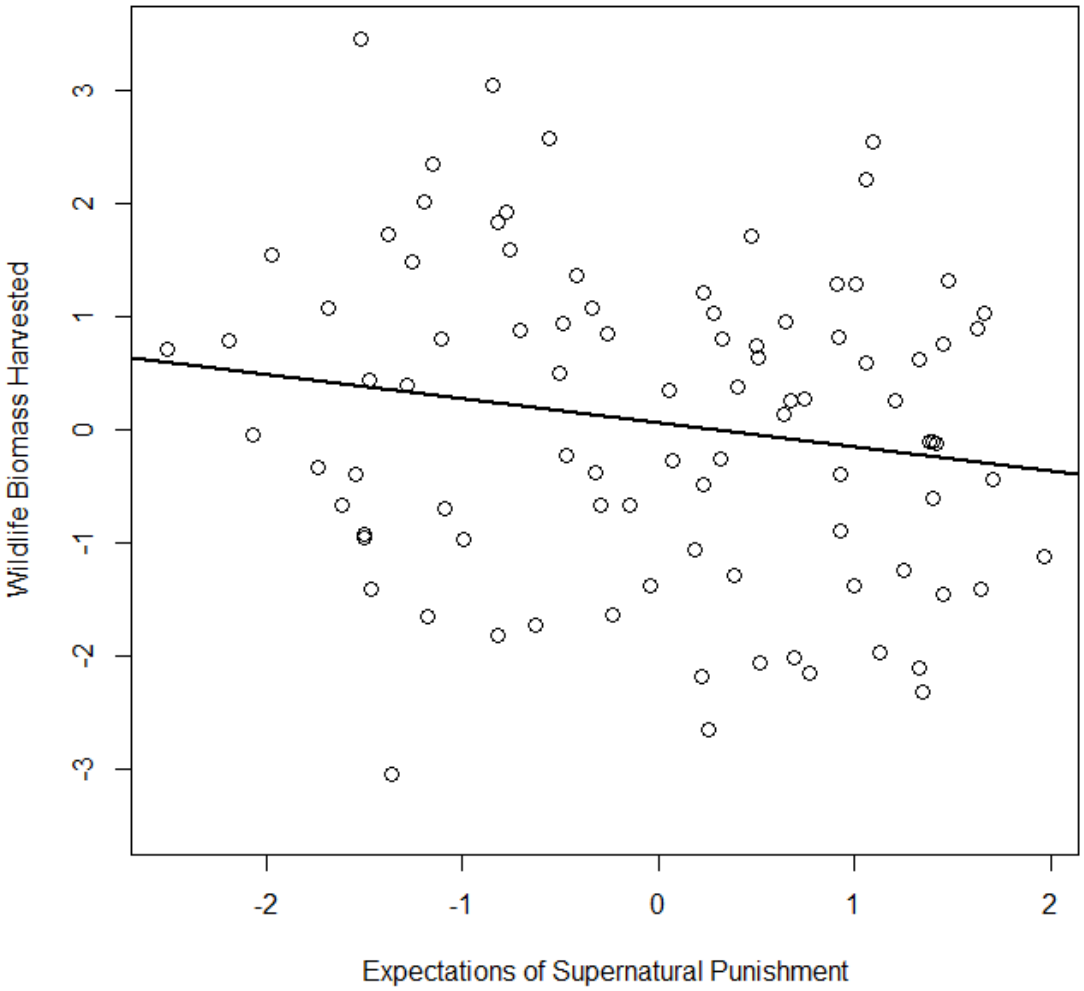

Figure 3. Partial residual plot showing the relationship between beliefs in supernatural punishment for overharvesting and wildlife biomass harvested (logarithmic scale), controlling for village, sex, age, absenteeism, wealth, formal education, and number of consumers, and including only people whose harvest size was greater than zero (n = 91).

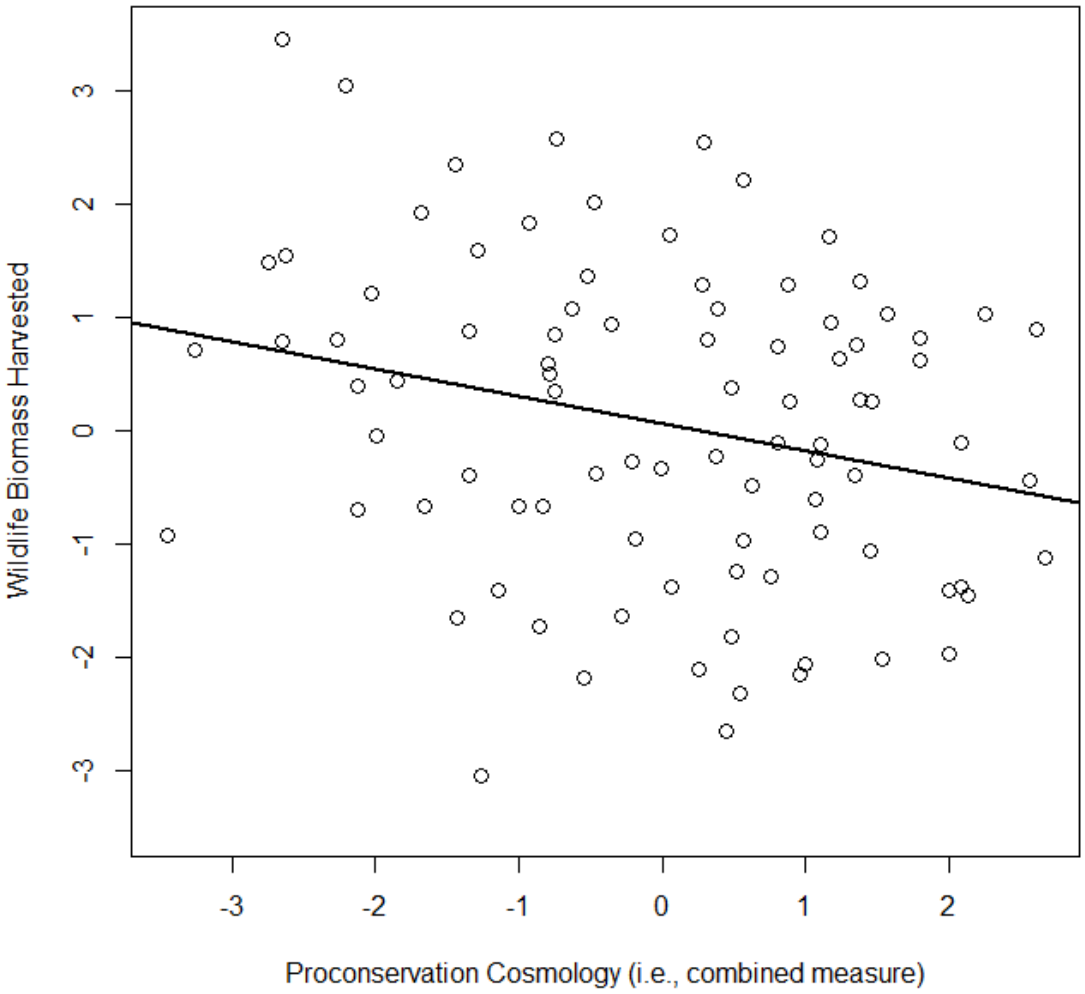

Figure 4. Partial residual plot showing the relationship between "proconservation" cosmological beliefs (i.e., the combined measure of beliefs in interconnectedness, nonhuman personhood, and punitive spirit guardians) and wildlife biomass harvested (logarithmic scale), controlling for village, sex, age, absenteeism, wealth, formal education, and number of consumers, and including only people whose harvest size was greater than zero (n = 90).

Since generally only men hunted but both men and women fished, I also looked separately at men and women (Table 11). Because several control variables had been found not to be significantly related to harvest size in the multivariate models (see Table 5), these were not included here in order to increase degrees of freedom. The results show that men, but not women, who have cosmological beliefs of interconnectedness and nonhuman personhood harvested less wildlife (Table 11, Model 1). No significant effect was found for expectations of supernatural punishment or the combined measure of "proconservation" cosmological beliefs for either men or women; although, directionality of their beta coefficients was negative, as expected, in all models except the model of men's expectations of supernatural punishment (however, excluding one outlier changed the sign to the expected direction).

Given the relationship between cosmology and harvest size among men, I explored whether men with more beliefs in interconnectedness and nonhuman personhood went on fewer foraging trips[17] or harvested less wildlife biomass per trip than other men.[18] Looking at the full sample of men, and controlling for education, men with more INP beliefs did not go on significantly fewer trips (partial $r_s = -0.15$, $p > .10$, $n = 61$) or harvest significantly less per trip than other men (partial $r_s = -0.20$, $p > .10$, $n = 58$). However, focusing on the subsample of men whose harvest size was greater than zero, and controlling for education, men with more beliefs in interconnectedness and

[17] "Foraging trip" refers to any excursion on which wild faunal resources, including not only vertebrates but also invertebrates, were killed or collected by *any* member of the foraging party. Not all foraging trips were intentional hunting or fishing trips; sometimes people encountered wildlife in the course of other activities (e.g., bathing or weeding a garden) and opportunistically captured the animal. I have no record of foraging trips that were complete failures (i.e., no wild faunal resources were acquired by any member of the foraging party).

[18] In this study, the focus is on the actual kills attributed to an individual. However, if a person went on a hunting or fishing trip as a "helper," then he or she would typically receive a portion of the catch even if he or she was not directly responsible for it. Thus the harvest-per-trip calculation may over- or under-estimate the amount an individual actually took home.

Table 11

Multiple regression results showing sex differences in the relationship between cosmology measures and log-transformed kg of wildlife biomass harvested (dependent variable) for the subsample

	Model 1		Model 2		Model 3	
	Men (n = 53)	Women (n = 43)	Men (n = 53)	Women (n = 43)	Men (n = 53)	Women (n = 42)
	B (*SE*)	*B* (*SE*)	*B* (*SE*)	*B* (*SE*)	*B* (*SE*)	*B* (*SE*)
(H1) INP cosmology	**-0.46*** **(0.19)**	**-0.09 (0.14)**	___	___	___	___
(H2) Expectations of supernatural punishment	___	___	**0.05 (0.17)**	**-0.31† (0.16)**	___	___
(H3) Combined measure of "proconservation" cosmology	___	___	___	___	**-0.18 (0.15)**	**-0.17 (0.12)**
Absenteeism	-0.13 (0.15)	-0.38* (0.16)	-0.13 (0.16)	-0.43** (0.15)	-0.12 (0.16)	-0.43* (0.16)
Formal education	-0.03 (0.05)	-0.10† (0.06)	-0.05 (0.06)	-0.08 (0.06)	-0.04 (0.06)	-0.09 (0.06)
(intercept)	4.07*** (0.83)	1.84** (0.68)	2.46*** (0.61)	1.89*** (0.48)	2.45*** (0.57)	1.47** (0.48)
Adjusted R^2	0.08	0.12	-0.03	0.20	-0.01	0.16
F	2.51	2.84	0.46	4.58	0.91	3.59

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Note: the subsample includes only those whose harvest sizes were greater than zero.

nonhuman personhood harvested significantly less wildlife biomass per trip (partial r_s = -0.33, $p < .05$, $n = 53$).

Qualitative analysis

The Miskitu people of this study varied in their perceptions of a clear ontological distinction between humans and nature. Fifty-two percent of respondents thought that plants and animals share some kind of kinship with humans, 40% thought animals seem almost human sometimes, and 72% believe that plants and animals have souls (Table 6). Yet, near perfect consensus (95%) was obtained regarding whether plants and animals have as much right to exist as humans. It would seem then that Miskitu people believe in this right in a very fundamental way that is independent of their particular ontologies of kinship and personhood. However, because such survey responses can be viewed with skepticism (e.g., How do respondents understand the questions? Do they feel comfortable enough to answer openly? What does a "yes" or "no" really mean?), a closer examination of the elaborations that many interviewees gave following their responses to the structured cosmological questions is especially valuable. These data form the foundation for the following analysis, which also incorporates information from other parts of the formal interviews as well as informal conversations throughout the research period. The perspectives presented not only illustrate the ways that people reflect upon and make meaning of their beliefs but also validate the measures used in the quantitative analyses and develop a fuller context for interpretation of the quantitative results.

As just mentioned, the question about whether animals seem almost human received a 40% positive response – but rather than articulating notions of shared essence

(but see below), several people's comments indicated that their beliefs were akin to pet owners in the U.S. who see human-like qualities in their pets. For example, Ariana[19], who thought that sometimes animals did indeed seem "almost human," recalled an experience from her youth when she worked as a cook for laborers harvesting *tunu*. When the men left for work, she and another woman stayed behind and "a *wakling* [white-faced monkey] came and saw the [other] woman in her underwear and wanted to grab her as if he were a man!" In contrast to Ariana, Cornelio thought that animals did *not* ever seem like people. He explained, "when we encounter animals, they run from us." I asked him if he thought that people would not run, and he replied, "no, they'd come over and chat with us about how to solve a problem or something." Surely the most existential response I heard came from a young man named Tomás, who observed that, "the animals walk about and eat and do not think about the hour of death. Therefore they are not like people – they are less."

By comparison, asking whether people thought of plants and animals as kindred seemed to evoke less literal anthropomorphizing and more reflection on reciprocal relationships. Several respondents pointed out that trees and animals help people and therefore they are "like family." Winston expressed this mutualistic, kin-like relationship in two languages by making explicit reference to *pana pana*, the Miskitu conceptualization of cooperation and reciprocity (see Helms 1971: 129-132; Coe & Anderson 1997: 177), and then explaining in Spanish "*juntos sobrevivimos*" ("together we survive"). Even though 48% of respondents did not think in such relational terms, 86% of respondents felt sad when they saw animals suffering, suggesting that empathy was not necessarily reserved for humans and nonhuman kindred. However, a few people

[19] All participant names are pseudonyms.

articulated a distinction between domesticated and wild animals. For example, Gretal said that she was sad when her domesticated animals suffer, but not when wild animals suffer. One interpretation is that Gretal and those that think like her care about the suffering of their domesticated animals because of obvious self-interest – but another, not mutually incompatible, interpretation is that the close interdependence of domesticates and people fosters greater empathy through an on-going and personal relationship.

The most inclusive ontological category to emerge from the interviews is that of *sôlka*[20] (soul): 72% of respondents thought that animals and trees have souls. Four people said that only animals, not trees, have souls. When Maura said specifically that *daiwan nani* have souls, I asked her if she also thought that *dus nani* (trees/plants) have them. She thought pensively for a minute and then said that because they breathe air "they too have *sôlka*." Sulan, a quiet-tempered elder, explained to me that "the trees have a small hole inside and when they are cut, the souls escape." Maura and Sulan agreed that trees have souls but what this meant to each of them differed: Maura emphasized the materiality of the soul through its connection to bodily function, whereas Sulan emphasized the immateriality of souls through their separability from their bodies. Winston, who thought like Maura that respiration marked the presence of souls, distinguished between breath and life. A bilingual woman named Gladys, on the other hand, did not identify breath as the most salient marker of *sôlka*, but rather the heart. Gladys said in response to my

[20] Although there are translations in the ethnographic literature of *lilka* as the Miskitu word for "soul" (Dennis, 2004; Minks, 2007), the word has multiple meanings. As noted by Jamieson (2008) – and as I heard for myself in the field – *lilka* not only refers to "the spirits of the living," but also "shadow" and "photograph" (pp. 562-563). *Sôlka* also means "soul" (Melgara Brown, 2008), but its evident English origin implies an association with Christian notions of the soul. A discussion with key informants/interpreters about the distinction between *lilka* and *sôlka* suggested that *sôlka* was thought of as something inherent to humans but not necessarily other life forms. Thus, using *sôlka* would not only provide greater conceptual equivalence across participants (given the multiple meanings of *lilka*) but would also reveal a strong belief in nonhuman personhood if participants extended *sôlka* to nonhumans.

question about *sôlka* that "*sí, tienen vida*" ("yes, they have life"). Not sure if her use of the Spanish word *vida* corresponded to the Spanish word *alma* (soul), I pressed her further: "well, do they have *almas*?" She explained that indeed they do because "palms have *corazones* [hearts] so they have souls." I asked her where the souls of humans reside. She said in the heart. If souls are the animating principle of living beings, then it is perhaps unsurprising that so many people thought nonhumans had souls; on the other hand, it is interesting that the degree of consensus that was seen for the question regarding the right to exist was not obtained for the question about souls. In light of this, it seems that for the Miskitu, the right to exist is not predicated upon the possession of a soul.

As prevalent as it was, the belief in the right of nonhumans to exist did not seem associated with feelings of obliged self-sacrifice for the well-being of these nonhuman others. This sentiment was well-expressed by Cornelio who said (with laughter) of plants and animals: "they have the right [to exist], but they have to lose that right when we are hungry!" It may be sad to have to clear forest for agriculture or pasture – as 51% of respondents expressed – but people must live. The primacy of human well-being emerged in Diego's reflection about forest clearance. An elder and avid hunter, Diego mused that "for agriculture it is good [to clear land] but for pasture it is bad because the wild animals run far away – where are they going to live?" His implied point that agriculture does not cause animals "to run" is corroborated by data on hunting returns for at least some species in agricultural plots (Koster 2008b). Therefore, Diego's differential concern about the effects of deforestation on wildlife reflects not only a cultural devaluation of pastureland but also the valuation of good hunting grounds.

Like many other indigenous cultures, there was a recurring "no waste" ethic. This was expressed in the context of land use as well as hunting. Leaving meat to spoil in the forest was considered a very improper act. For example, Iker, another avid hunter, thought that it was fine if a hunter killed 4 tapir during one hunting trip as long as he did not leave the meat to spoil. If he brought the meat back to the village for sharing and selling, then that was good. For the Miskitu, "wasting" seems to be defined in anthropocentric terms. This contrasts with Pierotti's (2011) view that leaving carcasses behind (e.g., after chasing buffalo over cliffs) is not necessarily "wasteful" if viewed from an ecological perspective rather than an environmental perspective (because other organisms consume the buffalo remains and nutrients and energy cycle through the ecosystem). In addition to avoiding waste, the continued use of resources, an important principle in many indigenous cultures (e.g., Berkes, 2008, p. 113), was also expressed by Iker when he said, "God made [the forest] for people to use. If people do not clear it and use it, that's bad." His emphasis on God creating nature for human use takes on a decidedly Christian worldview with the implication of dominion over nature.

The syncretism between Christianity and traditional indigenous beliefs was most evident when it came to beliefs about spirit owners and supernatural punishment. Two examples are especially striking. The first comes from a man named Herman who told me that he knows there are "people of the river" (*liwa*) but he does not believe that they are owners of the fish. He explained: "according to the Bible, these people come from the *cielo* [sky or heaven]. There was a war and God kicked them out of heaven and they took up in various places. They are evil spirits. The Bible explains this." The second example comes from Torlin who recounted to me a story he had heard from his grandmother:

> A man went hunting with a shotgun and killed *wari* [white-lipped peccary]. Later he was found hung from a tree with his mouth and chest cut open, his shotgun flung afar. The people took him down and buried him. But this was not the doing of *lasa*. Rather, it was the doing of God because the man had been hunting on Sunday. For a lack of respect of Sunday as a day of rest, God punished him.

These examples vividly illustrate the merging of traditional beliefs in *lasa* with Christian concepts. Both Herman and Torlin had answered "no" to the earlier question asking if they believed some trees and animals have spirit owners or *lasa*. Given the evident difference in their later comments, in the case of Torlin, it was easy to take him at his word because there was no apparent discrepancy across his responses. In the case of Herman, I was concerned that his earlier "no" response was due to a desire to give a "good Christian answer." My concern was both validated and allayed when Herman explained that the character from the *liwa mairin* vignette would not be punished for taking too many fish because "if you believe in evil spirits, you will see them. If you don't believe, you won't. You have to have faith that there are no evil spirits." Herman was thus giving a good Christian answer and simultaneously creating a reality in which there are no evil spirits. Dennis (2004) heard a similar "postmodern philosophy" (p. 215) in the Miskitu coastal community of Awastara. Consequently, I interpreted Herman's seemingly inconsistent (from a positivist perspective) responses as reflections of his own cosmological understanding of reality.

Finally, several people explained their lack of belief in supernatural punishment as the result of their own lived experience through which they had learned that they could cut a large Ceiba or harvest large quantities of fish and nothing would happen to them. The role of individual learning in people's beliefs may help explain why older people were less likely to believe in supernatural punishment than younger people: they had

lived long enough to have violated these norms and observed the lack of consequences. That the stories are evidently still being told to younger generations may reflect cultural pride as much as cautionary tales about the consequences of improper behavior.

Discussion

The results of this study among the Miskitu provide initial quantitative evidence at the individual-level of the direct link between people's cosmological beliefs and their observed environmentally-significant behavior, namely hunting and fishing harvests. Specifically, controlling for other factors, those individuals who held more "proconservation" cosmological beliefs (i.e., the combined measure that included beliefs in nonhuman personhood, interconnectedness between humans and the rest of nature, and spirit guardians that punish for overharvesting) harvested less wildlife biomass, supporting hypothesis 3 (Model 3 in Tables 4 and 5; see also Figure 3). INP cosmology and expectations of supernatural punishment – the components of the combined measure just mentioned – were found to be independently associated with lower wildlife harvests in the subsample and the full sample, respectively (Model 1, Table 5; Model 2, Table 4). Although the relationship between the cosmological variables and harvest size in the full sample was sensitive to outliers, the relationship was robust to outlier exclusion for the subsample with individuals whose harvest sizes were greater than zero. Looking at men and women separately, INP cosmology was associated with lower harvest size for men only; neither expectations of supernatural punishment nor the combined measure had a significant association with harvest size for either sex (Table 6). The magnitude of the relationship between INP cosmology and harvest size was substantial among men:

holding absenteeism and formal education constant, when the number of beliefs in interconnectedness and nonhuman personhood increase by 1, wildlife biomass harvests decrease by 46%. The lack of a relationship between INP cosmology and harvest size among women could be due, at least in part, to lower variance among women's harvest sizes.

An important caveat when interpreting these results is that only particular cosmological beliefs were examined (see Tables 1 and 2) – and two of these beliefs were not included in the final index of INP cosmological beliefs due to low intercorrelations among the items (but see footnote 9). For the dropped question about forest clearance, the problem was most certainly with the question itself because it referenced both agriculture and pasture – yet these two land-uses are thought of very differently by Miskitu people because agriculture is the foundation of their subsistence way of life, whereas pasture is used for cattle-ranching, still primarily a *mestizo* practice. For the dropped question about belief in *lasa*, participants sometimes gave an answer to this question that differed from their subsequent answers to the supernatural punishment questions, implying that their response to one or the other was an inaccurate indicator of their actual beliefs. However, as noted in the qualitative analysis, some interviewees explained their answers in a very postmodern fashion: you will encounter spirits if you believe in them, but not if you do not. It is tempting then to interpret the low intercorrelation of this item with the five index items as the statistical footprint of this postmodern thinking.

Beliefs in interconnectedness and nonhuman personhood were only weakly correlated with expectations of supernatural punishment, suggesting that they do not tap into the same underlying cosmological construct. Importantly, as just mentioned, INP

cosmology was more robustly associated with lower wildlife harvests than were beliefs in supernatural punishment. These two constructs also appear to differ in the degree to which they are modified through real-world feedback. Age was unrelated to INP cosmology, but negatively related to expectations of supernatural punishment. An argument made by Smith (1991, p. 24) about foraging offers some illumination as to why this might be so: because the payoffs to foraging are immediate and repeated, it is a domain in which cumulative experience can motivate an individual to deviate from cultural norms. In the present context, several Miskitu participants commented that they had taken large quantities of fish or cut a large Ceiba tree and never received any punishment from *lasa*. So it seems that a belief about a causal relationship between *x* and *y* is readily challenged by the lived experience of *x* without *y*.

Regarding the supernatural punishment hypothesis put forward by Johnson and Krüger (2004) that belief in supernatural punishment facilitates public goods cooperation, the present study found no statistically significant support not dependent on the inclusion of three outliers. Nevertheless, negative trends were found more often than not, and it is possible that this study simply lacked the statistical power to demonstrate a significant effect. On the other hand, it could be that the examples in the vignettes were so extreme that it was easy for participants to say that the character would be punished even if they felt that they themselves would not be punished for harvesting at high (but not *that* high) levels. Another possible explanation is that regardless of such beliefs people tend to discount the future. Perhaps controlling for either time preference or inclinations towards risk-taking behavior would reveal a stronger relationship between expectations of punishment and harvest size. A third reason could be that the syncretism between

traditional Miskitu beliefs and Christianity has muddied the relationship between beliefs in supernatural punishment and foraging behavior. Recall the story told by Torlin in which a *wari* hunter was killed for hunting on a Sunday, a Christian day of rest. Although Torlin believed in supernatural punishment for improper hunting behavior, the punishment came from God, not *lasa*. Future research could parse these issues.

The results of the INP cosmology analysis suggest that ontological beliefs of interconnectedness and nonhuman personhood can facilitate cooperation towards commons management; punishment is not necessarily the integral ingredient. For example, in a study among Buddhist mushroom harvesters in Bhutan, Brooks (2010) examined the role of "other-regarding" orientation (arguably a form of interconnectedness) in determining individuals' willingness to show harvest restraint. He found individuals who were more "other-regarding" – a highly valued principle in Buddhism – were more likely to express a willingness to reduce their harvest to ensure sustainability. Psychological studies have similarly shown the importance of self-transcendence for cooperation (Sagiv et al., 2011) – even cooperation in a hypothetical commons dilemma (Arnocky et al., 2007). It seems plausible that INP cosmology might relate to other measures of self-transcendence.

Finally, since this study did not evaluate sustainability (as in MSY) or conservation (as in restraint; see Alvard, 1993) per se, the question of the effect of indigenous cosmologies specifically on sustainability or conservation was not addressed here. Nevertheless, to the extent that harvesting *less* wildlife biomass can be generally considered to have a lower environmental impact than harvesting *more* wildlife biomass, these results are consistent with the argument that indigenous cosmologies promote

sustainable resource use and conservation. We should keep in mind though that this study was not designed to determine causality; it only demonstrated an *association* between certain cosmological beliefs and wildlife harvests. Aside from the point that correlation does not equal causation, much of the behavioral data were collected prior to the survey questions about beliefs (perhaps a stronger case for beliefs causing behavior could be made if beliefs were measured before behaviors). Also, since wildlife harvests per trip were lower for men with more INP cosmological beliefs, it is possible that these men were not as skilled at hunting and fishing as other men (why this would be so is itself an interesting question). Ultimately, it may turn out that the causal relationship between cosmology and ecological behavior is bidirectional.

There were other study limitations as well. First, the behavioral data used for these analyses come from the beginning of May through most of December, which corresponds to the wet season. Because fish (but not hunting) harvests peak during the dry season from January to May (Koster, 2007), fishing harvest data in this study do not reflect fishing harvests for the peak season. Second, some wildlife caught by participants during the study period was not weighed. Villagers would travel away from their villages, and it is certain that they engaged in some hunting and fishing. Controlling for absenteeism helps address this, but does not fully eliminate the issue. Furthermore, sometimes people simply did not want to be bothered about having their catches weighed. One young man who was a very prolific fisher participated in interviews with field assistants inconsistently. Yet, despite the missing data, he nonetheless emerged from the behavioral data set as one of the most productive fishers. Third, relying on Spanish and only a limited knowledge of the Miskitu language limited my capacity to understand

Miskitu expressions, opinions, and worldviews. However, the extensive care taken in the translation of interview questions, the use of written interview questions (read in Miskitu), and the construction of questions that required only simple responses (e.g., yes/no) from participants all helped to ensure mutual understanding with respect to the specific questions being asked and answers given. Moreover, the commentary many participants provided following their yes/no responses to the cosmological questions validated the measures by demonstrating not only participants' comprehension of the questions but also their serious contemplation of them. Certainly a richer understanding awaits future research.

In conclusion, this study showed that Miskitu hunters and fishers whose cosmology included beliefs in interconnectedness and nonhuman personhood harvested less wildlife. Replication of these results for the Miskitu – as well as extension to other cultures – is facilitated by this study's use of scientific methods. To be sure, however, the interpretation of the quantitative data benefitted from the commentaries and thoughtful reflections of participants, and I recommend a mixed methods approach – perhaps even interdisciplinary and collaborative – for future research in this domain.

CHAPTER 5

CONCLUSION

The overarching aim of this dissertation was to understand why some people behave in ways that are more conducive to sustainable resource use than other people. As discussed in the Introduction, sustainability problems can often be characterized as *social dilemmas* because the "rational" strategy for an individual's short-term self-interest is suboptimal if everyone follows the same strategy. Such dilemmas can be overcome through social institutions – such as common property regimes – that alter the costs and benefits, or at least the *perception* of costs and benefits, for certain behaviors. However, although social institutions are generally analyzed as *human* institutions, they involve *nonhuman* others – and in some cultures nonhuman others may be thought of as having agency and being part of the social community (Descola, 2005; Schmidt & Dowsley, 2010). These nonhuman others may therefore be more aptly described as nonhuman *persons*, and they may affect how people perceive the costs and benefits of certain sustainability-related behaviors. Thus, this dissertation examined how costs and benefits were perceived in terms of both common property institutions and cosmological beliefs about nonhuman persons, and how these cognitions related to sustainability-related behaviors among the Miskitu people of Nicaragua.

Summary of major findings

Since this dissertation is organized around three stand-alone papers, I will begin by summarizing the major findings of each chapter before drawing some general conclusions.

Barriers to institutional efficacy

The common property regime in Kipla Sait Tasbaika did not appear to be a high functioning one. In interviews many people noted its poor functionality and criticized the leaders and forest guards for not fulfilling their enforcement duties. As I argued in Chapter 2, there were few incentives for these individuals to incur the costs of monitoring and sanctioning their fellow villagers. Additionally, some people perceived the natural resource management rules and/or their enforcement as unjust and illegitimate. These sentiments may have reduced people's willingness to comply voluntarily with the management rules, thus compounding the problem of weak enforcement. However, there were rays of hope for better management in the future: most people recognized that human activities were the cause of increasing resource scarcity, and many people thought that the natural resource management system should be better enforced in order to ensure the well-being of future generations. In other words, people were aware of the problem as well as its potential solution. Unfortunately, these beliefs in and of themselves do not alter the costs and benefits of prosustainability behavior. I argue that a participatory revision of the rules and enforcement system – perhaps with the support of relevant external actors – could reduce the costs of monitoring and sanctioning, thereby leading to greater institutional efficacy.

Cognition of compliance

Chapter 3, which tested hypotheses about the role of four cognitive variables in compliance with natural resource management rules, further developed the point that awareness of sustainability problems, while perhaps a necessary condition, is insufficient for behavioral change. Results showed that people's beliefs in increasing natural resource scarcity and their knowledge of natural resource management rules did not relate to their observed compliance with the rules. Looking explicitly at perceptions of costs for violating the rules, I found that people's expectations (in terms of both severity and certainty) of civic punishment also did not relate to compliance. Altogether these results do not support the notion that these cognitive variables play important roles in compliance with common property institutions in Kipla Sait Tasbaika. However, these results should be interpreted with caution, bearing in mind the study's limitations. For example, the study only included a few types of violations, and the methods used to assess expectations of punishment may have solicited responses about what people thought *should* happen more so than what they thought *would* happen.

Cosmology and wildlife harvests

To test for a relationship between cosmological beliefs about nonhuman others and human ecological behavior, in Chapter 4 I analyzed the relationship between individuals' harvests of wildlife and their beliefs in nonhuman personhood, interconnectedness between humans and nature, and supernatural punishment by spirit guardians for overharvesting. Results for both the full sample and the subsample (including only those whose harvest size was greater than zero) showed that individuals

with more of these beliefs (i.e., the combined measure) harvested significantly less wildlife biomass than people with fewer such beliefs. Looking at each component of the combined measure, people with greater expectations of supernatural punishment harvested less wildlife biomass in the full sample, and people with more beliefs in interconnectedness and nonhuman personhood harvested less wildlife biomass in the subsample. Although the relationship between the cosmological variables and harvest size in the full sample was sensitive to outliers, the relationship was robust to outlier exclusion for the subsample. Finally, looking at men and women separately, INP cosmology was associated with lower harvest size for men only; neither expectations of supernatural punishment nor the combined measure had a significant association with harvest size for either sex. Taken together, the results of this study suggest that cosmologies of interconnectedness and nonhuman personhood may play a role in limiting environmental impact, at least when assessed in terms of wildlife biomass harvested.

General conclusions

Snodgrass et al. (2013) argued that individuals often do not act according to their mental models of nature: "Rather, they decide whether or not to act on a rule or sanction associated with a social institution set up to regulate a resource that is collectively deemed to be important and worth protecting" (p. 347). However, the results of this dissertation suggest that cosmological beliefs regulate resource use more so than common property institutions in Kipla Sait Tasbaika. Moreover, the cosmological beliefs that were most consistently found to be associated with lower harvests were beliefs about interconnectedness and nonhuman personhood, not supernatural punishment. Taken

together, these results suggest that expectations of sanctions (civic or supernatural) may not be as important as INP beliefs for determining how people weigh costs and benefits of hunting and fishing activities.

The relative contribution of cosmologies and institutions to sustainable resource use probably varies across cultures and political-economic contexts, and it is likely to change if institutional efficacy improves over time. Therefore, instead of emphasizing one over the other as the best route to promoting sustainable behavior, researchers and policymakers should be alert to situations in which belief systems and institutions contradict rather than reinforce each other, as is likely to be the case in communities with externally imposed institutions for resource management. In the case of Kipla Sait Tasbaika, the natural resource management system was established through participatory processes, but its legitimacy and justice were nonetheless questioned by some residents. Moreover, de facto enforcement was weak; under conditions of stronger enforcement, individual belief systems may have a negligible relationship to resource use. Future research could explore this.

Future research

There are several additional directions for future research. Given the time that has elapsed since the research was conducted, there may have been changes to the natural resource management rules and enforcement system in Kipla Sait Tasbaika. Revisiting the site to determine what, if any, changes have occurred, why they occurred, and how well the institutions are now functioning could provide valuable insight into the process of institutional change, including “the coevolutionary dynamics between behaviors and

institutions" (Brooks, 2010, p. 782). For example, now that baseline data have been collected on the proportion of people who cooperated and defected from the common property institutions, a follow-up study could evaluate whether changes to the institutions reduced the proportion of defectors in the population. Also, there is a need for interdisciplinary collaboration to develop better methods for analyzing (1) how cognition mediates the relationship between social institutions and compliance in common property contexts, and (2) how (and why, in an ultimate sense) cosmologies relate to ecological behavior and environmental impact. In the interest of brevity, I will focus on three specific directions I am especially interested in pursuing.

Cognition and behavior: what is the causal direction?

The research in this dissertation was motivated by my interest in the relationship between cognition and behavior. As implied by the decision to use cognitive variables as predictor variables and behavioral variables as outcome variables, I have tended to think that beliefs, values, attitudes, and worldviews cause behaviors rather than the other way around. However, causality could flow from behaviors to beliefs. This has been argued for expectations of punishment and illicit behavior because individuals who violate the law and are not punished are less likely to believe in punishment (Paternoster, 1987). Likewise, if hunting and fishing failures are more likely than successes to be attributed to the agency of the animals or their spirit guardians, then people who are less successful at harvesting wildlife may be more likely to hold beliefs in nonhuman persons. In the present study, some individuals explained that they did not believe in *lasa* because they had harvested large quantities without receiving supernatural punishment. On the other

hand, individuals with stronger beliefs in *lasa* might be more likely to attribute supernatural causes to unfortunate events and, consequently, perceive supernatural punishment where and when others would not. In this way, people's cosmologies affect how they interpret and experience reality, and it may be that no simple relationship between beliefs and behavior exists. Future researchers would be wise to entertain the possibility that causality is bidirectional.

Measuring INP cosmology cross-culturally

Although the details of cosmological beliefs vary across cultures, there are certain recurring elements of nondualist, animistic thinking across the Americas, Asia, Oceania, and, to a lesser degree, Africa (Descola, 2005, 2013). Future research could explore these commonalities in a systematic way through the use of a scale like that used in Chapter 4 to measure INP cosmology. The items included in the final 5-item INP measure were not very specific to the Miskitu (in fact, the two items that were the most specific were ultimately not included), suggesting that it may be possible to develop a scale, or set of related scales, for use in cross-cultural research. Certainly most scales designed for measuring pro-environmental values, attitudes, and worldviews have been developed for use in "Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies" (Henrich et al., 2010, p. 61). Although some items from these scales may be appropriate for use in non-WEIRD societies (see Chapter 4), many items are worded in ways that betray a worldview in which humans are separate from nature, and nonhuman personhood is rarely recognized.[21] Therefore, an expanded scale focused on ontologies of

[21] For example, the New Ecological Paradigm measures a person's ecological worldview with 15 items (each with 5 response options from strongly agree to strongly disagree), including the following: "When

animism rather than *naturalism* (sensu Descola, 2013) could be used to collect systematic evidence to inform our understanding of the role of such beliefs in regulating human resource use.

Costs, benefits, and moral communities

As suggested in Chapter 4, it might be fruitful to think of INP cosmology as tapping into a more general construct of self-transcendence. There is convergent thinking across several disciplines about the importance of self-transcendence for pro-environmental behavior. Specifically, anthropologists and others have argued for the importance of cosmologies and ontologies that do not draw sharp distinctions between humans and the rest of nature (Berkes, 2008; Chernela, 1987; Salmón, 2000; Sponsel, 2012); psychologists have argued for the importance of empathy, connectedness to nature, universalism, and altruistic and ecocentric values and attitudes (Dietz et al., 2005; Schultz, 2000; Tam et al., 2013); and even biologists have argued for the importance of *biophilia* ("the innately emotional affiliation of human beings to other living organisms" [Wilson, 1993, p. 31]; Kellert & Wilson, 1993; Wilson, 1984). In a sense, they are all arguing, as philosophers have done, for the importance of moral inclusiveness (or ethical *extensionism*) for sustainability, i.e., the extension of our moral circle to be more

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humans interfere with nature it often produces disastrous consequences" (Dunlap et al., 2000, p. 434). Agreement with this item "indicates a proecological view" because it reflects a belief in "the fragility of nature's balance" (Dunlap et al., 2000, p. 433). This is a characteristically Western way of thinking: people are not a part of nature; they *interfere* with it – and in disastrous ways. The view that humans are part of the society of nature (Descola 1996, 2005) is not reflected here, nor is the view that humans can contribute positively to biodiversity or ecosystem health through their use of traditional ecological knowledge for resource management (Berkes, 2008; Gadgil et al., 1993). Moreover, these Western-based scales rarely recognize that respondents may think of natural entities as *persons*. Like Chapter 4, Snodgrass et al. (2013) took a step in the right direction with their use of eight items about "nature as a 'sacred person'" for use in Rajasthan, India (e.g., "Mining and the cutting of trees cause the mountain to feel pain" and "The jungle is more like my 'father and mother' than my property"; p. 336).

inclusive of others beyond ourselves, our family, our tribe, humans, sentient beings, living things, and all existing things (Gorke, 2003; Singer, 2011; see also Schwartz, 2007).

Since people's perceptions of costs and benefits of particular actions are presumably affected by considerations of collateral effects, individuals who extend moral consideration more widely should be expected to choose different courses of action than those with more narrow moral circles (Schwartz, 2007; Stern, 2000). Although it may be collectively rational to prioritize the greatest good for the greatest number, individual humans tend to prioritize the well-being of those with whom they share biological, cultural, and emotional closeness. As products of natural selection, humans may not have been selected to have broadly inclusive moral circles (Singer, 2011) – and yet, there is variation among people and societies (Schwartz, 2007). What causes this variation and what it means for creating a more just and sustainable world are questions worthy of continued study.

APPENDIX

MULTIPLE REGRESSION ANALYSIS EXCLUDING OUTLIERS

Table 12

Multiple regression results showing relationship between cosmology measures and log-transformed kg of wildlife biomass harvested (dependent variable) for the full sample excluding cases with standardized residuals greater than 2.5

	Model 1 Excluding 2 Outliers (n = 108)	Model 2 Excluding 3 Outliers (n = 108)	Model 3 Excluding 2 Outliers (n = 108)
	B (*SE*)	*B* (*SE*)	*B* (*SE*)
(H1) INP cosmology	**-0.12 (0.09)**	___	___
(H2) Expectations of supernatural punishment	___	**-0.11 (0.08)**	___
(H3) Combined measure of "pro-conservation" cosmology	___	___	**-0.12†** (0.07)
Village	-0.38 (0.27)	-0.41 (0.26)	-0.41 (0.26)
Sex (0 = female, 1 = male)	1.33*** (0.22)	1.19*** (0.21)	1.32*** (0.22)
Age	-0.02* (0.01)	-0.03** (0.01)	-0.03** (0.01)
Absenteeism	-0.13 (0.08)	-0.12 (0.08)	-0.13 (0.08)
Wealth	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Table 12 continued

	Model 1	Model 2	Model 3
	Excluding 2 Outliers (n = 108)	Excluding 3 Outliers (n = 108)	Excluding 2 Outliers (n = 108)
	B (*SE*)	*B* (*SE*)	*B* (*SE*)
Formal education	-0.01	-0.04	-0.02
	(0.03)	(0.03)	(0.03)
Number of consumers	0.01	0.02	0.01
	(0.05)	(0.05)	(0.05)
(intercept)	2.11**	2.32***	1.88**
	(0.63)	(0.63)	(0.59)
Adjusted R^2	0.25	0.25	0.26
F	5.45	5.42	5.71

† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

REFERENCES

Acheson, J. M. (2006). Institutional failure in resource management. *Annual Review of Anthropology*, *35*, 117-134.

Acosta, M. L. (2010). Los retos del proceso de titulación y saneamiento como protección a la propiedad indígena. *WANI*, *60*, 5-17.

Adams, G. S., & Mullen, E. (2012). The social and psychological costs of punishing. *Behavioral and Brain Sciences*, *35*(01), 15-16.

Agrawal, A. (1994) Rules, rule-making and rulebreaking: Examining the fit between rule systems and resource use. In E. Ostrom, R. Gardner, and J. Walker (Eds.), *Rules, games and common-pool resources* (pp. 267-282). Ann Arbor: University of Michigan Press.

Agrawal, A. (2001). Common property institutions and sustainable governance of resources. *World Development*, *29*(10), 1649-1672.

Agrawal, A. (2003). Sustainable governance of common-pool resources: Context, methods, and politics. *Annual Review of Anthropology*, *32*, 243-262.

Agrawal, A., & Gibson, C. C. (1999). Enchantment and disenchantment: The role of community in natural resource conservation. *World Development*, *27*(4), 629-649.

Alvard, M. S. (1993). Testing the "ecologically noble savage" hypothesis: Interspecific prey choice by Piro hunters of Amazonian Peru. *Human Ecology*, *21*(4), 355-387.

Alvard, M. S. (1994). Conservation by native peoples: Prey choice in a depleted habitat. *Human Nature*, *5*(2), 127-154.

Alvard, M. (1995). Intraspecific prey choice by Amazonian hunters. *Current Anthropology*, *36*, 789-818.

Alvard, M. S. (1998). Evolutionary ecology and resource conservation. *Evolutionary Anthropology: Issues, News, and Reviews*, *7*(2), 62-74.

Anderson, E. N. (1996). *Ecologies of the heart*. Oxford University Press.Andersson, K. P., & Ostrom, E. (2008). Analyzing decentralized resource regimes from a

polycentric perspective. *Policy Sciences*, *41*(1), 71-93.

Arnocky, S., Stroink, M., & DeCicco, T. (2007). Self-construal predicts environmental concern, cooperation, and conservation. *Journal of Environmental Psychology*, *27*(4), 255-264.

Atkinson, Q. D., & Bourrat, P. (2011). Beliefs about God, the afterlife and morality support the role of supernatural policing in human cooperation. *Evolution and Human Behavior*, *32*(1), 41-49.

Barrett, C. B., Brandon, K., Gibson, C., & Gjertsen, H. (2001). Conserving tropical biodiversity amid weak institutions. *BioScience*, *51*(6), 497-502.

Basurto, X. (2005). How locally designed access and use controls can prevent the tragedy of the commons in a Mexican small-scale fishing community. *Society and Natural Resources*, *18*(7), 643-659.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy, 76*, 169-217.

Beckerman, S., & Valentine, P. (1996). On Native American conservation and the tragedy of the commons. *Current Anthropology, 37*(4), 659-661.

Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology*, *18*(3), 621-630.

Berkes, F. (2007). Community-based conservation in a globalized world. *Proceedings of the National Academy of Sciences*, *104*(39), 15188-15193.

Berkes, F. (2008). *Sacred ecology* (2nd edition). New York: Routledge.

Berkes, F., Feeny, D., McCay, B. J., & Acheson, J. M. (1989). The benefits of the commons. *Nature*, *340*(6229), 91-93.

Bird-David, N. (1990). The giving environment: Another perspective on the economic system of gatherer-hunters. *Current Anthropology*, *31*(2), 189-196.

Borgerhoff Mulder, M., & Coppolillo, P. (2005). *Conservation: Linking ecology, economics, and culture*. Princeton, NJ: Princeton University Press.

Bourgois, P. (1986). The Miskitu of Nicaragua: Politicized ethnicity. *Anthropology Today*, *2*(2), 4-9.

Boyd, R., Gintis, H., & Bowles, S. (2010). Coordinated punishment of defectors sustains cooperation and can proliferate when rare. *Science*, *328*(5978), 617-620.

Bromley, D. W., & Cernea, M. M. (1989). *The management of common property natural resources: Some conceptual and operational fallacies*, *57*. World Bank Publications.

Brooks, J. S. (2010). The Buddha mushroom: Conservation behavior and the development of institutions in Bhutan. *Ecological Economics*, *69*(4), 779-795.

Brown, L. A., & Emery, K. F. (2008). Negotiations with the animate forest: Hunting shrines in the Guatemalan Highlands. *Journal of Archaeological Method and Theory*, *15*(4), 300-337.

Büscher, B. (2012). Payments for ecosystem services as neoliberal conservation: (Reinterpreting) evidence from the Maloti-Drakensberg, South Africa. *Conservation and Society*, *10*(1), 29.

Byers, B. A., Cunliffe, R. N., & Hudak, A. T. (2001). Linking the conservation of culture and nature: A case study of sacred forests in Zimbabwe. *Human Ecology*, *29*(2), 187-218.

Campbell, B., Mandondo, A., Nemarundwe, N., Sithole, B., De JonG, W., Luckert, M., & Matose, F. (2001). Challenges to proponents of common property recource systems: Despairing voices from the social forests of Zimbabwe. *World Development*, *29*(4), 589-600.

Chapin, M. 2000. *Defending Kuna Yala: PEMASKY, The Study Project for the Management of the Wildlands of Kuna Yala, Panama.* A case study for *Shifting the power:Decentralization and biodiversity conservation.* Washington, D.C.: Biodiversity Support Program.

Chernela, J. (1987). Endangered ideologies: Tukano fishing taboos. *Cultural Survival Quarterly*, 11.2.

Chhatre, A., & Agrawal, A. (2008). Forest commons and local enforcement. *Proceedings of the National Academy of Sciences*, *105*(36), 13286-13291.

Coe, F. G., & Anderson, G. J. (1997). Ethnobotany of the Miskitu of eastern Nicaragua. *Journal of Ethnobiology*, *17*, 171-214.

Colding, J., & Folke, C. (2001). Social taboos: "Invisible" systems of local resource management and biological conservation. *Ecological Applications*, *11*(2), 584-600.

Conzemius, E. 1932. *Ethnographical Survey of the Miskito and Sumu Indians of Honduras and Nicaragua*. Smithsonian Institution, U.S. American Ethnology Bulletin 106, Washington, D.C.: Smithsonian Institution.

Cordón, M. R. & Toledo, V M. (2008). La importancia conservacionista de las comunidades indígenas de la Reserva de Bosawas, Nicaragua: Un modelo de flujos. *Revista Iberoamericana de Economía Ecológica*, 7, 43-60.

Cox, A. (1998). *Cosmovisión de los pueblos de Tulu Walpa: según relatos de los sabios ancianos miskitos*. Ed. Carlos Alem6n Ocampo. Managua: URACCAN.

Cox, S. J. B. (1985). No tragedy of the commons. *Environmental Ethics*, *7*(1), 49-61.

Cupples, J. (2012). Wild globalization: The biopolitics of climate change and global capitalism on Nicaragua's Mosquito Coast. *Antipode*, *44*(1), 10-30.

Dennis, P. A. (2004). *The Miskitu people of Awastara*. Austin, TX: University of Texas Press.

Descola, P. (1996). *In the society of nature: A native ecology in Amazonia*. Translated by Nora Scott. Cambridge: Cambridge University Press. (Original English translation published in 1994.)

Descola, P. (2005). Ecology as cosmological analysis. In A. Surrallés and P. García (Eds.), *The land within: Indigenous territory and the perception of the environment* (pp. 22-35). Copenhagen: International Work Group for Indigenous Affairs.

Descola, P. (2013). *Beyond nature and culture*. Chicago: University of Chicago Press.

Dietz, T., Fitzgerald, A., & Shwom, R. (2005). Environmental values. *Annual Review of Environment and Resources*, *30*, 335-372.

Dowie, M. (2005). Conservation refugees. *Orion*, *24*(6), 16-27.

Duncan, D. H., & Wintle, B. A. (2008). Towards adaptive management of native vegetation in regional landscapes. In C. Pettit, W. Cartwright, I. Bishop, K. Lowell, D. Pullar, and D. Duncan (Eds.), *Landscape analysis and visualization: Spatial models for natural resource management and planning* (pp. 159-182). Berlin: Springer.

Dunford, R. G., Mejia, E. B., Salbador, G. W., Gerth, W. A., & Hampson, N. B. (2002). Diving methods and decompression sickness incidence of Miskito underwater harvesters. *Undersea and Hyperbaric Medical Society*, *29*(2): 74-85.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues*, *56*(3), 425-442.

Durham, W. H. (1976). Resource competition and human aggression, part I: A review of

primitive war. *Quarterly Review of Biology*, *51*, 385-415.

Eggert, H., & Lokina, R. B. (2010). Regulatory compliance in Lake Victoria fisheries. *Environment and Development Economics*, *15*(02), 197-217.

Fagoth, A. R., Gioanetto, F., & Mercado, A. S. (1998). *Wan Kaina Kulkaia = Armonizando con nuestro entorno*. Managua: Imprimatur Artes Gráfica.

Feeny, D., Berkes, F., McCay, B. J., & Acheson, J. M. (1990). The tragedy of the commons: Twenty-two years later. *Human Ecology*, *18*(1), 1-19.

Fehr, E., & Gächter, S. (2000). Cooperation and punishment in public goods experiments. *American Economic Review*, *90*(4), 980-994.

Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature*, *415*(6868), 137-140.

Fehr, E., & Rockenbach, B. (2003). Detrimental effects of sanctions on human altruism. *Nature*, *422*(6928), 137-140.

Gadgil, M., Berkes, F., & Folke, C. (1993). Indigenous knowledge for biodiversity conservation. *Ambio*, *22*(2/3), 151-156.

Gavin, M. C., Solomon, J. N., & Blank, S. G. (2010). Measuring and monitoring illegal use of natural resources. *Conservation Biology*, *24*(1), 89-100.

Gibson, C. C., Williams, J. T., & Ostrom, E. (2005). Local enforcement and better forests. *World Development*, *33*(2), 273-284.

Gintis, H., Bowles, S., Boyd, R., & Fehr, E. (2003). Explaining altruistic behavior in humans. *Evolution and Human Behavior*, *24*(3), 153-172.

Godoy, R., Reyes-García, V., Huanca, T., Leonard, W. R., McDade, T., Tanner, S., Vadez, V., & Seyfried, C. (2007). Signaling by consumption in a native Amazonian society. *Evolution and Human Behavior*, *28*(2), 124-134.

Gorke, M. (2003). *The death of our planet's species: A challenge to ecology and ethics*. Washington (DC): Island Press.

Grim, J. A., Ed. (2001). *Indigenous traditions and ecology: The interbeing of cosmology and community.* Cambridge, MA: Harvard University Press.

Guala, F. (2012a). Reciprocity: Weak or strong? What punishment experiments do (and do not) demonstrate. *Behavioral and Brain Sciences*, *35*(01), 1-15.

Guala, F. (2012b). Strong reciprocity is real, but there is no evidence that uncoordinated

costly punishment sustains cooperation in the wild. *Behavioral and Brain Sciences*, *35*(01), 45-59.

Hale, C. R. (1994). *Resistance and contradiction: Miskitu Indians and the Nicaraguan state, 1894-1987*. Stanford, CA: Stanford University Press.

Hallowell, A. I. (2002). Ojibwa ontology, behavior, and world view. *Readings in Indigenous Religions*, *22*, 17-49.

Hames, R. (2007). The ecologically noble savage debate. *Annual Review of Anthropology*, *36*, 177-190.

Hardin, G. (1968). The tragedy of the commons. *Science*, *162*(3859), 1243-1248.

Hawkes, K., Hill, K., & O'Connell, J. F. (1982). Why hunters gather: Optimal foraging and the Ache of eastern Paraguay. *American Ethnologist*, *9*(2), 379-398.

Hayes, T. M. (2007a). Does tenure matter? A comparative analysis of agricultural expansion in the Mosquitia forest corridor. *Human Ecology*, *35*(6), 733-747.

Hayes, T. M. (2007b). *Forest governance in a frontier: An analysis of the dynamic interplay between property rights, land-use norms, and agricultural expansion in the Mosquitia forest corridor of Honduras and Nicaragua*. Ph.D. Dissertation, Indiana University, Bloomington, IN. ProQuest.

Helms, M. W. (1971). *Asang: Adaptations to culture contact in a Miskito community*. Gainesville, FL: University of Florida Press.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2-3), 61-83.

Henriksen, K., & Kindblad, C. (2011). Neoliberalism, patriarchal rule, and cultural change at the turn of the twentieth century: The case of Tabapauni. In L. Baracco (Ed.), *National integration and contested autonomy: The Caribbean Coast of Nicaragua* (pp. 191-219). New York: Algora Publishing.

Herlihy, L. H. (2002). *The mermaid and the lobster diver: Gender and ethnic identities among the Río Plátano Miskito Peoples.* PhD Dissertation, University of Kansas, Lawrence, KS.

Herlihy, L. H. (2012). *The mermaid and the lobster diver: Gender, sexuality, and money on the Miskito Coast*. Albuquerque, NM: University of New Mexico Press.

Hill, K. (1996). The Mbaracayú reserve and the Aché of Paraguay. In K. H. Redford and J. A. Mansour (Eds.), *Traditional peoples and biodiversity conservation in large tropical landscapes* (pp. 159-195). Arlington, VA: The Nature Conservancy.

Hill, K., Kaplan, H., Hawkes, K., & Hurtado, A. M. (1987). Foraging decisions among Ache hunter-gatherers: New data and implications for optimal foraging models. *Ethology and Sociobiology*, *8*(1), 1-36.

Homer-Dixon, T. F. (1994). Environmental scarcities and violent conflict: Evidence from cases. *International Security*, *19*(1), 5-40.

Hunn E. 1982. Mobility as a factor limiting resource use in the Columbian Plateau of North America. In N. Williams and E. Hunn (Eds.), *Resource managers: North American and Australian foragers* (pp. 17–43). Denver, CO: Westview Press.

Hunn, E., Johnson, D., Russell, P., & Thornton, T. (2003). Huna Tlingit traditional environmental knowledge, conservation, and the management of a "wilderness" park. *Current Anthropology*, *44*(S5), S79-S103.

Indígenas piden expulsar a colonos de Bosawás. (2014, February 26). *El Nuevo Diario*. Retrieved from http://www.elnuevodiario.com.ni/nacionales/312536.

Jamieson, M. (1998). Linguistic innovation and relationship terminology in the Pearl Lagoon basin of Nicaragua. *Journal of the Royal Anthropological Institute*, *4*(4), 713-730.

Jamieson, M. (2009). Contracts with Satan: Relations with "spirit owners" and apprehensions of the economy among the coastal Miskitu of Nicaragua. *Durham Anthropology Journal*, *16*(2), 44-53.

Jenny, A., Fuentes, F. H., & Mosler, H. J. (2006). Psychological factors determining individual compliance with rules for common pool resource management: The case of a Cuban community sharing a solar energy system. *Human Ecology*, *35*(2), 239-250.

Johnson, A. (1989). How the Machiguenga manage resources: Conservation or exploitation of nature. *Advances in Economic Botany*, *7*(2), 1.

Johnson, D. D., & Krüger, O. (2004). The good of wrath: Supernatural punishment. *Political Theology*, *5*, 159-176.

Johnson, K. A., & Nelson, K. C. (2004). Common property and conservation: The potential for effective communal forest management within a national park in Mexico. *Human Ecology*, *32*(6), 703-733.

Kaimowitz, D., Fauné, A., & Mendoza, R. (2003). *Your biosphere is my backyard: The story of Bosawas in Nicaragua*. CIFOR Working Paper No. 25.

Keane, A., Jones, J. P., Edwards-Jones, G., & Milner-Gulland, E. J. (2008). The sleeping policeman: Understanding issues of enforcement and compliance in conservation.

Animal Conservation, *11*(2), 75-82.

Keane, A., Ramarolahy, A. A., Jones, J. P., & Milner-Gulland, E. J. (2011). Evidence for the effects of environmental engagement and education on knowledge of wildlife laws in Madagascar. *Conservation Letters*, *4*(1), 55-63.

Kellert, S. R., & Wilson, E. O. (1993). *The biophilia hypothesis*. Washington (DC): Island Press.

Kipla Sait Tasbaika: Normas ecológicas de manejo. (2001). 2nd ed. Nicaragua: Servindsa. (Original work published as The Nature Conservancy. [1998]. *Kipla Sait Tasbaika: Normas ecológicas de manejo*. Managua, Nicaragua: IMPRIMATUR.)

Koster, J. M. (2007). Hunting and subsistence among the Mayangna and Miskito of Nicaragua's Bosawás Biosphere Reserve. Ph.D. Dissertation, Pennsylvania State University.

Koster, J. M. (2008a). Hunting with dogs in Nicaragua: An optimal foraging approach. *Current Anthropology*, *49*(5), 935-944.

Koster, J. M. (2008b). The impact of hunting with dogs on wildlife harvests in the Bosawas Reserve, Nicaragua. *Environmental Conservation, 35*(3): 211-220.

Kuperan, K., & Sutinen, J. G. (1998). Blue water crime: Deterrence, legitimacy, and compliance in fisheries. *Law and Society Review*, *32*(2), 309-338.

Lee, K. N. 1999. Appraising adaptive management. *Conservation Ecology, 3*(2): 3. [online] URL: http://www.consecol.org/vol3/iss2/art3

Low, B. S. (1996). Behavioral ecology of conservation in traditional societies. *Human Nature*, *7*(4), 353-379.

Lu, F. E. (2001). The common property regime of the Huaorani Indians of Ecuador: Implications and challenges to conservation. *Human Ecology*, *29*(4), 425-447.

Lu Holt, F. (2005). The Catch-22 of conservation: Indigenous peoples, biologists, and cultural change. *Human Ecology*, *33*(2), 199-215.

Madrigal-Ballestero, R., Schlüter, A., & Claudia Lopez, M. (2013). What makes them follow the rules? Empirical evidence from turtle egg harvesters in Costa Rica. *Marine Policy*, *37*, 270-277.

Mansuri, G., & Rao, V. (2004). Community-based and-driven development: A critical review. *The World Bank Research Observer*, *19*(1), 1-39.

McKean, M. A. (1992). Success on the commons: A comparative examination of institutions for common property resource management. *Journal of Theoretical Politics*, *4*(3), 247-281.

McKean, M. A. (2000). Common property: What is it, what is it good for, and what makes it work? In C. Gibson, M. McKean, and E. Ostrom (Eds.), *People and forests: Communities, institutions, and governance* (pp. 27-55). Cambridge, MA: MIT Press.

Melgara Brown, D. F. (2008). *Diccionario: Español-Miskito Miskito-Español*. Waspam, Rio Coco.

Minks, A. (2007). "Goblins like to hear stories": Miskitu children's narratives of spirit encounters. In M. Bamberg, A. DeFina, and D. Schiffrin (Eds.), *Selves and identities in narrative and discourse*, (pp. 9-40). Amsterdam: John Benjamins.

Minks, A. (2010). Socializing heteroglossia among Miskitu children on the Caribbean coast of Nicaragua. *Pragmatics*, *20*(4), 495-522.

Murtinho, F., Eakin, H., López-Carr, D., & Hayes, T. M. (2013). Does external funding help adaptation? Evidence from community-based water management in the Colombian Andes. *Environmental Management*, *52*(5), 1103-1114.

Nadasdy, P. (2005). Transcending the debate over the ecologically noble Indian: Indigenous peoples and environmentalism. *Ethnohistory*, *52*(2), 291-331.

Nagin, D. S. (1998). Criminal deterrence research at the outset of the twenty-first century. *Crime and Justice*, *23*, 1-42.

Nietschmann, B. (1973). *Between land and water: The subsistence ecology of the Miskito Indians, Eastern Nicaragua.* New York: Seminar Press.

Nikiforakis, N. (2008). Punishment and counter-punishment in public good games: Can we really govern ourselves? *Journal of Public Economics*, *92*(1), 91-112.

Nikiforakis, N., & Engelmann, D. (2011). Altruistic punishment and the threat of feuds. *Journal of Economic Behavior & Organization*, *78*(3), 319-332.

North, D. C. (1990). *Institutions, institutional change and economic performance*. New York: Cambridge University Press.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.

Ostrom, E. (1998). A behavioral approach to the rational choice theory of collective action: Presidential address, American Political Science Association, 1997. *American Political Science Review*, *92*(1), 1-22.

Ostrom, E. (2000). Collective action and the evolution of social norms. *The Journal of Economic Perspectives*, *14*(3), 137-158.

Ostrom, E., Janssen, M. A., & Anderies, J. M. (2007). Going beyond panaceas. *Proceedings of the National Academy of Sciences*, *104*(39), 15176-15178.

Ostrom, E., Walker, J., & Gardner, R. (1992). Covenants with and without a sword: Self-governance is possible. *American Political Science Review*, *86*(2), 404-417.

Paternoster, R. (1987). The deterrent effect of the perceived certainty and severity of punishment: A review of the evidence and issues. *Justice Quarterly*, *4*(2), 173-217.

Pedersen, M. A. (2002). Totemism, animism and North Asian indigenous ontologies. *Journal of the Royal Anthropological Institute*, *7*(3), 411-427.

Platteau, J. P. (2004). Monitoring elite capture in community-driven development. *Development and Change*, *35*(2), 223-246.

Pierotti, R. (2011). *Indigenous knowledge, ecology, and evolutionary biology.* New York: Routledge.

Pierotti, R., & Wildcat, D. (2000). Traditional ecological knowledge: The third alternative (commentary). *Ecological Applications*, *10*(5), 1333-1340.

Posey, D. A. (1985). Indigenous management of tropical forest ecosystems: The case of the Kayapo Indians of the Brazilian Amazon. *Agroforestry Systems*, *3*(2), 139-158.

Redford, K. H., & Padoch, C. (1992). *Conservation of neotropical forests: Working from traditional resource use*. New York: Columbia University Press.

Redford, K. H., & Stearman, A. M. (1993). Forest-dwelling Native Amazonians and the conservation of biodiversity: Interests in common or in collision? *Conservation Biology*, *7*(2), 248-255.

Reichel-Dolmatoff, G. (1976). Cosmology as ecological analysis: A view from the rain forest. *Man*, 307-318.

Ridley, M., & Low, B. S. (1993, September). Can selfishness save the environment? *The Atlantic Monthly*, 76-86.

Robbins, P., McSweeney, K., Waite, T., & Rice, J. (2006). Even conservation rules are made to be broken: Implications for biodiversity. *Environmental Management*, *37*(2), 162-169.

Robinson, P. H., & Darley, J. M. (2004). Does criminal law deter? A behavioural science investigation. *Oxford Journal of Legal Studies*, *24*(2), 173-205.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Foley, J. A. (2009). A safe operating space for humanity. *Nature*, *461*(7263), 472-475.

Rogers, T. (2013, April 30). Indigenous congressman warns of bloodshed in Bosawas. *The Nicaragua Dispatch*. Retrieved from http://nicaraguadispatch.com/2013/04/indigenous-congressman-warns-of-bloodshed-in-bosawas/.

Rustagi, D., Engel, S., & Kosfeld, M. (2010). Conditional cooperation and costly monitoring explain success in forest commons management. *Science*, *330*(6006), 961-965.

Sagiv, L., Sverdlik, N., & Schwarz, N. (2011). To compete or to cooperate? Values' impact on perception and action in social dilemma games. *European Journal of Social Psychology*, *41*(1), 64-77.

Salick, J., Amend, A., Anderson, D., Hoffmeister, K., Gunn, B., & Zhendong, F. (2007). Tibetan sacred sites conserve old growth trees and cover in the eastern Himalayas. *Biodiversity and Conservation*, *16*(3), 693-706.

Salmón, E. (2000). Kincentric ecology: Indigenous perceptions of the human-nature relationship. *Ecological Applications*, *10*(5), 1327-1332.

Schmidt, J. J., & Dowsley, M. (2010). Hunting with polar bears: Problems with the passive properties of the commons. *Human Ecology*, *38*(3), 377-387.

Schultz, P. (2000). Empathizing with nature: The effects of perspective taking on concern for environmental issues. *Journal of Social Issues*, *56*(3), 391-406.

Schwartz, S. H. (2007). Universalism values and the inclusiveness of our moral universe. *Journal of Cross-Cultural Psychology*, *38*(6), 711-728.

Shinada, M., & Yamagishi, T. (2007). Punishing free riders: Direct and indirect promotion of cooperation. *Evolution and Human Behavior*, *28*(5), 330-339.

Singer, P. (2011). *The expanding circle: Ethics, evolution, and moral progress*. Princeton, NJ: Princeton University Press.

Smith, E. A. (1991). *Inujjuamiunt foraging strategies: Evolutionary ecology of an Arctic hunting economy*. New York: Aldine de Gruyter.

Smith, E. A., & Wishnie, M. (2000). Conservation and subsistence in small-scale societies. *Annual Review of Anthropology*, *29*, 493-524.

Smith, N. (2001). Are indigenous people conservationists? Preliminary results from the Machiguenga of the Peruvian Amazon. *Rationality and Society*, *13*(4), 429-461.

Snodgrass, J. G., Sharma, S. K., & Lacy, M. G. (2013). Nature reverence does not mean conservation in tribal Rajasthan: Culture, cognition, and personal and collective commitments to the environment. In B. K. Sharma, S. Kulshreshtha, and A. R. Rahmani (Eds.), *Faunal heritage of Rajasthan, India: Conservation and management of vertebrates* (pp. 327-350). Switzerland: Springer International Publishing.

Snodgrass, J., & Tiedje, K. (2008). Indigenous nature reverence and conservation: Seven ways of transcending an unnecessary dichotomy. *Journal for the Study of Religion, Nature and Culture*, *2*(1), 6-29.

Sponsel, L. E. (2012). *Spiritual ecology: A quiet revolution*. Santa Barbara: ABC-CLIO.

Stankey, G. H., Clark, R. N., & Bormann, B. T. (2005). Adaptive management of natural resources: Theory, concepts, and management institutions. General Technical Report. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Stearman, A. M. (1994). Revisiting the myth of the ecologically noble savage in Amazonia: Implications for indigenous land rights. *Culture & Agriculture*, *14*(49), 2-6.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, *56*(3), 407-424.

Stocks, A. (2003). Mapping dreams in Nicaragua's Bosawas reserve. *Human Organization*, *62*(4), 344-356.

Stocks, A., Beauvais, J., & Jarquín, L. (1998). Indigenous ecological activism in Nicaragua. Paper presented at the *1998 Annual Meeting of the Rocky Mountain Council on Latin American Studies*, Missoula, Montana.

Stocks, A., McMahan, B., & Taber, P. (2007). Indigenous, colonist, and government impacts on Nicaragua's Bosawas Reserve. *Conservation Biology*, *21*(6), 1495-1505.

Sullivan, S. (2009). Green capitalism, and the cultural poverty of constructing nature as

service-provider. *Radical Anthropology*, *3*, 18-27.

Tam, K. P., Lee, S. L., & Chao, M. M. (2013). Saving Mr. Nature: Anthropomorphism enhances connectedness to and protectiveness toward nature. *Journal of Experimental Social Psychology*, *49*(3), 514-521.

Tang, S. Y. (1991). Institutional arrangements and the management of common-pool resources. *Public Administration Review*, *51*(1), 42-51.

Terborgh, J. (2000). The fate of tropical forests: A matter of stewardship. *Conservation Biology*, *14*(5), 1358-1361.

The Nature Conservancy (TNC). (2007). *Bosawas Biosphere Reserve, Nicaragua: Parks in Peril End-of-Project Report.* Arlington, VA: The Nature Conservancy.

Thompson, S. C. G. & Barton, M. A. (1994). Ecocentric and anthropocentric attitudes toward the environment. *Journal of Environmental Psychology*, *14*(2), 149-157.

Tucker, C. M. (2012). Syncretism and conservation: Examining indigenous beliefs and natural resource management in Honduras. In C. M. Tucker (Ed.), *Nature, science, and religion: Intersections shaping society and the environment* (pp. 107-128). Santa Fe, NM: School for Advanced Research Press.

Turner, N. J., Ignace, M. B., & Ignace, R. (2000). Traditional ecological knowledge and wisdom of aboriginal peoples in British Columbia. *Ecological Applications*, *10*(5), 1275-1287.

Uzendoski, M. A. (2004). Manioc beer and meat: Value, reproduction and cosmic substance among the Napo Runa of the Ecuadorian Amazon. *Journal of the Royal Anthropological Institute*, *10*(4), 883-902.

van Laerhoven, F., & Berge, E. (2011). The 20th anniversary of Elinor Ostrom's *Governing the Commons*. *International Journal of the Commons*, *5*(1), 1-8.

Vickers, W. T. (1994). From opportunism to nascent conservation. *Human Nature*, *5*(4), 307-337.

Viveiros de Castro, E. (1998). Cosmological deixis and Amerindian perspectivism. *Journal of the Royal Anthropological Institute, 4*(3):469–488.

von Rueden, C. R., & Gurven, M. (2012). When the strong punish: Why net costs of punishment are often negligible. *Behavioral and Brain Sciences*, *35*(01), 43-44.

Waldo, G. P., & Chiricos, T. G. (1972). Perceived penal sanction and self-reported criminality: A neglected approach to deterrence research. *Social Problems*, *19*, 522-540.

Wedel, J. (2009). Healing and spirit possession in the Caribbean. *Stockholm Review of Latin American Studies*, *4*, 49-60.

West, P., Igoe, J., & Brockington, D. (2006). Parks and peoples: The social impact of protected areas. *Annual Review of Anthropology*, *35*, 251-277.

Wiessner, P. (2005). Norm enforcement among the Ju/'hoansi Bushmen. *Human Nature*, *16*(2), 115-145.

Wiessner, P. (2012). Perspectives from ethnography on weak and strong reciprocity. *Behavioral and Brain Sciences*, *35*(01), 44-45.

Willerslev, R. (2004). Not animal, not not-animal: Hunting, imitation and empathetic knowledge among the Siberian Yukaghirs. *Journal of the Royal Anthropological Institute*, *10*(3), 629-652.

Williams-Guillén, K., Griffith, D., Polisar, J., Camilo, G., & Barman, K. (2006). Abundancia de animales de caza y características de cacería en el territorio indígena de Kipla Sait Tasbaika, reserve de biosfera BOSAWAS. *WANI*, *46*, 37-61.

Williams-Guillén, K., Griffith, D., Polisar, J., Dixon, O., Camilo, G., Asa, C., Bauman, K., McDaniel, P., Bradshaw, L., Shank, S., Zidek-Vanega, A., Koster, J. & Espinoza Mendiola, V. (2006). Poblaciones de animales silvestres y sostenabilidad de la cacería en Kipla Sait Tasbaika Kum, Bosawás, Nicaragua. Unpublished Report, Saint Louis Zoo, Managua, Nicaragua.

Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.

Wilson, E. O. (1993). Biophilia and the conservation ethic. In S. R. Kellert and E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 31-41). Washington (DC): Island Press.

Wright, B. R., Caspi, A., Moffitt, T. E., & Paternoster, R. (2004). Does the perceived risk of punishment deter criminally prone individuals? Rational choice, self-control, and crime. *Journal of Research in Crime and Delinquency*, *41*(2), 180-213.

Zavaleta, E. (1999). The emergence of waterfowl conservation among Yup'ik hunters in the Yukon-Kuskokwim delta, Alaska. *Human Ecology*, *27*(2), 231-266.