COMPLIANCE AND NONCOMPLIANCE WITH ENVIRONMENTAL RULES IN THE BRAZILIAN PANTANAL

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ABSTRACT

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The protection of natural areas around the world requires legitimately created laws with which people comply. The Pantanal is among the world's largest wetlands and a conservation priority region—a natural area where protection is imperative. Most of the Pantanal is in Brazil, which protects the wetland's natural resources with a wide-ranging set of laws and rules. Voluntary compliance with natural resource management rules theoretically depends on perceived legitimacy of rules and those in charge of creating and enforcing them, but related attitudes have not been explored in the Pantanal. The goal of this research was to establish baseline insights about noncompliance in the Pantanal to inform efforts aimed at improving protection in the region. I explored both at noncompliance with natural resource laws in general and specific violations of fishing rules by professional fishermen. I first conducted exploratory key-informant interviews (N=11), through which I found strong sentiments in the community that enforcement is incapable of coercing compliance, and lack of perceived fairness of between those creating and enforcing rules. Then I administered a face-to-face questionnaire (N=41) in March–September, 2016. Most participants self-reported that they violated the rule (85.4%). Trust in biologists who help define the size limits significantly influenced frequency of violations. Half of the participants distrusted biologists to set the rules, even though a large majority (87.8%) had never talked to biologists. The literature suggests that interpersonal interactions can increase perceptions of fairness, and therefore in this community more positive interactions between biologists, enforcement, and locals may increase compliance.

This thesis is dedicated to my mother, who inspires me to live life to the fullest, with whom I learned to love and appreciate nature, and without whom I would have never had the chance to explore the Brazilian Pantanal.

ACKNOWLEDGEMENTS

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PREFACE

This thesis is inspired by experiences that I had first as a traveler, then as a student, and finally as a professional. There is something about the extinction of species and destruction of beautiful natural areas that is incredibly sad—knowing that recreating a species or a natural area is impossible makes that type of loss so different from other damages. I grew up in a time of a great realization, when humanity collectively was realizing the impacts of their society. The extinctions that inspired me were not those of the dinosaurs, but rather were the more recent and human-caused extinctions of mammoths and the great auk. I, like many, love nature and wildlife, and would not want to live in a world in which I could not get outside and explore the wilderness. I have seen incredible animals and beautifully scenery all over the world. I have also seen national parks side by side with shanty villages, people living in squalor while rich tourists seeking adventure stay in lavish hotels next door. I have seen many scientists and environmentalists treat local people who have lived in proximity to natural areas for generations as if they were worthless, stupid, lazy, and as if the nature surrounding them was far more important than their own lives. This thesis is about these people—the scientists and the locals—, these beautiful natural areas and these shanty villages. I hope readers of this thesis will take its main assertion to heart: there is a rift in understanding between locals and scientists, between the educated and those without the opportunity to go to school, and between those with no power and those in positions of authority. Everyone seeks to protect natural areas, but prevailing perceptions tend to position the locals, who have less power and less education, against scientists, police, and government rulemakers. People in positions of power play an important role in local people's decisions, but perhaps simply ordering those without power around is not

always the best way. Scientists are intellectual authorities and possess power because of it. To help fill the rift between the powerful and those without power, we scientists must reach out to those without power as their friends and equals, not as morally and intellectually superior beings.

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ORGANIZATION AND POSTURE OF THIS THESIS

Two basic questions drove this research: (1) Why do humans overexploit nature and the environment? (2) How can risks from this overexploitation be minimized? More specifically, this research focuses on the related questions of why people violate environmental laws and how the violations of environmental laws can be reduced. In order to help answer these questions, I attempt to first posture questions of compliance within a grander scheme of protection of nature. Then, I zoom in on the compliance problems in one natural area—the Brazilian Pantanal—in an effort to shed light on similar regions worldwide.

In Brazil and across the globe, natural areas similar to the Pantanal face threats from human encroachment. Environmental damage is any detrimental change to the environment. Because these changes often happen gradually over time, or even can be far removed in time from their causes, detrimental change is often considered in terms of environmental risk—the chance of future damage. Environmental regulation to minimize damage done by humans is inherently different than other regulation because environmental damage is frequently removed in time and space from its causes, there is often uncertainty in who or what caused damage, damages are not easy to valuate, have multiple contributing causes and also produce unforeseen collateral damages. Regulation of natural resources is further complicated by scientific uncertainty about what limits will sustainably protect resources, sociopolitical differences in opinion about how resources should be used, and shortcomings in enforcement and voluntary compliance.

This thesis begins with a review of the pertinent legal and economic philosophy behind environmental law, a contextual overview that provides a comparison of US and Brazilian

solutions to legal problems and justifies the laws that I will explore more closely in this work. Second, I apply the interdisciplinary conservation criminology approach to compliance issues in the Brazilian Pantanal, focusing on possible structural problems with governance and policing. Third, I address a specific fishing rule and the reasons people might choose not to comply with it, highlighting the rift between rulemakers and locals in the Pantanal. Finally, based on empirical results, I suggest interventions that might be successful at increasing compliance in the Pantanal, highlighting an avenue for future research. Many natural areas in regions worldwide have human populations that face similar difficulties due to lack of education, access, and economic opportunities; many natural areas worldwide also face similar environmental threats from development. Although this work is based on case studies and thus its specific conclusions do not apply outside the case study areas, its principles may be replicated, adapted, and applied more broadly.

CHAPTER 1

THE PHILOSOPHY, ECONOMICS, AND LAWS PROTECTING NATURE IN THE BRAZILIAN PANTANAL

Introduction: Protection of nature and its component parts

There is something special about nature that people value. Exactly what that "something" is depends on whom is asked, but humans unquestionably desire to keep some of Earth in its natural state. Nature itself is not easily defined, and different people ascribe different values to its protection. Economists use straightforward techniques to estimate the values of saleable and rentable components of nature (i.e., natural resources), but often struggle to quantify the nonuse value of nature (Crowards, 1997). Among the chief problems in quantifying the value of nature is that it consists of more than the value of its component parts—people seem to value its mere existence (Dana, 2003). Governments create protected areas to directly ensure that some of Earth remains in a natural state. Regulation of the use of nature's component parts—natural resources—is a secondary means of protecting nature as a whole, both inside and outside protected areas.

Throughout history, humans have relied on the continuous availability of natural resources to perpetuate their societies. In the past, many believed that natural resources were inexhaustible (Gordon, 1954). Today, the environment around us succumbs to the forces of human development and many natural resources, formerly plentiful, near depletion. Some degree of alteration of the Earth is necessary for the human population to continue to grow (Malthus, 1798). Collectively we recognize the conservation of biodiversity and of nature as important parts of continued human existence on Earth, and we place limits on development in light of this recognition. However, the limits are incomplete and in many cases fail to accomplish their

ultimate conservation goals. In this chapter, I describe the ways in which the systems in place to safeguard nature and biodiversity can fail to achieve objectives by focusing on a conservation hotspot fighting the pressures of development: the Brazilian Pantanal.

The primary means of guaranteeing that natural resources are not exhausted by humans in the Pantanal, as in the majority of the rest of the world, are written laws and rules promulgated by agencies and governments. These laws and rules attempt to regulate behavior of individual humans and of groups, using subsidies to encourage good behavior and penalties to discourage bad behavior. These laws restrict behavior in a variety of ways; their efficacy, however, depends not only upon their definition, but also on people's compliance with them. People's compliance with laws and rules depends in part on the subsidies and penalties, and in part on individuals' perceptions of the rules themselves. I begin this chapter with a review of the philosophy behind environmental management and law, including the types of rules that exist and how those rules work. I then introduce the Brazilian Pantanal as a region that embodies broader problems with conservation worldwide, and describe the suite of environmental legislation in the Brazilian Pantanal. Finally, I provide a brief review the field of compliance theory, the interdisciplinary study of ways in which laws can fail to elicit behaviors necessary to protect the environment and natural resources. This overview of the field and research provides a roadmap to how environmental rules and laws can fail, in order to better understand how to create policy that may succeed.

Philosophy and economics of protecting nature

Thomas Malthus predicted problems associated with population expansion of humans due to ever-increasing need to produce food, and thus by implication introduced the philosophical problems of environmental decline (Malthus, 1798). The central premise of

Malthus's work is that populations expand exponentially while agriculture and development increase in production linearly, and therefore Earth will regulate human population growth with famine and disease. Twenty years before Malthus released his treatise on population, Adam Smith outlined free market economics in *The Wealth of Nations* (1776). Smith argued that market forces (the "invisible hand") create an ideally efficient society. The free market model of economics assumes, among other things, that people are rational actors who know fully the costs and benefits of their decisions—tenets that are not always met. One way in which the free market paradigm fails to produce ideal solutions is when there are externalities, or effects that lie outside the supply and demand parts of the market itself. Environmental damage is often an externality, because it is not typically part of the costs directly related to consumption of a product. For example, when considering the availability and production of food, a free market system would value production of food over existence of natural areas, because they have no obvious saleable or rentable value except for the natural resources they contain—in other words, the saleable and rentable values of natural areas are externalities because they are not obvious. One solution to controlling these externalities is to internalize them. Arthur Pigou offered internalization as a solution to externality-based problems in his *Economics of Welfare* (1920). If all the environmental damage were included in the price of a commodity or of a development project, then the market could balance environmental conservation and human development and advancement.

Internalizing externalities is not a simple programmatic endeavor. Garrett Hardin described one failure of a free market in his seminal work, *Tragedy of the Commons* (1968). In this example, Hardin laid out a common land that is used by several herders to graze their flocks. A rational herder will add animals to his flock because he will receive the full benefit from each

sheep added his flock while he will only be responsible for a fraction of the damage done to the common land. If herders continue adding animals to their flocks, the commons is eventually degraded to the point that no herders can graze their flocks any more. The damage in this case is partly external to the transaction of acquiring and keeping an extra sheep. Gordon (1954) explained this problem differently—that damage to the commons is not due to a market failure, but rather due to incomplete property rights that include value for economic rents (Wilen, Cancino, & Uchida, 2012).

Incomplete property rights on common grounds are one way that the free market fails to protect the environment. There can also be externalities on private property. The maxim "*sic utere tuo ut alienum non laedas*" (use your own so as not to injure another) is a traditional limit to property use (Smead, 1935). Certain natural resources (e.g., water, wildlife) move from one piece of property to another, and thus using privately owned natural resources often causes remote damage to other private natural resource owners. The common law offense of nuisance is built upon the *sic utere* maxim, but normally requires proof that an action actually caused damage that is often far-removed in space or time. The market must be controlled to account for incomplete property rights, including internalizing the complex and uncertain causes of environmental damage.

These examples demonstrate that individuals can do damage to the environment without recognizing the extent of the damage done. Environmental damage has unique and problematic features that make internalizing environmental costs in a free market difficult (Lazarus, 1999). Environmental damage is any detrimental change to the environment, but is often formulated in terms of risk of damage because environmental damages are frequently removed in time from their causes. In many cases, this means that only future generations will see the full extent of

problems caused by people today. Removing the causes of problems from their effects gives those causing damage little incentive to fix the problem. Furthermore, environmental damage is almost always caused by a number of people or industries, not just one; this makes deciding whom to blame more difficult still. In some cases, the damage done to the environment is catastrophic, ongoing, and permanent, and thus it is extremely difficult to assess and valuate. Environmental problems are hard to valuate in general because they frequently are so far removed from markets that would indicate their value. Last, in addition to all of these issues, questions of environmental damage also involve high levels of scientific uncertainty, especially dealing with how some things might cause damages in the future (Lazarus, 1999).

Collectively, these distinguishing complications of environmental problems render it difficult to sustainably protect the environment. Different approaches exist to try to rectify this difficulty. In some cases, unwritten norms have proved sufficient to protect the environment against harmful overharvesting or modification (Moritz, Hamilton, Chen, & Scholte, 2014). Such situations generally involve traditional people who have inhabited natural areas for long periods of time, and who have both strong ties to land and natural resources and relatively low population density and distributions that do not harm the natural environment. Others have argued similarly that social contracts, rather than top-down government regulation, are sufficient to protect the government (Ostrom, Walker, & Gardner, 1992). In spite of this, the most common form of environmental protection is from top-down regulation through laws and rules. Governments, ideally, should promulgate environmental rules according to accurate scientific research, setting limits conservatively so that risk of damage is minimized, following the precautionary principle.

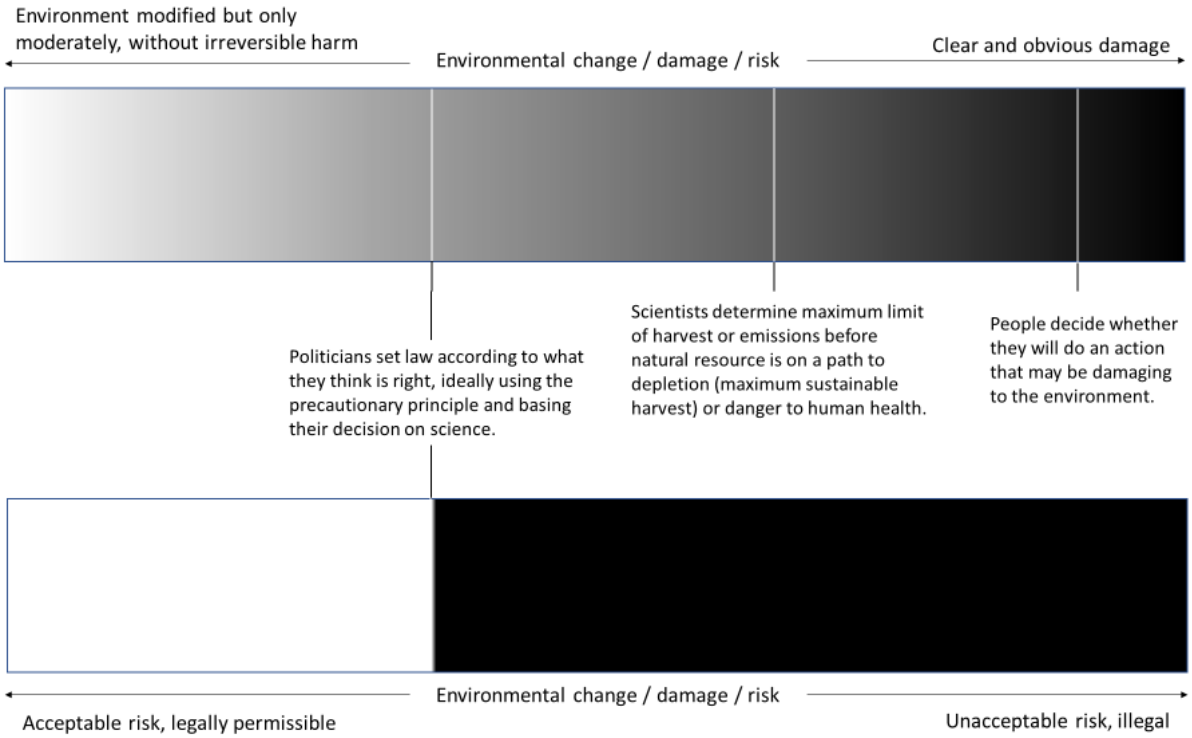

Figure 1-1. Representation of environmental change (or risk of environmental change or damage) with and without regulation and laws; darker shades indicate higher levels of damage. People's likely individual choices (given the difficulty of estimating environmental damage), scientists' definition of maximum harvest or emissions limits before doing permanent damage, and governments' idealized creation of laws and regulations following the precautionary principle are depicted on each damage plot. Scientists' work may help individuals make decisions in the absence or presence of a law. A law or rule simplifies the environmental risk to acceptable risk versus unacceptable risk, according to law. Ideally, the acceptable risk as determined by politicians lies to the left (erring on the side of caution) of the maximum limit defined by scientists; however, there are often a range of scientific assessments, and governments often disregard environmental risks in favor of economic benefits of development. Typically, individuals tend to act to the right of the maximum determined by scientists because of the difficulties in assessing environmental risk described in Lazarus (1999).

The laws and rules promulgated by governments to prevent overexploitation of the environment sometimes merely formalize pre-existing functional social contracts and norms, but more frequently also include top-down regulatory elements. These laws and rules are promulgated by agencies and legislative bodies and implemented through research and enforcement on the ground. Examples of direct regulation include limits on the harvest of natural resources. Indirect limits include technology restrictions and Pigouvian taxes, which internalize

external costs by adding a tax to the price of a product or service. In other words, indirect limits generally focus on modifying the market, rendering externalities as part of the market and clarifying costs and benefits for consumers and for producers. Direct limits are burdensome on personal freedoms, and thus are in many cases unpopular.

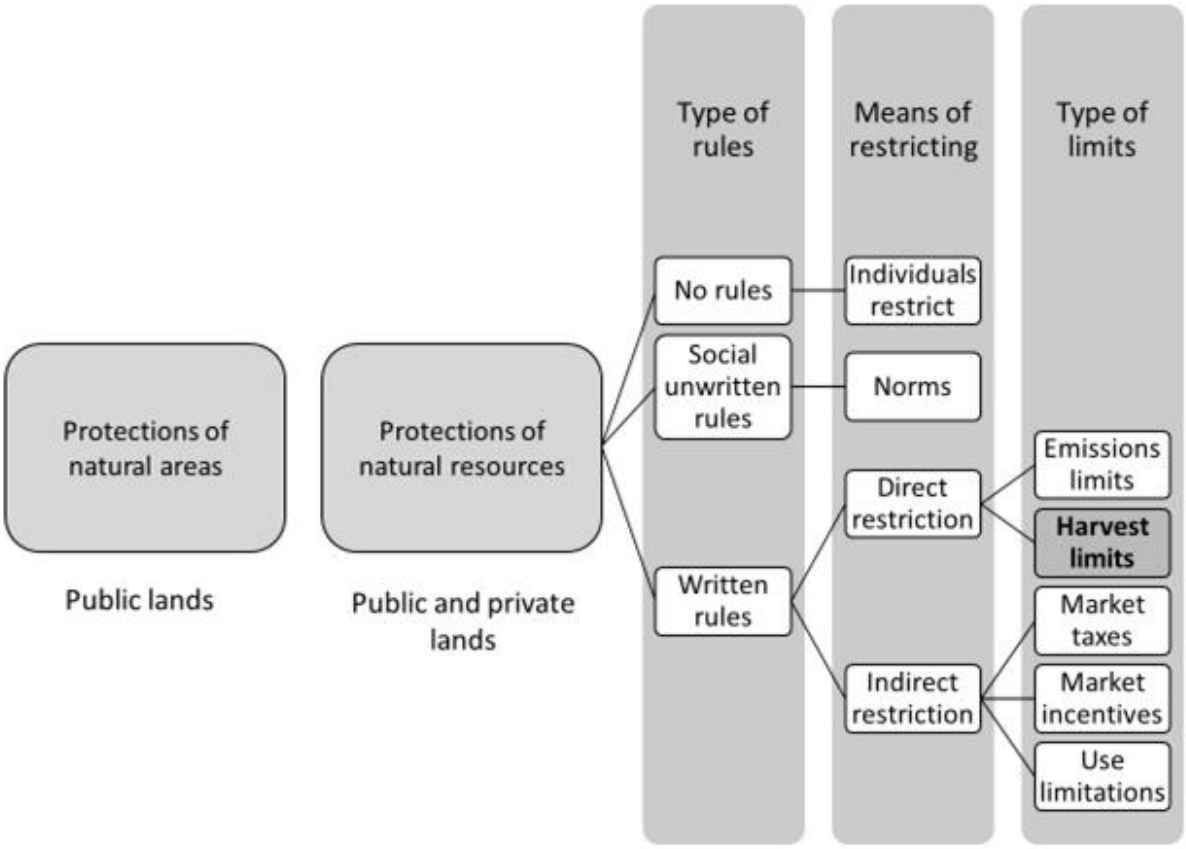

Figure 1-2. Conceptual map of rules, laws, and norms protecting nature, focusing on limits on exploitation of natural resources and how they are made. These include personal limits to protect the environment (an individual probably will not burn down a whole forest intentionally without reason); social limits (communities or family groups may have arrangements to share common resources or land); and government-imposed limits. Protections of natural areas, in contrast to natural resource limitations, include the creation of national parks, national forests, or other forms of protected public lands.

There are clear reasons to protect the environment against pollution that is harmful to humans and there are clear reasons to protect renewable resources so that they continue to be available in perpetuity. Internalizing environmental damages is difficult; but it is even more

difficult to quantify the existence values of nature, why we might want to save nature itself. Vast natural areas, such as the Amazon rainforest, harbor high levels of biodiversity and perform important ecosystem services for Earth. Technological advances could theoretically perform the same services as these natural areas in the future. However, in there is value in the mere existence of natural areas that goes beyond the natural resources within them and the services they provide (Dana, 2003). Mere existence is not something that is clearly defined—what types of activities should be permitted in areas while still maintaining this inherent value of nature is a philosophical question, not one that can be answered empirically by biologists or environmentalists. Natural areas like the Amazon are too big to simply put entirely in a park, because private landowners inhabit them and sovereign nations have incentives to develop them. Instead, a concert of natural resources and environmental laws work together with other laws that restrict development to certain regions to offer some sort of permanent protection to the region. In order to look more closely at how inherent and other values of nature are protected, I consider a case study that is smaller than the Amazon: the Brazilian Pantanal.

Protecting nature with laws and rules: a case study of the Brazilian Pantanal

The Pantanal is among the world's largest inland wetlands (Keddy et al., 2009). It spans 150,000 square kilometers across Paraguay, Bolivia, and Brazil, with its largest area covering the western portions of the Brazilian states of Mato Grosso and Mato Grosso do Sul. The Pantanal is a geological depression within the Paraguay River basin, thought to be the result of fluvial dissection in the Paleocene-Eocene followed by infill and planation in the Oligocene and Miocene. There is some debate about the exact timing and origin of the depression, with some scientists noting contributions of the Andean Orogeny and current tectonic activity (Mercante, Rodrigues, & Ross, 2011). The depression is notable for its lack of relief—within the Pantanal

the altitude varies only from 80 to 250m above sea level, and there are virtually no natural hills or outcrops. The region collects water from surrounding highlands of Precambrian and Cambrian origin, from which major rivers transport sediment into the wetlands. Much of the water that originates in the highlands evaporates, leaving only the sediments in the Pantanal (Gonçalves, Mercante, & Santos, 2011). Among the major tributary rivers flowing through the Pantanal and into the Paraguay River are the Cuiabá River, the São Lourenço River, the Taquarí River, the Piquirí River, and the Miranda River. The Paraguay River now flows south into the Paraná River, before joining the Rio de la Plata, passing through major urban areas and into the Atlantic Ocean.

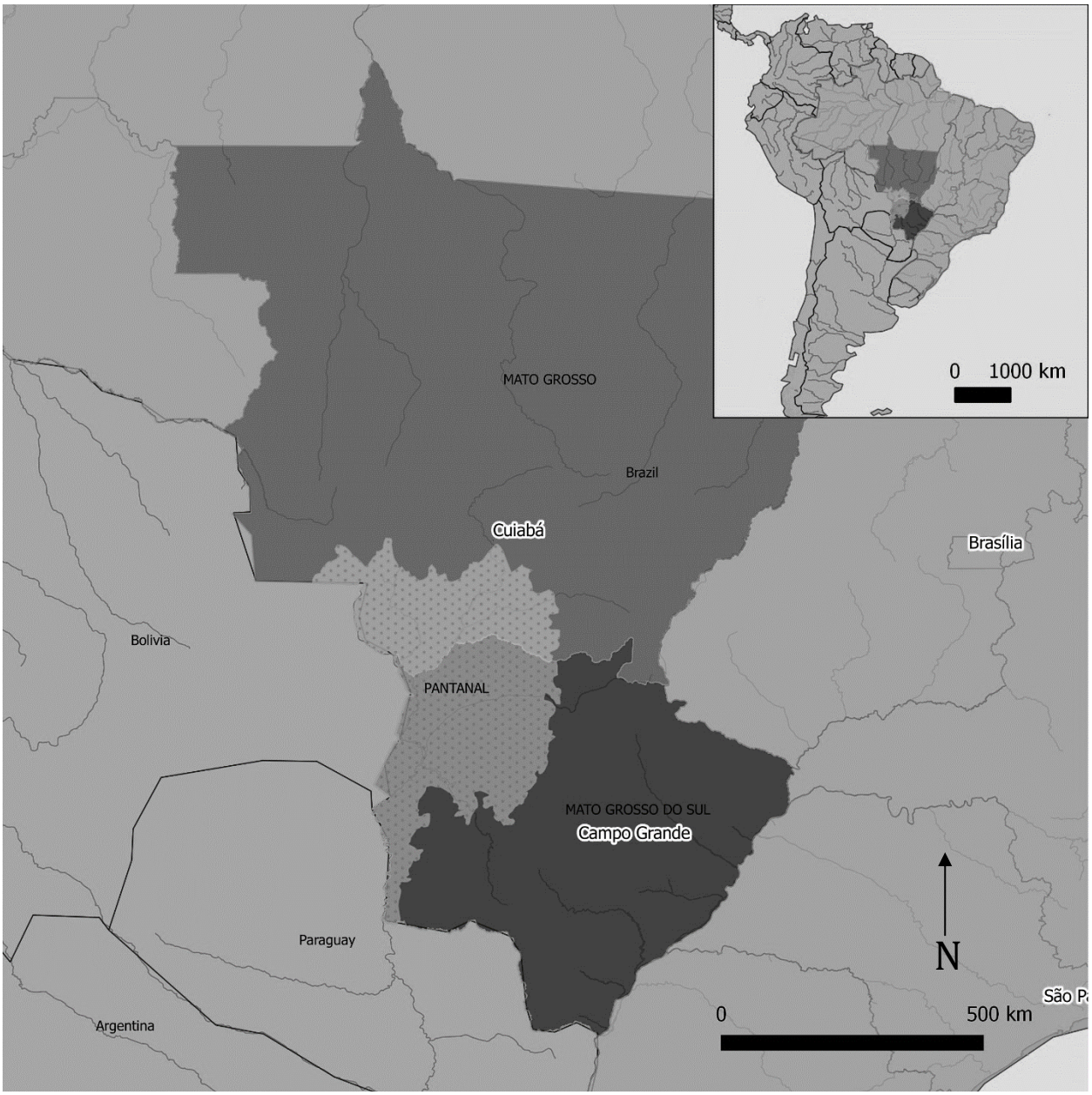

Figure 1-3. Map of Brazil with the Pantanal and the states of Mato Grosso and Mato Grosso do Sul highlighted.

The Pantanal filters water for downstream human populations and provides nutrient-rich biomes for nonhuman life. Although the Pantanal is collectively called a wetland, it contains a number of different biomes. In higher areas, dry deciduous forests dominate, where in wetter and lower areas sedges and grasses stretch across wide open areas. The region's climate is warm year-round with average daytime temperatures above 30 degrees Celsius. There are two

predominant seasons, with the rainy season stretching from November through March and being characterized by frequent torrential downpours. During the dry season, there is very little rain and parts of the region become extremely arid. Availability of food for animals and plants varies with the availability of water, and the Pantanal is an important migratory stop for numerous bird species during and after the rainy season. To cope with the extreme aridity of the dry season, caiman and other water-dependent species estivate. Many fish species migrate upriver to smaller tributaries in the wet season to breed in areas where there are fewer predators (Alho, 2008).

The Pantanal is known for its biodiversity, but has relatively low endemism of plants and animals (Junk et al., 2006). Most animals and plants found in the region can also be found in the Amazon rainforests and the Cerrado dry forests and savannas. However, because of the richness of nutrients in the Pantanal, the animals and plants that do live in the region exist at higher abundances than they do elsewhere. The Pantanal is home to a number of species that are endangered in other parts of their range but are locally common and have increasing population trends. These include jaguars, hyacinth macaws, giant river otters, and Brazilian tapirs. The abundance of resources also could explain large body size in Pantanal species and subspecies—the hyacinth macaw is the parrot with the largest body size in the world and the subspecies of jaguar in the region is the largest subspecies of jaguar. The Pantanal is also known for having the highest population densities of crocodilians (caiman) and birds of prey. The Pantanal is perhaps best recognized in Brazil as having giant fish and great sport fishing. There are some 300 fish species in the Pantanal basin, with the most well-known being several species of large Siluriform catfish (e.g., pintado, cachara, jau); Characiforms including the pacu, dourado, and several species of piranha; and freshwater stingrays (L. Mateus, Penha, & Petrere, 2004).

The region has a rich history of human presence. The earliest occupation is thought to be

some six thousand years ago. Because of its central location in South America, it became a meeting point for indigenous peoples speaking different languages. The Guató, Terena, Borôro, Kaiowá, and Kadiwéu all occupied different parts of the region and spoke languages that come from distinct language families. Arawakan languages like that which the Terena speak are common in the Amazon rainforest to the north. Macro-Jê languages like that of the Borôro are common in the Brazilian Cerrado to the east. Tupí-Guaraní languages like that of the Kaiowá were common throughout the Chaco and are spoken as a national language in Paraguay to the southwest. Guaykuruan languages like that of the Kadiwéu were spoken to the south and west of the region as well. Terena groups relied on slash-and-burn agriculture in the region, while Borôro were hunter-gatherers and Guató were nomadic fishermen. All of these groups now have some small recognized territories in the region, but their cultures were largely wiped out by European and later Brazilian pioneers.

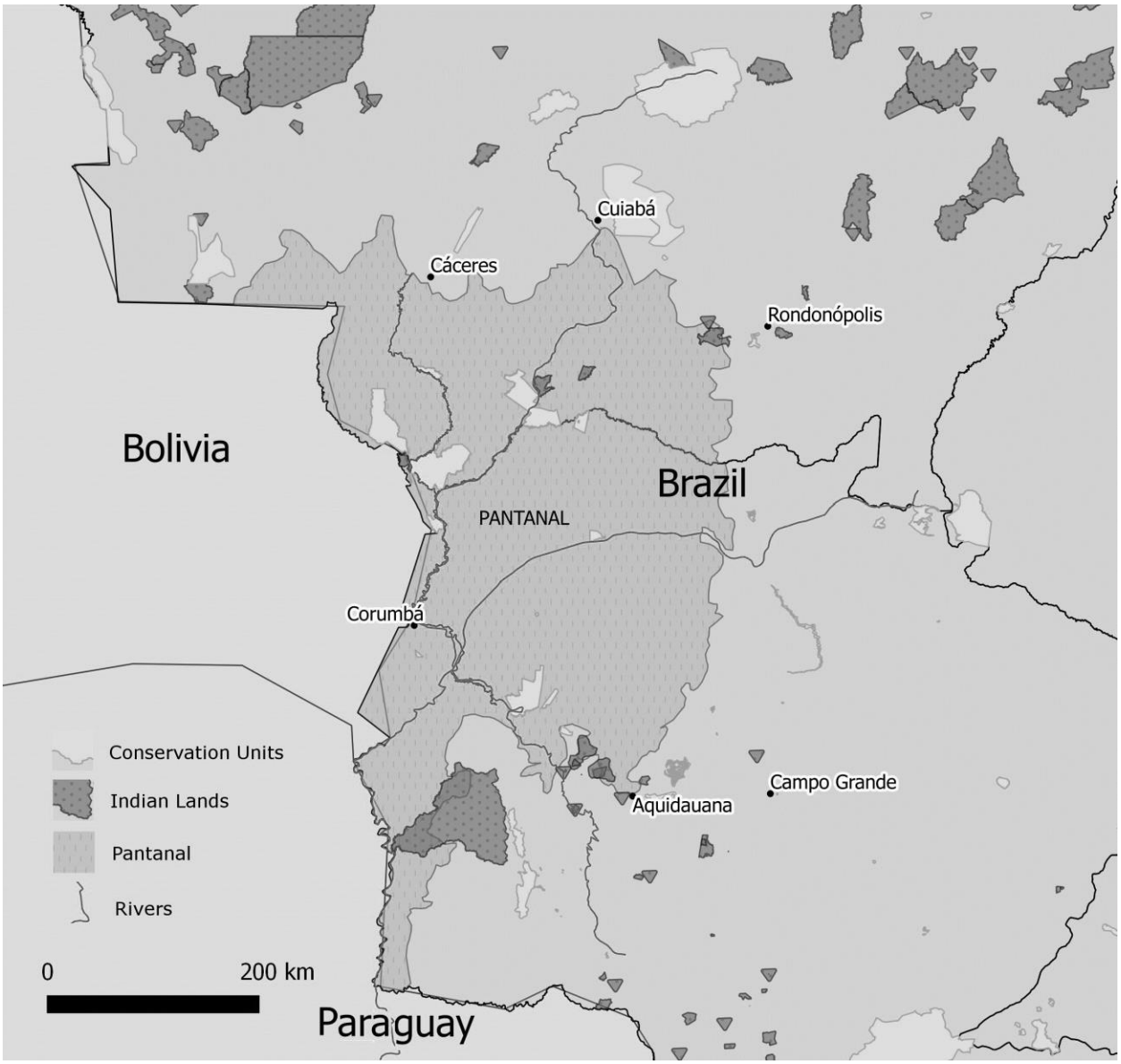

Figure 1-4. Detailed map of the Brazilian Pantanal, with major rivers, protected areas (conservation units), and indigenous peoples' lands delineated. A small portion of the Pantanal (roughly 5 percent of Brazilian land area) is protected in parks and reserves, with another small portion protected in indigenous reservations. Protection of the remainder of the region is offered through natural resources laws that limit fishing and deforestation and ban hunting altogether.

Human activities in the Pantanal have evolved over time. Indigenous peoples who formerly dominated the area were "pacified" by government forces and "civilized" by Jesuits. Communes created by Jesuits united all indigenous people together indiscriminately, and the union resulted in a fusion of languages and the creation of a new indigenous identity, known as

the Chiquitano. During the time of expansion west, escaped slaves also formed communities in the region, known as Quilombos, and early pioneers began claiming land for cattle ranching as others looked for gold dust in streams and rivers. The War of the Triple Alliance in the 1860s brought an influx of soldiers to the frontier where many stayed after the war. A final push to integrate indigenous people into Brazilian society occurred with expeditions in the late 19th and early 20th centuries, many led by Brazilian army Marshall Cândido Rondon, who was himself of mixed Terena, Borôro, and Portuguese descent. Rondon is also known for his journey through the Pantanal with President Theodore Roosevelt in 1914, who discusses the region's abundant natural resources at length in his memoir, *Through the Brazilian Wilderness* (1914).

Today the Pantanal is known as a tourist location for adventurous travelers looking for big cats and big fish. The tourism sector is booming while the cattle ranching and gold mining industries that were formerly extremely profitable become less popular with the advent of more modern ranching techniques and the depletion of gold veins. Over ninety-percent of the region is privately owned, belonging to descendants of indigenous people, Quilombolas, soldiers, and more recent migrants to the region (Junk et al., 2006). The region's conservation challenges are primarily related to development, including filling in of wet areas to support agriculture, the construction of hydroelectric dams and changing water flow patterns, as well as dredging of major rivers to facilitate large-ship transport of freight (Junk & da Cunha, 2005). However, other conservation problems persist in the Pantanal, including hunting and trapping of endangered and threatened species, overfishing, and deforestation.

Conservation of the Brazilian Pantanal presents many challenges that are emblematic of those in other conservation contexts worldwide. It is a massive region harboring a complex intermingled set of ecosystems, and is only partly protected by nature reserves (Junk et al.,

2006). Because the majority of the Pantanal is private property, there alternate restrictions in place to protect its biodiversity. The primary protections of biodiversity in the Pantanal are harvest limits and land use limits. Logging is illegal without permit per the federal Forestry Code (Código Florestal, Lei Nº 12.651, de 25 de Maio de 2012). The Forestry Code also sets a percentage (20 percent in the Pantanal) of private land aside in a "legal reserve," on which there is a permanent negative easement against development and defines "areas of permanent preservation" along courses of water and on hills with grade. Hunting non-fish wildlife has been prohibited in full, save a select few invasive species, by the federal hunting code of 1967 (Código da Caça, Lei N° 5.197, de 3 de Janeiro de 1967). Fishing is subject to regulation primarily at the state level; each state promulgates a fisheries law with species-specific regulations supported by scientific research.

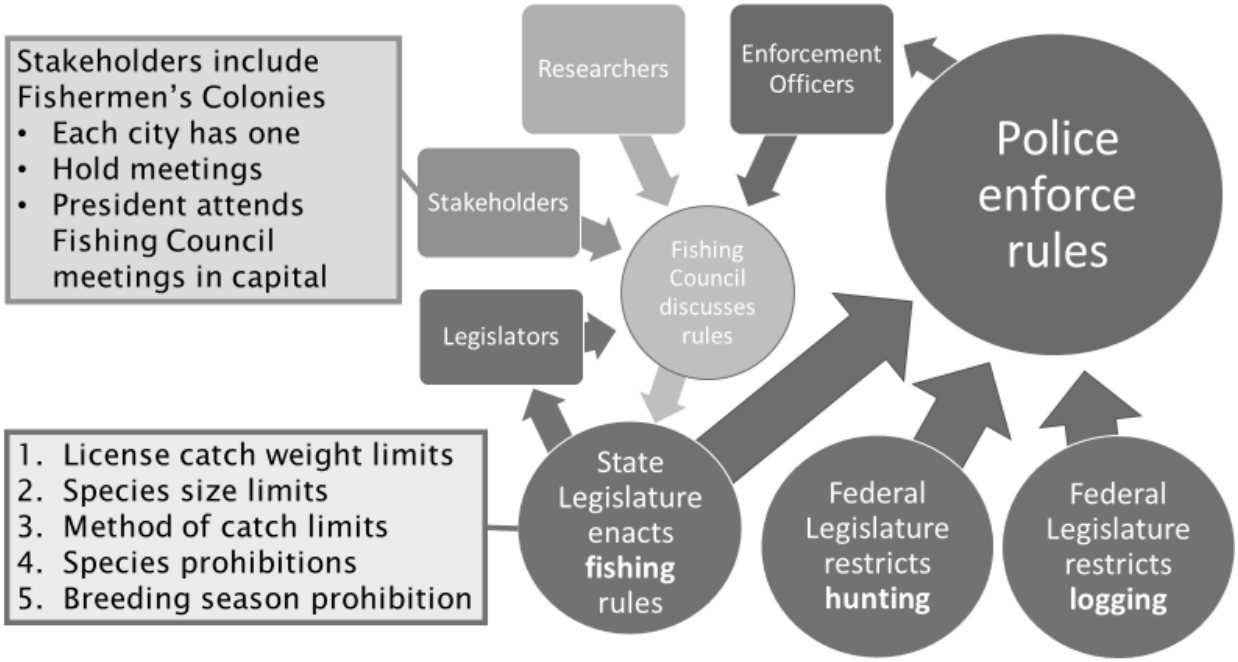

Figure 1-5. Representation of sources and processes creating and applying natural resources laws in the Pantanal of Mato Grosso, Brazil. A fishing council consisting of some state legislators, some enforcement officers, along with researchers and stakeholders, creates recommendations for fishing rules that are adopted by the full state legislature. The federal

government bans hunting and severely limits logging with permitting and creation of automatic negative easements on private property. Police from state and federal agencies enforce fishing, hunting, and logging laws and rules.

Five general types of fisheries rules exist, as established by different laws. A fishing committee (CEPESCA) composed of legislators, police, researchers, and stakeholders sets many of these rules. The local Secretary of the Environment (Secretaria do Meio Ambiente—SEMA) in each state is ultimately responsible for enforcement of the rules and the maintenance of the fishery. The five types of rules are: (1) license limits, which restrict who can catch how many fish; (2) species size limits, which set minimum fish sizes for people to be allowed to catch in order to ensure juveniles reach maturity; (3) method of catch limits, which prohibit the use of dynamite, poison, and nets in fishing; (4) species limits, which altogether prohibit the taking of the dourado; and (5) season limits, which prohibit fishing during the spawning season, which roughly corresponds with the wet season in the Pantanal. These limits, which depend in part on scientific research and in part on political will, are frequently broken by fishermen in the region.

In the Pantanal, only around 10 percent of land is publicly owned and protected, so 90 percent of the region's nature is protected only by the suite of natural resource regulations. Private landowners are affected by land use laws, including the automatic negative easements of the Forestry Code. Industries are the primary targets of pollution laws that threaten the region's water and air. Virtually everyone is affected by prohibitions and limitations on takings. The prohibition on hunting, prohibition of cutting down trees, and restrictions on fishing apply to anyone who sets foot in the region, on private or on public property. Like many natural areas in the developing world, the protected areas and the natural resource laws offer substantial legal protection for the Pantanal as a natural region. However, on-the-ground circumstances can often render these legal protections more aspirational than effective.

The failure of laws and rules to protect nature

Even when laws exist to limit individuals' behavior and protect natural areas like the Pantanal, legal protections do not always prevent environmental damage. Whether nature is protected as a whole or by limits on use of its component natural resources, there are four ways in which environmental damage can occur. First, environmental damage can happen because of stochastic natural events, such as wildfires or storms, or gradual processes like erosion. Laws and rules are not designed to prevent this sort of damage, but in certain cases this damage can be catastrophic. Second, philosophical differences in people and governments may create rules that are not sufficiently strong to prevent environmental damage. Consider a situation in which protected areas created are not big enough to maintain an ecosystem or natural area, or a government ignores scientific evidence to limit the harvest of natural resources, instead favoring the economic benefits of development. The size of land required to be protected and the harvest limits of individual resources are largely based on scientific modeling of how ecosystems and resources are able to maintain themselves in light of human activities. In defining these limits, the assumption is usually that they will be followed. However, the third type of failure occurs when science is not able to accurately model the problem, and in spite of the best precautionary intentions of lawmakers, limits set exceed those necessary for protection of the environment. The fourth type of failure is when people do not follow the rules—they do not comply with the limits. Regardless of the way governments choose to limit actions and conserve natural areas, whether for their inherent value or to protect clear human interests, the success of laws depends on people's compliance with them. In contemplating the creation of a law to protect the environment, it is necessary to also consider how to ensure people will comply with that law.

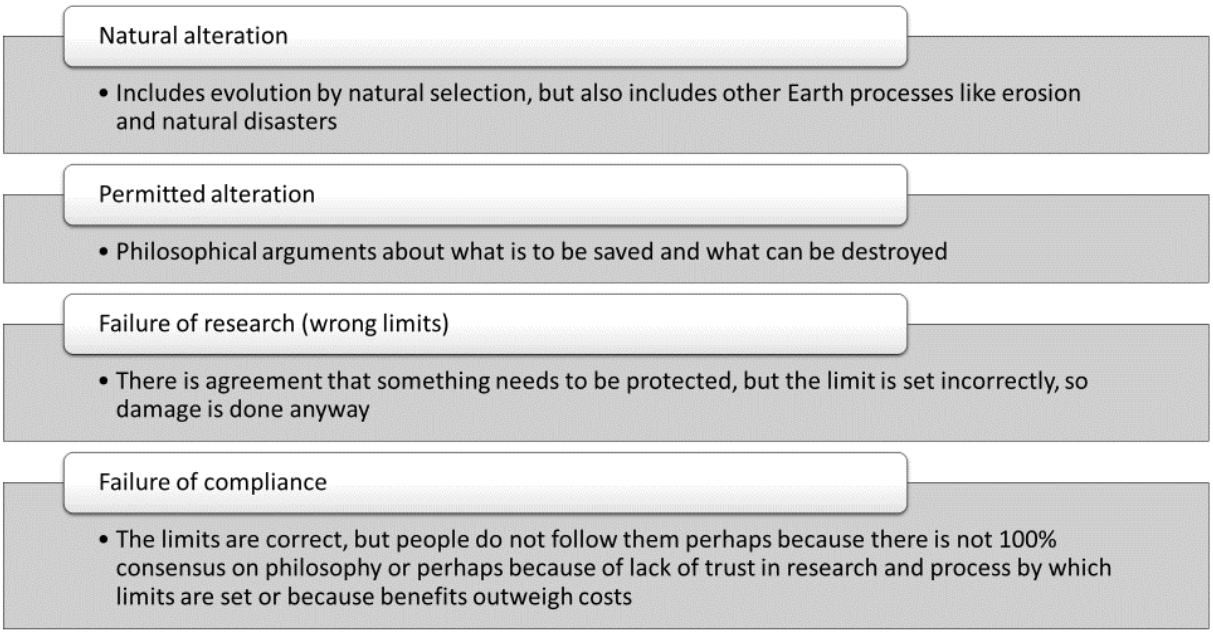

Figure 1-6. Sources of changes that can happen in natural areas. Permitted alterations might also be categorized as failure of the political process to implement correct limits. Three of the four potential alterations are natural or under government control. The final source of alterations depends on individual actors.

Compliance and noncompliance are complex concepts involving multiple, sometimes contradictory, motivations, along with non-intentional causes (Etienne, 2011). Compliance with laws defines a set of behaviors that are considered an acceptable risk by lawmakers. These behaviors occur at a baseline rate determined by habit and culture. In general, the non-intentional causes of violations include lack of understanding or awareness of laws and accidents. Intentional compliance and noncompliance describes instances of behavior in compliance with or in violation of laws that does not occur out of habit or by accident. Conflicting motivations for intentional instances of compliance or noncompliance are: (1) gains and losses (economic and other benefits as well as punishments); (2) societal norms; (3) hedonic reasons (Etienne, 2011). Other authors have focused on perceived procedural fairness and legitimacy of rules as an important part of compliance (Tyler, 2003). Legitimacy factors may be viewed as part of the normative forces (a personal duty to comply may depend on legitimately crafted rules) or

calculative forces (legitimately created rules more clearly quantify risks in a cost-benefit calculus) contributing to compliance decisions.

Compliance with natural resource rules and laws, more specifically, follows models from the literature on compliance in general. Arias (2015) and others in the natural resources literature also focus on legitimacy as an important factor in compliance decisions. Empirical studies have characterized five factors in natural resource compliance decisions: (1) economic factors (including coercive forces as costs and personal benefits); (2) normative forces (both societal norms and personal norms, including perceptions of legitimacy); (3) social pressure from other members of the community; (4) knowledge and understanding of rules; and (5) ability to comply (Winter & May, 2001). The baseline compliance rate is generally determined by habits and cultural norms of the community. Although motivations for compliance and noncompliance are not the same, and are frequently not the inverses of one-another (Arias, 2015; Kahler & Gore, 2012), reasons for compliance and noncompliance tend to all fit within these five compliance factors.

There are two ways to improve compliance, fundamentally: (1) coerced compliance (people are forcefully compelled to comply) and (2) voluntary compliance (people comply on their own). Two types of coercive compliance are common, and these play into the economic factors determining compliance decisions—punishing bad behavior is far more prevalent than rewarding good behavior. The efficacy of coercion by punishment depends not only on the severity of the penalty, but also on the risk of an offender being apprehended. Increasing perceived rates of detection may be more effective than increasing severity of penalties in improving compliance (Leader-Williams & Milner-Gulland, 1993).

The Pantanal region of Brazil is a place where an intractable landscape of seasonally

flooded savannas and forests renders detection of violations of environmental rules extremely difficult. This is further complicated by a lack of public roads and other infrastructure, underfunded police, and a large proportion of privately owned land. Voluntary compliance, rather than coerced compliance, thus should be the focus of natural resource managers in the region. Previous studies have highlighted the importance of perceived legitimacy in voluntary compliance in other regions. To prevent failure of natural resource laws and rules in the region, therefore, understanding of how to improve legitimacy of those rules is paramount.

Conclusion

There are three fundamental ideas that conservationists can consider in conserving nature. First, a philosophical consideration: what nature must actually be protected? Second, a natural science consideration: what are the limits that must be placed on human activities to protect nature? And third, a social science consideration: to what extent will humans actually abide by the limits placed upon them to protect nature? We often take the first and last for granted, focusing instead on the physical limits required—this is perhaps because it is the easiest question to answer. The philosophical and social science problems are often more complicated because they are human problems that require human solutions. Individuals are entitled to their own philosophical points of view; but given those views, there are numerous ways to improve compliance with limits on human behavior. On a broad scale, compliance happens either by coercion or by volition. Failures of protection of nature therefore may be avoided with stronger coercion or with measures to enhance voluntary actions in compliance with laws. However, conditions in areas like the Pantanal are such that increasing voluntary compliance is far more viable than increasing detection and thus strengthening coercion.

CHAPTER 2

A CONSERVATION CRIMINOLOGY APPROACH FOR ASSESSING PROBLEMS OF NATURAL RESOURCES MANAGEMENT IN THE BRAZILIAN PANTANAL

Introduction and Theory

Context

The coexistence of nature and people usually requires some degree of natural resources management (NRM) (Hardin, 1968). Management rules need not be written (Moritz, Hamilton, Scholte, & Chen, 2014); nor must they be enforced by a government (Ostrom et al., 1992). But, in most modern societies NRM rules are promulgated in the form of laws and regulations under authorization from a central government. Today, natural resource managers recognize the importance of local stakeholder contributions to many decisions about these rules, shifting many NRM systems from a purely top-down approach to a form of co-management in which government officials and local stakeholders both bear responsibility for management of natural resources. Optimizing benefits from coexistence in NRM can be challenging and highly dependent on context; scholars have approached the challenges on different levels. Some have focused on the organizational structure of management as being essential for effective outcomes (Ostrom et al., 1992). Others have focused on individuals' attitudes and behaviors to inform management (e.g., environmental risk perceptions, Gore, Knuth, Curtis, & Shanahan, 2006; trust and legitimacy, Davenport, Leahy, Anderson, & Jakes, 2007; Hamm et al., 2013; Rudolph & Riley, 2014; Sharp & Curtis, 2014). Still others have considered how management structures evolve through time (e.g., adaptive co-management; Walters, 1986). These approaches all combine various academic disciplines (e.g., Ostrom's work bridges microeconomics and

political science; others utilize behavioral economics and sociology); studying NRM is fundamentally interdisciplinary.

One novel interdisciplinary approach for considering coexistence of humans and nature is conservation criminology. Conservation criminology draws upon risk and decision science, NRM, and criminology (Gibbs, Gore, McGarrell, & Rivers, 2010). Integrating theory, methods, and practice from these fields facilitates simultaneous analysis of management structure, individual motivations and decisions to conserve nature and minimize risks, and rule-breaking behavior and enforcement responses. Here, I demonstrate how using a conservation criminology approach to analyze noncompliance decisions can inform more effective NRM by explicitly adding insights from the perspective of criminological science on policing. The purpose of this chapter is to highlight the advantages of using conservation criminology to bridge theoretical and practical gaps in the sustainable use and conservation of natural resources.

I applied conservation criminology to noncompliance with environmental rules in the Brazilian Pantanal with three objectives: (1) characterize noncompliance with environmental rules in the Brazilian Pantanal using paradigms from the decision literature on compliance; (2) describe perceptions about police and how to improve enforcement from the criminology literature; and (3) describe public perceptions about the NRM system using principles from the NRM literature. Below, I introduce conservation criminology as a framework for interpreting environmental problems and proposing solutions. I present a brief review of the risk and decision science literature, NRM literature, and criminology literature. I then present qualitative results and analysis together. I discuss the problems reported with policing in the Pantanal in light of modern criminological evaluations of policing strategies. My discussion of the current NRM in the Pantanal system employs Ostrom's popular framework of co-management principles (Ostrom

& Cox, 2010), for which I focus on the fishery co-management system, exploring how problems with noncompliance may be addressed by changes in governance.

Conceptual framework: conservation criminology

Management of natural resources ideally employs scientific data to prevent depletion. Although the question of to what extent humans can use natural resources without depleting them is one that may be answered by geologists and biologists, NRM is essentially a discipline about humans. Fundamentally, the management of people's behavior to limit damage to natural resources can be explored on three levels: the individual decision-maker; the system in place to create rules to control behaviors; and the system in place to respond to violations of rules. Conservation criminology provides a framework that unites these three levels of analysis. This union constructs a more holistic picture of natural resource problems and solutions, and although it has been utilized in other contexts, it has never been used to describe noncompliance issues in the Pantanal.

Table 2-1. Summary of the three fields united in conservation criminology, the framework of each field used in this analysis, and the strengths and weaknesses of each component when employed alone.

	Conservation Criminology Components		
	Risk and Decision Science	**Natural Resource Management**	**Criminology and Crime Science**
Framework applied in this study	Psychometric motivations underlying compliance behaviors (Winter & May, 2001)	Principles of adaptive co-management (Ostrom & Cox, 2010)	Problem-oriented and community policing, guardianship (Goldstein, 1979)
Key strengths	Focus on individual's reasoning	Focus on governance, rather than personal interactions	Focus on response to noncompliance
Key weaknesses	Focuses on individuals' beliefs and opinions, sometimes not looking at structure with rigor	Misses personal motivations and individual reasoning	Focuses too much on punishments and incentives, too little on political structure changes and personal motivations

Risk and decision science: motivations for compliance

The first part of the conservation criminology approach is risk and decision science, which focuses on the cognition of decisions. Risk and decision science classically treated individuals as rational actors calculating costs and benefits to their actions. Behavioral economics shifted the rational actor paradigm, describing individuals' valuations of costs and benefits as nonlinear functions (Amos Tversky & Kahneman, 1981) that depend on the effects of affective state (Slovic, 1987; Slovic, Finucane, Peters, & MacGregor, 2004, 2007; Slovic & Peters, 2006), Loewenstein 2001) and attitudes (Ajzen & Fishbein, 1980). The extant literature on compliance decisions more specifically has largely paralleled this trajectory. Becker (1968) approached the problem of compliance with a criminology background using a rational actor model in which people calculate the benefits and costs of a decision to comply. Other approaches for understanding compliance decisions model compliance within the framework of the theory of planned behavior, focusing on attitudes of actors as factors for compliance or noncompliance (Arias, 2015). Factors for compliance and noncompliance decisions may be divided into five types: (1) cost-benefit calculations including sanctions and retail value; (2) normative forces in society regarding the behavior; (3) social pressure from other individuals; (4) necessity of noncompliance or impossibility of compliance, for instance in the case of a starving family illegally fishing; (5) and knowledge and understanding of the rule in the first place (Winter & May, 2001). A number of attitudes contribute to these factors, including the perceived legitimacy of rules (Honneland, 1999, 2000; Kuperan & Sutinen, 1998; Raakjær Nielsen, 2003; Sutinen & Kuperan, 1999). Legitimacy is a factor of compliance with laws more generally, and is determined by whether rules are fairly conceived and enforced (Tyler, 2003).

Natural resource management: participation and governance

In 1990, Elinor Ostrom released her treatise on "Governing the Commons." Among her contributions in this work were eight design principles that have been widely regarded as markers of successful governance of common pool resources (CPRs) (Cox, Arnold, & Tomás, 2010). These principles have been tested empirically in a number of contexts, from marine fisheries, to land use and farming regimes, to forestry resources, and hunting (Ostrom & Cox, 2010). These principles have also been expanded upon to more accurately reflect the realities of different management situations (Cox et al., 2010). Empirical evidence largely supports that premise that the eight principles of management schemes can be used as indicators of management success as well as to highlight problems in management structure (Cox et al., 2010).

Table 2-2. Summary of Elinor Ostrom's management principles as modified and updated by Cox (2010), arranged by the part of the management structure to which they apply: (1) the characteristics of the rules; (2) characteristics of the structure to encourage fairness; and (3) the manner in which the structure interacts with individuals.

	Ostrom-Cox principles (2010)	
	Principle	***Related question***
(1) Properties of the rules	Clearly defined user boundaries	Who is subject to management rules?
	Clearly defined resource boundaries	What resources are restricted?
	Congruence between rules and local conditions	How well do rules match reality?
	Proportional equivalence	Are punishments proportional to transgressions?
	Graduated sanctions	Are sanctions graduated with respect to context?
(2) Properties of structure encouraging fairness	Conflict resolution mechanisms	Are there ways to challenge the power structure?
	Minimal recognition of rights to organize	Are stakeholders allowed to organize and lobby for rights?
	Nested enterprises	Are management structures organized to counterbalance power?
(3) Properties of interactions	Collective choice arrangements	Can stakeholders contribute to rulemaking process?
	Monitoring rule enforcement	How do stakeholders ensure proper enforcement of rules?
	Monitoring resources	How do stakeholders ensure quality research on natural resources?

Criminology and crime science: problem-oriented policing

As Ostrom and others were looking into collective governance, criminal justice scholars had also begun to move towards suggesting more community involvement in policing (Community Policing Consortium, 1994). The status quo of policing before the 1970s was largely based on incident response, or rather, primarily reactionary in nature. With newfound recognition of the community as a partner in policing in away from a top-down reactive response or incident-based scheme to problem-oriented policing (Goldstein, 1979). Problem-oriented policing re-focuses police efforts on the causes and solutions for problems, rather than reactionary incident-based crime enforcement (Goldstein, 1979). A common thread between

these two paradigm shifts in different compliance-related fields is the recognition of the benefits associated with those in positions of power communicating better with stakeholders. As Ostrom investigated collective governance and involving locals in decision-making, departments implementing problem-oriented policing began conducting more community outreach, allowing locals to have a say in how enforcement happens and truly contributes to enforcement efforts. The problem-oriented approach to policing provides a framework to analyzing problems in the community: Scanning, Analysis, Response, and Assessment (SARA, Eck & Spelman, 1987). Problem-based approaches, along with community interaction to reduce fear and disorder, as well as hot-spot policing are not mutually exclusive, and represent empirically better strategies than reactionary incident-based policing models (Weisburd & Eck, 2004).

Applying the conservation criminology framework

Although the conservation criminology framework has existed for some time, there are very few applications in specific natural resource management contexts (e.g. Gibbs, McGarrell, Axelrod, & Rivers, 2011). I applied the conservation criminology framework to the problem of noncompliance with natural resource laws in the Brazilian Pantanal. I present results from exploratory interviews organized by compliance theme, following a decision science philosophy—something that has never been done in this region. Then I fit results into the Ostrom-Cox principles of co-management and Goldstein's problem-oriented policing paradigm. Ostrom's principles have shown to be an invaluable evaluation tool in the marine fisheries literature in Brazil (Trimble & Berkes, 2015). However, analyzing the weaknesses of a governance structure has not been applied to inland fisheries in the Pantanal. Finally, I discuss potential contributions from problem-oriented and community policing, which have not been applied in the conservation context.

Methods and study site

Study site description

The Pantanal is among the world's largest inland wetlands and a conservation priority region (Keddy et al., 2009). It is known for its biodiversity and recognized for its natural wonder both internationally as a Ramsar Site and UNESCO Natural World Heritage Site (Junk et al., 2006). It stretches over three countries and two Brazilian states; the Northern Pantanal in the Brazilian state of Mato Grosso was the case study area for this research. Hunting in the region is banned altogether and forestry resources are tightly controlled by federal and state statutes, but there is a co-management system in place for the fishery. The fishery is regulated by a Committee (CEPESCA) that holds public monthly meetings. Stakeholders in the fishing and tourism sectors are represented by leaders of their lobbies at meetings in the state capitals. The Committee consists of legislators, scientists, and police representatives, in addition to members of fishermen's colonies and tourism syndicates. The Committee sets rules through an addendum to the state fisheries law based on recommendations from stakeholders and biological research, conforming to higher-level limits and rules set by the federal government. Environmental laws in general in the region are enforced by state environmental military police, who have full enforcement powers despite being enlisted in the state Secretary of the Environment. These police patrol and enforce fisheries rules as well as moratoria on hunting and logging.

Data collection

In order to explore in more detail the community's perceptions of noncompliance in the region, I conducted semi-structured exploratory interviews with key informant stakeholders (N = 10) living in the Pantanal (following Honneland, 2000) to supplement direct observations and participation in the fishery management system (following Trimble & Berkes, 2015). The rural

land of the region is dominated by cattle ranches, some of which have their own schools or ecotourism operations. Along the rivers, there are small houses and communities belonging to *ribeirinhos*, who are primarily subsistence fishermen who sell excess catch for money. The stakeholders I interviewed were ranchers, fishermen, a schoolteacher, a ranking member of the ranchers' syndicate, and an ecotourism hotel owner, collectively representing the important rural industries in the region. I also asked an environmental police officer to identify policing problems in the region (N=1). Questions about compliance were projective in nature, allowing informants to speculate about others' reasoning in order to minimize effects of social desirability bias (Fisher, 1993; Gavin, Solomon, & Blank, 2010). In the ethnographic mold, I sought in-depth responses to questions and allowed conversations to flow, following methodologies of noncompliance from marine fisheries (Honneland, 1999).

Data analysis

I analyzed qualitative data using the RQDA package (Version 0.3) in R (64-bit, version 3.4.3). I used a simple iterative coding process (Srivastava & Hopwood, 2009) to find themes in responses to two general questions: (1) Why do people break the law? and (2) What is wrong with enforcement? To the first question, I first listened, finding themes, before recoding themes by compliance theme identified in the literature (calculated, normative, social, knowledge, and impossibility, Winter & May 2001). I provide examples and describe the frequency of occurrence of codes to give an idea of their prevalence among respondents. In response to the second question I report general impressions including some quoted material (following Honneland, 2000). I also report comments from a police officer in response to themes from the other interviews, which corroborates and describes the reasons behind certain perceptions of enforcement in the community. Methods and analysis associated with research was deemed

exempt by the Michigan State University Internal Review Board on human subjects research for the duration of the project (#15-643e).

Findings and discussion

In total, ten community members and one police officer were interviewed between June and August, 2015. Interviews took approximately 30 minutes on average. All agreed to be interviewed and provided informed consent after a brief description of the research objectives and identification of the principal investigator and institutions.

Views on noncompliance from the perspective of decision science

Our first objective was to characterize noncompliance with environmental rules in the Brazilian Pantanal using paradigms from the decision literature on compliance. Following the five major themes of compliance (Winter & May, 2001), I found that virtually everyone identified a lack of police and related economic motivations as the primary reason behind noncompliance. Other reasons for noncompliance with environmental laws in the Pantanal included normative reasons—violations are common enough that people recognize them as being the norm, and the seemingly arbitrary nature of enforcement strengthens the notion that individual violations are not problematic. Fewer interviewees pointed to lack of knowledge or understanding of the law and necessity or impossibility to comply as reasons for noncompliance. None of those interviewed cited social pressures to comply as important in compliance decisions.

Table 2-3. Summary of prevalence and examples of reported reasons for noncompliance and ways to improve compliance based on key-informant semi-structured interviews (N=10), grouped by important compliance themes identified by Winter & May (2001).

Subject identified by Winter & May (2001) as important theme in compliance with explanation	***Prevalence in community and example responses***
Economic reasons or calculated noncompliance The benefits of noncompliance outweigh the risks associated with noncompliance, or the chance of being arrested and fined.	**Prevalence:** All 10/10 respondents described economic reasons for noncompliance. "The violation of the law, if there were a more rigorous enforcement, could make them think twice. But as the punishment is something far away, they violate because they know nothing will happen." (Respondent 4)
Normative reasons for noncompliance The norm is not to comply with the rules because of arbitrary enforcement and widespread conception that local people know better.	**Prevalence:** 8/10 respondents described normative reasons for noncompliance. "[Others] see a person doing wrong and think, 'if that they can get away with it every day, why can't I?'" (Respondent 2)
Social factors for noncompliance People choose to comply or not to comply because people they look to in the community would judge them harsh if they did not.	**Prevalence:** No (0/10) respondents mentioned social factors as a cause of noncompliance.
Knowledge and understanding of rules People without knowledge of the rules, or without understanding the rules properly, may unknowingly and accidentally break them.	**Prevalence:** 3/10 respondents described noncompliance due to lack of knowledge or lack of understanding of environmental risks or rules. One example provided of a rule that seemingly contradicts another version of itself is the blanket ban on fishing the dourado—another part of the law defines legal size limits for the same species.
Impossibility of compliance or necessity Near impossibility of compliance—or necessity of noncompliance to eat or provide for family—leads to noncompliance with laws.	**Prevalence:** 3/10 respondents indicated this was a problem with NRM compliance Specific examples provided included people who constructed or deforested areas before laws preventing those activities existed. Others said that the permitting process is impossible for non-lawyers. Others noted that rural dwellers mostly break the law to feed their families.

These categories are neither mutually exclusive nor independent of one-another but suggest widespread recognition of a multiplicity of reasons that violators choose not to follow the law. People may choose to break the law because of more than one reason. People may also cognitively weigh normative reasons or social factors against economic benefits in a calculative

fashion, meaning these categories might blend together in people's decision-making processes. Regardless of mutual exclusivity or independence, these factors may indicate that an increase of police presence and building of norms to comply with laws could increase compliance. Many indicated an "us versus them" mentality when discussing environmental rules—that people outside the community were setting restrictive environmental rules that were not in line with the community's desires or local conditions. One way to build a norm of compliance might be to establish a more collaborative rulemaking process. These changes, coupled with a reduction in bureaucratic barriers to compliance and better economic opportunity in rural communities, logically follow from this analysis. Future confirmatory research could validate and elaborate on these exploratory considerations.

Locals' perceptions of police and improvement from criminology literature

My second objective was to use criminology literature to describe perceptions about police and how to improve enforcement. The criminology literature on problem-oriented policing outlines a framework for practitioners that begins with surveying for possible problems and analyzing those problems, before suggesting responses to them (Eck & Spelman, 1987). The story told by the interview respondents largely pointed to a lack of fair (i.e., not arbitrary) enforcement as the major problem in this region. The apparent lack of enforcement was noted as the primary reason for noncompliance.

"The [enforcement agency] should monitor this [area]. But they do not. I do not know if it's because they are too lazy to patrol or too scared."
-Respondent 2

Although respondents tended to suggest that more enforcement officers in the region would lead to better outcomes, empirical data show that increasing numbers of police or enforcement presence alone has mixed results on crime rate (Weisburd & Eck, 2004). One factor

identified that renders enforcement difficult in the Pantanal is the vast size of the region combined with few access points to rivers and few public roads. Lack of infrastructure and poor access make it difficult to detect violations of rules and easy for rulebreakers to avoid police.

"Enforcement is very scarce. The river has almost none. And another thing that also makes it very difficult are the large [distances]. The rivers here are kilometers and kilometers of river and there are few officers."
-Respondent 5

The region is over 150,000 square kilometers of rivers, lakes, forests, and savannas, which is over 90 percent privately owned (Junk et al., 2006); there is ample space for violators of the law to hide. Environmental police are based in cities and in a few remote stations—the majority of the remote outposts are unmanned most of the time, however. Manning these posts on a more frequent basis might help somewhat. A different way to remedy this type of coverage difficulty is by relying more on community members to help direct enforcement response. This is described as "guardianship" in the criminological literature, and is a fundamental part of approaches to controlling crime based on routine activity theory (Hollis-Peel & Welsh, 2014). Some of those interviewed indicated that increasing guardianship by locals in the Pantanal might help enforcement efforts.

"Yes, because that […] helps facilitate the work of the environmental police and IBAMA ... So these people who have a duty to fulfill, would be [better informed]. So I think that communication would serve to let them know where the offenses were occurring."
-Respondent 4

However, guardianship requires some level of cooperation with enforcement in order to work. Guardians operate by "providing a possibility that the crime will be noted and an intervention (whether by directly approaching the offender or indirectly through bringing the crime to the attention of a police)"(Hollis-Peel, Reynald, van Bavel, Elffers, & Welsh, 2011). A frequent commentary of individuals discussing noncompliance and policing in the Pantanal was

a lack of reporting and cooperation with the police, suggesting guardianship might not be possible. When asked if they would report someone who was breaking a rule, nearly everyone said they would not. “Reporting [a crime] is very damning. So, many people know who committed crimes, but are too afraid to file a complaint” (Respondent 4). There was especially a fear of physical retribution for reporters.

“It’s better to keep quiet and say that you saw nothing to keep the peace. Because if you report you risk your life… If you go ask the *ribeirinhos* [local rural-dwelling subsistence fishermen who earn a living from bait collecting and selling their catch] and they turn someone in, people there find out who it was and it is dangerous because someone will want harm or even kill a *ribeirinho* who is reporting crime, so people do not have any protection because no enforcement officers are in the area.”
-Respondent 1

In addition to fear of physical retribution from other members of the community, others said they would not report out of a lack of trust in police. Guardianship effects on compliance with rules might be inhibited without first mending relationships between enforcement agencies and the public, so that there is actual risk of intervention while crimes are happening or at least a risk of reporting the crime to the police. Several respondents erroneously blamed the dangers of reporting on a reporting system that required identification (i.e., providing names when reporting crimes). The reporting system in place is fully anonymous, not requiring any personal information to tip off police, and the people erroneously claiming it requires personal information have never tried to report. With small communities it may be easy for a neighbor to figure out who turned someone else in by process of elimination in spite of anonymity in reporting. But, those who said they did not report because they would be identified also described not reporting because of distrust of police.

“I do not think it's safe. I'm afraid. Because these days, how many times friends of people who are police officers ... so we are afraid because many are involved. When you report someone they ask for your name and CPF [a personal identification number, something like a Social Security Number], complete identification, and they say that because they have a lot of work, they do not

even want to go anywhere like this before confirming the data and such. Then you're unsure of making any complaint like that. I do not trust [them]. I don't [report people]."
-Respondent 2

On the other hand, some do not feel afraid to report, but rather that it is not their job to report—they are paying police to do this work, not them. "I do not think [I would report]. Not for fear, [but] because that's not my job. It's up to IBAMA [the federal natural resources institute], in my view IBAMA is paid to do that" (Interview 8). Others contend that it is not fear of physical harm, but fear of revenge in the form of neighbors later reporting them. When the norm is breaking the law, everyone does it—so if one person turns someone else in one day, the person that was turned in might report the original reporter the next day.

"I think it's not necessarily fear. But people here tend to think, 'If I report him today, tomorrow he will report to me later...' That's mostly what happens here. Mostly the hotels. They get people of all kinds, environmentalists, people fishing who want to take the fish, those who do sport fishing and release the fish after ... But if the owners denounce sport fishing? Yeah, they're in the right. But tomorrow another type of people who are guests, who come to take the fish. So if the hotel reported last time, someone else will report it this time. So I think that's the kind of thing that happens. 'I do not tell on you, you do not tell on me.'"
-Respondent 5

This sort of concern is normative in nature: the norm in the community is to occasionally break the rules, but not to report. Several other interviewees also highlighted normative issues in describing noncompliance in the region. Normative reasons for noncompliance are mixed with reasons that involve fairness in enforcing rules. If enforcement is arbitrary and the norm is that many in the community break the law, then many individuals may think they, too, should not be missing out on the opportunity to harvest more fish. But many viewed enforcement as not arbitrary, but slanted against the poor: "For the 'big guys' everything is easier!" (Respondent 7).

"In the Pantanal here, there are police that go out enforcing ... They find anyone fishing here, a person who has no money, a simple person. They get arrested, appear on TV ... [Then] they catch the big ranchers who have money, are covered in money they have, and then everything is erased and seems like no one saw it. So it is difficult to speak of the environmental police ... Complicated. When you take a poor person, he goes to jail, he appears on television, and there is

that whole mess."
-Respondent 2

This sort of problem is just one way in which local people see police and government authorities as corrupt. This research was conducted at a time when public perceptions of corruption in government were extremely high in Brazil due to the *lavajato* scandal—a widespread corruption scandal implicating all levels of government officials in taking bribes and creating phony construction contracts to launder money. The president of Brazil was impeached due to election misconduct in 2016, and the former president was sentenced to more than ten years in prison for money laundering. Corruption has been shown to be prevalent in natural resources contexts elsewhere (Sundström, 2012), and stands in the way of proper commons governance (Sundström, 2015).

"Enforcement is like ... trust, everywhere in the world, almost no one trusts police, because the main thing we see, especially in this kind of work, is corruption. These are people who are easily corrupted, because of the difficulty they have in work, the remuneration they have ... Bribes ... This is mostly what happens. Turning a blind eye. Suppose I go fishing and catch a fish outside the limit, [salary] is late and you pass me a good offer. I pay and you pretend you did not see and it goes away, this ends up happening."
-Respondent 5

"Many [police] accept bribes and end up forgetting about functions like taking care of the environment, preserving the environment, and doing the policing. So this problem of bribery ends up being the major issue and reason ends up being replaced by personal [preferences]. If there was a professional commitment, those would be the people for the job. But a person who accepts bribes is just coercing with crime and becoming an accomplice of the crime."
-Respondent 4

Enforcement agencies in the Pantanal face numerous difficulties in applying fishing rules. The Pantanal is a vast area most of which is only accessible by boat and plane and only when the weather is cooperating. Additionally, most of the land is privately owned, creating legal access problems for police. The police officer interviewed described some other difficulties: (1) the environmental police did not have a vehicle; (2) the environmental police received a vehicle but

had a very limited supply of gas; (3) the department's phone bill had not been paid for three years by the state. Increasing police forces may be difficult in a place where current levels of enforcement are under-funded. Perhaps the first problem that could be fixed in this region is providing the necessary equipment and infrastructure to police in order to respond when called.

The regional environmental police seized a record quantity of illegal fish in 2016. Among those caught red-handed were a federal prosecutor, which contributed to local people's distrust of the law. There is a general distrust of enforcement agents and not an ideal relationship between them and the local community. When asked about corruption and taking bribes, the police officer interviewed denied that this type of corruption was commonplace. However, the officer did offer a justification for why some people are let off while others spend time in jail. According to the officer, police will sometimes let one individual go if that individual turns in several others, or if that individual helps them prevent a larger violation of environmental laws. Offering this explanation to members of the community may build trust. Some have argued that trust-building with police agencies is possible by door-to-door discussions with people and foot patrols, rather than random interrogations and incident-based reactive policing (Weisburd & Eck, 2004). Building trust also may have a collateral effect on individuals reporting crimes—those who currently erroneously believe that reporting systems are not anonymous may be more likely to report if they perceive police to be trustworthy and on their side.

Problems with management in a NRM framework

The third objective was to describe public perceptions about the NRM system using principles from the NRM literature, which focus more on rules and rulemakers than law enforcement officials. The lack of trust and perceived fairness in the respondents goes beyond police. It seems that participants felt some individuals have little understanding of the process of

rulemaking, do not believe they have a voice in the process, and instead see rulemakers and enforcers as coming in from afar to regulate their personal lives. The rules highlighted for this part of the discussion are promulgated by the Fishing Committee in the state of Mato Grosso, which holds monthly open meetings and makes rules on legal sizes of fish based on input from scientists who conduct their studies in river communities where many respondents live. Representatives from the fishermen's colonies in the fishing communities are among the voting members of the committee. Despite this, respondents have little understanding of the system and insist that they have no say in the process of defining rules managing the fishery.

"I have no idea how [the rules] are made. Because these laws come from the senate. Senators who have never been to the Pantanal, right? They do not even know who lives in the Pantanal, who live as subsistence fishermen, right? Then they apply laws without knowing the Pantanal people's needs, which is fish that there are too many of ... There are hardly any studies to apply these laws, usually they make the laws there in the senate and that's where they vote and sign and apply ... So they do not have the idea to send a group to the Pantanal to verify the needs of *ribeirinhos*, fishermen, how they live, what they think, talk to us to see ... So, they do not have any of this. They apply these laws saying that the fish has a measured and that's right. No use, because nowadays they applied the law to the pintado [a type of catfish-*Pseudoplatystoma corruscans*]. Then every year they increase the size limits-and it's the big ones that reproduce! What good does it do to apply size limits [so that only the adults can be caught]? Are the little ones supposed to reproduce? They're not going to! So ... It's like the pacu [*Piaractus mesopotamicus*]. This year it went to forty-five [cm] ... so the little ones will not reproduce because we only kill the big ones. And it is these big ones that reproduce …"
-Respondent 1

Those interviewed noted that there was a difference between what the rules *were* and what they thought the rules *should be*. This incongruence in rules could partly be due to a lack of understanding of how the rules are made and partly due to the perceived inability by most to participate in rulemaking. However, respondents also highlighted a different problem—that the outsiders making the rules do not understand the local conditions. Such a perception of a lack of understanding could indicate that some think that the rulemakers do not possess the requisite abilities to be setting limits on fishing.

“It is SEMA [the State Secretary of the Environment]. Yes, they are biologists. It's hard because biologists are well-educated. However, they study, but do not have the practical experience, for example in the spawning season, ‘ah, let's close the fishery in October, but in October the fish do not spawn so we will close November.’ So they study, but have no experience in wildlife that here is something else. But most of the people and I particularly think that fishing should close five months [instead of three or four].”
-Respondent 3

Using the Ostrom-Cox (2010) principles as a guide, the challenges in the fishery management system can be illuminated. The state fishing law that outlines the structure of the Fishing Committee and the rules to be defined provides for a system in which all of the requirements of the Ostrom-Cox principles are met. However, based on interviews and observations of the system in practice, this may not be the case. The perception of the system in practice, instead of a co-management system, appears to be a system of imposed and unwanted or unneeded rules.

Table 2-4. Ostrom-Cox principles as applied to the Pantanal fishery management system (following Trimble & Berkes, 2015), under the law as it is written and what happens in practice, based on interviews and observations.

	Ostrom-Cox principles (2010)			
Part of management structure	***Principle***	***Accomplished by the law***	***Accomplished in practice and reason why not***	***Source***
(1) Properties of the rules	Clearly defined user boundaries	Yes	**Somewhat**—definitions unclear to some	Interviews
	Clearly defined resource boundaries	Yes	**Somewhat**—definitions unclear to some	Interviews
	Congruence between rules and local conditions	Yes	**No**—due to absence in perceived ability to influence rulemakers	Interviews
	Proportional equivalence	Yes	**No**—due to unfair or arbitrary enforcement	Interviews
	Graduated sanctions	Yes	**No**—due to unfair or arbitrary enforcement	Interviews
(2) Properties of structure encouraging fairness	Conflict resolution mechanisms	Yes	**No**—part of the monthly meetings	Interviews, observation
	Minimal recognition of rights to organize	Yes	**Somewhat**—collective bargaining possible through locally-organized fishermen's colonies, but not everyone can participate	Interviews, observation
	Nested enterprises	Yes	Yes	Interviews, observation
(3) Properties of interactions	Collective choice arrangements	Yes	**No**—fishermen's colonies send representatives, but majority of people do not know what is happening.	Interviews
	Monitoring rule enforcement	Yes	**No**—theoretically available in monthly meetings that nobody attends in practice. The only contact with enforcement is when police conduct random searches or respond to calls.	Interviews
	Monitoring resources	Yes	**No**—theoretically available in monthly meetings that nobody attends in practice. Very few locals have any interaction with scientists, and thus have their own ideas about abundance or scarcity of fish.	Interviews

Key problems reported by the respondents, as elucidated by the Ostrom-Cox framework, are perceptions of the fairness of rules and the ability to hold government officials accountable. Local people theoretically have access to monthly meetings, but because meetings are held in cities far away from communities, only the presidents of the fishermen's colonies attend the

meetings. In order for people to feel like they have a voice, changes could be made to the structure of the fisheries colonies to promote more community involvement and better communication. If people feel they are more involved and they have a voice, the rules may become more understandable to them and better reflect local conditions.

The "monitoring resources" and "monitoring enforcement" principles are theoretically met in the written law by the monthly meetings, as well. However, these meetings are not the only place where locals have the opportunity to interact with police and scientists. If police and scientists engage in enhanced outreach activities in the field, where they work in close proximity to communities, locals may feel like they have a better understanding of how enforcement and resource monitoring are being conducted in the region.

Conclusions

The objectives of this research were to first to describe views of noncompliance with environmental laws and rules in the region in general and then to describe problems with the police and management structure. The purpose was to clarify the advantages of using interdisciplinary frameworks, and specifically conservation criminology, when assessing NRM problems and solutions. Based on key informant interviews, I found four broad categories of response relating to policing and noncompliance perceptions in the community: (1) lack of police; (2) lack of procedural fairness; (3) lack of understanding of risks or knowledge of law; and (4) impossibility of compliance or necessity of noncompliance. These findings may suggest that improving compliance may be possible by increasing number of police, as well as increasing perceptions of fairness and understanding of rules. When I analyzed at key informants' perceptions of police using criminological theory, I considered that that merely increasing police presence may not be successful. However, door-to-door visits by police and more community

guardianship may be possible if bridges are built between police and community members. Finally, an analysis under the Ostrom-Cox design principles showed that the principal problems with the system are associated with the interaction between the power structure and local community members. Perceptions of incongruence of rules with local conditions may diminish with greater ability to participate in fishermen's colonies and the Fishing Committee meetings. Personal interaction between police and scientists and community members may increase perceptions of ability to monitor enforcement and natural resources in the communities, where scientists and police conduct their work.

These results derive from an interdisciplinary conservation criminology analysis and demonstrate how such an analysis can be used and why interdisciplinary approaches are useful in NRM. Individual analyses result in different recommendations to increase compliance and decrease crime in natural resource systems. Integrating multiple dimensions of analysis shows that there are often multiple layers of solutions to noncompliance problems. While these results are based on a small sample in one area and thus specific conclusions may not be widely replicable, they serve to demonstrate the importance of interdisciplinary approaches and may offer a baseline for future compliance studies in the Brazilian Pantanal.

CHAPTER 3

EFFECTS OF TRUST ON NONCOMPLIANCE WITH FISHERIES RULES IN THE BRAZILIAN PANTANAL

Introduction

Context: IUU fishing and conservation

Humans rely on natural resources, and the rules that exist to ensure the persistence of natural resources often fail to fully ensure their continued existence. As human populations increase, they increase pressure on the environment in which they live and the natural resources on which they rely (Hardin, 1968). Environmental rules ensure the persistence of important natural resources and prevent over-exploitation of resources that can be detrimental to society. Rules can exist in the form of laws, regulations, or even social norms and can fail in one of two ways: either (1) they are poorly defined (even if everyone follows the rule, the natural resource will be exhausted); or (2) they are well defined but not followed. An important example of the latter is illegal, unregulated, and unreported (IUU) fishing, or fishing in violation of existing rules, which poses threats to fisheries worldwide. IUU fishing is increasingly recognized as a global high policy priority issue, with the United Nations, civil society groups, nongovernmental organizations, and federal governments working, often together, to reduce its associated risks to global fisheries and the billions of people that depend on them (FAO, 2012). These efforts are ongoing in part because of the significant role fisheries play in sustaining healthy ecosystems and in part because of the natural food security they provide (Agnew et al., 2009).

I consider the case of inland IUU fishing in the Brazilian Pantanal, exploring and characterizing key factors influencing noncompliance with fishing regulations, including trust in those defining the rules, especially in the scientists doing field work supporting those definitions.

This study builds off previous work on compliance and noncompliance, and its interdisciplinary approach reflects that of conservation criminology, or the integration of conservation biology, criminology, and risk and decision science (Gibbs et al., 2010). Below, I review the case study context of the Brazilian Pantanal, before elaborating on my exploratory research methods, and justify my approach to data analysis. Finally, I present noteworthy results in response to the research questions and discuss the implications of these results for theory and practice.

Theories of compliance and noncompliance

IUU fishing, including noncompliance with existing fishing rules, poses many of the same risks to fisheries as those present in unmanaged fisheries: risks to the size and composition of fish populations from overharvesting, risks to ecosystem health and function from degradation, and risks to humans from reduced income from tourism and professional fishing, as well as increased investments required to catch fish. Improving compliance, which is unintentional or intentional behavior in adherence with laws and rules, reduces risks from IUU fishing. Within the context of conservation, motivations for compliance are not necessarily the inverse of those for noncompliance, or the violation of rules (Kahler & Gore, 2012). However, decreasing intentional noncompliance by definition increases compliance, and previous work has often addressed noncompliance and compliance together (Arias, 2015; Etienne, 2011; Winter & May, 2001).

The extant literature includes some foundational insight into answers for questions underlying noncompliance with IUU fishing in a marine context, affirming that higher levels of risk of getting caught from surveillance can increase compliance by decreasing noncompliance, and that greater opportunities for access and larger fish population size influence noncompliance rates (Petrossian & Clarke, 2014). Other studies demonstrate perceived legitimacy of rules and

rulemakers, as well as how social norms and morals influence decisions to intentionally comply or not comply with laws (Hatcher, Jaffry, Thebaud, & Bennett, 2000; Jagers, Berlin, & Jentoft, 2012; Moreto & Gau, 2017; Nielsen & Mathiesen, 2003). Attitudes about social norms and legitimacy are intertwined with perceived risks, including risk of social ostracism and risks to the environment (Tyler, 2003). This research explicitly considered perceived risks as a factor in noncompliance decisions.

Questions remain about the suite of attitudes underlying individuals' decisions to comply or not comply with conservation-based regulations. This gap in understanding widens when questions about compliance and IUU fishing are considered within the inland, freshwater fishing context. Inland fishing contexts may present different challenges from marine fisheries because they represent more restricted habitats and are easier to access than many areas of the open ocean. The few studies that do focus on this area avoid inquiry about perceived environmental risks and legitimacy of rules (Velez & Lopez, 2013). One attitude related to risk perception, and legitimacy, is trust, including trust in individual regulators, rulemakers, and the institutions that these individuals represent. Rulemakers are often geographically far-removed from the natural resources they are responsible for managing, while scientists and law enforcement officers work directly with natural resources and in the communities that use those resources (Carter & Gore, 2013). This study represents a contribution for advancing understanding about individuals' trust and risk attitudes underlying noncompliance with fisheries regulation in a freshwater context. New knowledge about why people choose to violate rules enhances design and evaluation of programs and policies as well as monitoring (Kahler & Gore, 2012). I focused this work on decisions not to comply with fishing rules in order to direct interventions to reduce IUU fishing in the Pantanal and minimize risks to the fishery.

Theoretical framework: conservation criminology

Conservation criminology adds insights from the fields of risk and decision science and natural resource management to classic criminological analysis (Gibbs et al., 2010). Criminologists characterize intentional compliance with rules as being either coerced or voluntary. Coerced compliance generally relies heavily on policing and penalties for offenders (Becker, 1968; Nøstbakken, 2008), and it is on the manner of coercion (e.g., increasing detection or punishment, (Leader-Williams & Milner-Gulland, 1993)) that many criminologists focus. These compliance studies look at external controls of behavior through fines and jail time for offenders who are caught (Becker, 1968; Leader-Williams & Milner-Gulland, 1993; Nøstbakken, 2008; Petrossian & Clarke, 2014). Theoretically, people calculate the risk of getting caught as being too high and the punishment too severe and are deterred from engaging in noncompliant behavior (Becker, 1968). However, IUU fishing often takes place in areas where enforcement of rules is not economically or physically viable, such as areas in the middle of the ocean that are too vast to patrol closely or inland lakes and rivers that are surrounded by forests and swamps with unreliable access points, no passable roads or other ingresses. Even with technology such as drones, these remote conditions render coercive strategies moot for achieving compliance. Voluntary compliance is intentional compliance that is not coerced; this type of compliance results from individual decisions to follow, rather than break, the rules, and has been the focus of more recent compliance work (Moreto & Gau, 2017). The interdisciplinary nature of conservation criminology allows consideration of coercive factors as well as factors related to management structure and individual attitudes and risk perceptions.

Attitudes, risk, and decision science

Approaching compliance through the lens of risk and decision science, decisions to comply with or violate rules can be thought of as individuals' cost-benefit analyses, with costs differing depending on views about agency actors, the rules, and the environment itself. The behavioral decisions are influenced by attitudes, and many attitudes are themselves influenced by the structure of natural resource management. Attitudes about fisheries conservation rules, including views on trust and legitimacy, can influence individuals' responses to those rules according to the Theory of Reasoned Action, (Ajzen & Fishbein, 1980). Attitudes affect perceptions of risk (i.e., external cues are utilized based on internal attitudes; Brunswik, 1952). Decisions with risks are fundamentally different than cognitively simpler decisions with clear costs and benefits (Tversky & Kahneman, 1991; Tversky & Kahneman, 1981). Risk is defined as the probability and the negative value (damage) associated with an action (Kaplan & Garrick, 1981). Risk perception generally describes the intuitive judgments people make about risks as opposed to the technical assessments made by experts (Slovic, 1987).

Environmental risks can be particularly difficult to assess in decision-making processes because they are often uncertain and difficult to quantify (Lazarus, 1999). When people individually make decisions to harvest natural resources such as fish, the damage they theoretically perceive themselves causing to the resource (i.e., the risk) is a fraction of the gain that they personally receive (Hardin, 1968). Rules can help clarify the acceptable levels of environmental risk, thus facilitating decision-making by identifying damage that might otherwise not be readily apparent (Lazarus, 1999).

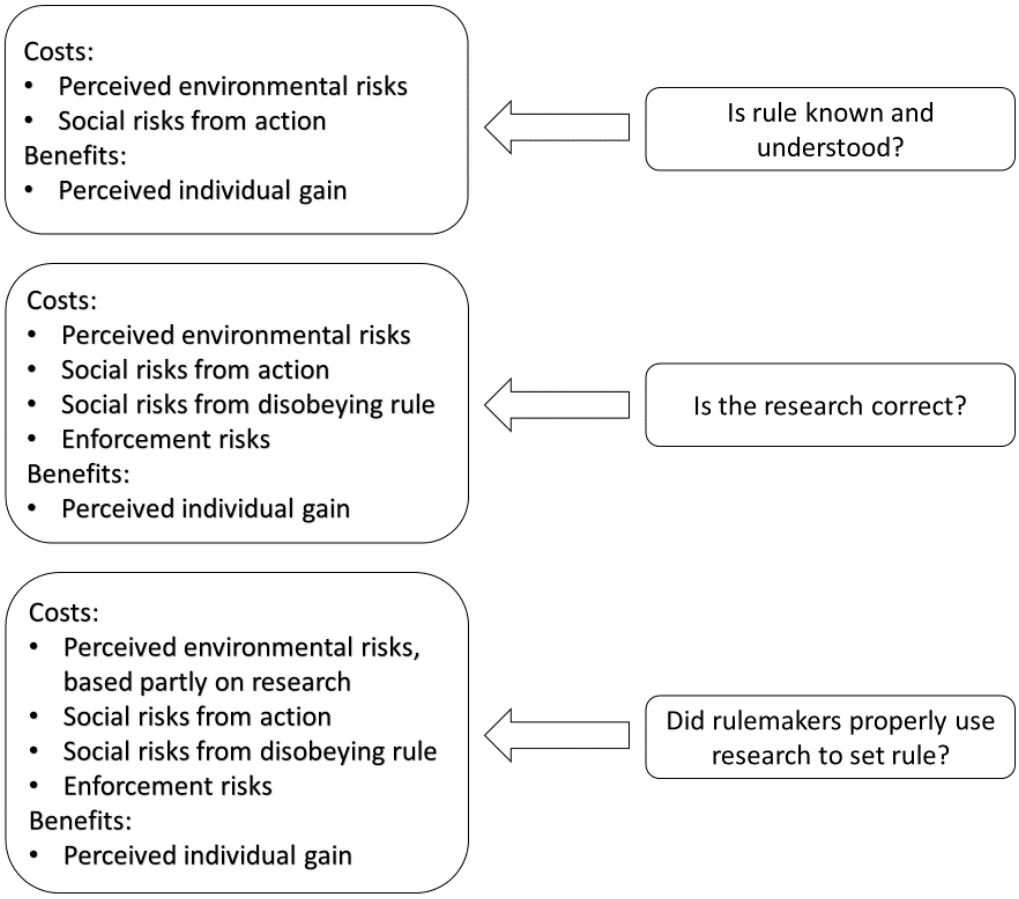

Figure 3-1. Noncompliance occurs under a number of circumstances. First, some noncompliance happens out of habit. If people do not know about a rule, but have a habit of occasionally breaking it, they are not complying with that rule unknowingly. Second, some individuals know about the rule, but choose to intentionally not comply with it anyway. They may choose to not comply with it because they believe the rule to be wrong, in the sense that it hurts them more than it benefits them. The costs and benefits weighed in the decision to comply with or violate a rule vary depending on attitudes. People choose to violate rules when perceived benefits (i.e., gain of money or food, social status) outweigh coercive forces (perceived risks of enforcement or perceived social risks) or perceived risks of damage to the environment (risks to the environment can be defined by the rule itself, by people's own interpretation of research, or by general observations of the environment).

Natural resource management studies and trust

Natural resource management (NRM) authorities, such as government agencies, commonly are the promulgators of environmental rules. They theoretically balance natural resource use and conservation, working to reduce environmental risks to acceptable levels. NRM

agencies help clarify risks, damages caused by noncompliance, and benefits of compliance. Empirical studies place attitudes relating to legitimacy of rules and of rulemakers among the range of attitudes determining compliance with laws (Hatcher et al., 2000; Tyler, 2003; Tyler & Bies, 1990). Legitimacy is related to trust in the NRM agency, which along with perceived procedural fairness (in creating and implementing the law) have been suggested to affect compliance decisions (Hamm et al., 2013; Rudolph & Riley, 2014). Trust in agencies is in part a function of trust in agents of the agency or rulemakers as individuals (Sharp & Curtis, 2014). Trust depends in part on trustworthiness factors grouped by some authors into categories of identity, ability, benevolence, and integrity (Mayer & Davis, 1999; Mayer, Davis, & Schoorman, 1995). Other authors have analyzed perceived procedural justice, or fairness of the procedures behind creation and enforcement of laws and rules, separately (Sunshine & Tyler, 2003). There is not one accepted universal model of trust, but the questions used to assess trust, procedural fairness, trustworthiness, and legitimacy are similar (Hough, Jackson, Bradford, Myhill, & Quinton, 2010).

Attitudes about procedural fairness and trustworthiness of the agency influence attitudes relating to the legitimacy of rules, rather than directly impacting an individual's compliance decisions. Success in improving NRM outcomes in terms of successful sustainable use and conservation of resources may be partly due to increasing and maintaining trust in management authorities (Dietz, Ostrom, & Stern, 2003). Gains in trust help explain why Participatory Resource Management (PRM) has repeatedly shown to lead to more enduring, sustainable, and publicly accepted conservation outcomes than top-down natural resource decision-making by federal or state agencies (Ostrom & Cox, 2010). Conversely, lack of trust in the agents and agency contribute to delegitimizing the protective conservation measures promulgated by

agencies. Without legitimate rules from NRM agencies, people may judge environmental risks differently than the agencies and voluntarily comply less frequently.

The conceptual foundation of this study was trust, or the willingness to accept vulnerability (Sharp & Curtis, 2014). Several studies have investigated the relationship between trust in agencies and natural resource management outcomes (Davenport et al., 2007; Hamm et al., 2013; Sharp & Curtis, 2014). Although natural resource management is often operationalized at different scales, trust in management agencies is often measured at a single scale (i.e., studies ask about perceptions of management or managers, Rudolph & Riley, 2014). Although scientists do their work in the field often in or near communities impacted by natural resource rules, studies exploring the relationship at the local scale, or between trust in scientists and noncompliance, do not exist in the literature. Considering the influence of trust at the different scales may be especially important where rulemakers are seen as outsiders imposing rules from afar. This situation is typical of rural communities in the developing world where and where biologists doing research on natural resources and police enforcing rules are seen as the local arm of power-wielding agencies (Carter & Gore, 2013).

The overarching goal of this research was to explore the influence of trust in scientists on compliance with inland fishing rules. I chose to focus on the Brazilian Pantanal, where local conditions render enforcement difficult, where a participatory co-management system is in place, and where scientists perform field work regularly. In the Pantanal, enforcement of fisheries rules by authorities is inhibited by the largely intractable landscape of rivers, private ranches, and underdeveloped infrastructure, so voluntary compliance is vital. Scientists are a critical part of the fisheries management structure, and are physically present in the Pantanal's most inaccessible areas, unlike politicians who work with scientists to set fisheries rules. Furthermore,

scientists rarely incorporate local people in their research, and much of the scientists' research is cognitively inaccessible to people in local communities due to low education levels. With this context in mind, I explored the extent to which trust in scientists (as a part of the management structure who maintain a presence near communities) influenced compliance decisions. To better understand the factors underlying IUU-related noncompliance decisions in the Pantanal, I (1) assessed rates of IUU-related noncompliance; (2) measured attitudes contributing to risk perceptions and decisions (e.g., trust in scientists, trustworthiness of agencies, procedural justice, and the environment); and (3) explored relationships between noncompliance, attitudes, and risk assessments. I achieved objectives via a survey of professional fishermen living on the banks of one of the principal Pantanal rivers to inform activities designed to increase voluntary compliance and reduce IUU fishing.

Materials and methods

Study site and fisheries management context

The Pantanal is among the world's largest wetlands (Keddy et al., 2009), spanning 150,000 square kilometers in the center of South America and stretching over parts of Bolivia, Paraguay, and Brazil. The largest proportion of the Pantanal belongs to Brazil, where its rivers, lakes, forests, and savannas provide refuge for endangered species of fauna and support migrations of birds from South America. The Pantanal drains part of the central Cerrado high plains of Brazil and its rivers feed into the De La Plata River basin before emptying into the Atlantic Ocean. The Pantanal is recognized as a conservation priority area because of its hydrological importance (Gonçalves et al., 2011) and its rich biodiversity, including endangered species (Junk et al., 2006). Despite its priority status, in Brazil the Pantanal's lands are over ninety-percent privately owned (Junk & da Cunha, 2005), and thus private citizens' compliance

with existing environmental laws and rules is critical to its conservation. Thousands of people live in the Pantanal, sparsely distributed over the vast, seasonally-flooded mosaic of forests, rivers, and savannas. Enforcement operations to increase compliance with comprehensive environmental regulations are hampered by a lack of infrastructure, and their efficacy is not well understood because patterns of and motives for noncompliance have never been studied in the region.

Conservation challenges in the Pantanal receive considerable attention (Junk et al, 2012), and include IUU fishing (L. Mateus et al., 2004). There are three types of regulated fishing in the Pantanal: (1) amateur, (2) subsistence, and (3) professional-artisanal. The professional-artisanal (also called professional) fishermen are organized into fishing colonies, which function as an advocacy-type lobby representing fishermen's rights in the region (Tocantins, Rossettto, & Borges, 2011). Many people who work as professional fishermen live in areas that are largely inaccessible to the relatively small number of enforcement officers who have limited patrol resources and basic levels of policing technology. In this regard, individual voluntary compliance with rules especially important in the Pantanal (L. Mateus et al., 2004). The organ responsible for setting the fishing rules for all types of fishing in each state is called the Fishing Council, (*Conselho da Pesca*, or CEPESCA), which involves a mixture of top-down and participatory co-management. In Mato Grosso, it is composed of biologists from the local state and federal universities, representatives from regulators at the State Secretary of the Environment (SEMA), and members of fishermen's colonies that represent fishermen's rights, along with legislators. CEPESCA defines laws and rules based on scientific research and the needs of fishermen and other community members, who are free to contribute to public debates and focus groups with legislators and others who draft the rules. The primary market fish in the region are three

siluriforms and four characiforms, including the pacu (*Piaractus mesopotaminus*) (L. Mateus et al., 2004). CEPESCA regulates fishing in the region by creating a minimum size limit for each species and a weight limit depending on what type of fishing license fishermen possess (Lei No. 9.096 de 16/1/2009, DOEMT de 16.1.2009).

Case study respondents

For this study, I focused on *in-loco* professional fishermen in the municipality of Poconé. In-loco professional fishermen in the region are a key stakeholder group with a vested interest in preserving the environment of the Pantanal for sustainable use. These professional fishermen live permanently on the banks of rivers and have for generations, and therefore have longstanding ties to the land and the sustainable harvest of resources in the region (Chiaravalloti, 2017). Previous work with local fishermen sought to representatively sample the fishermen's colony as a single stakeholder group (Tocantins et al., 2011). However, as many as two-thirds of all professional fishermen live in cities and use their professional license to collect welfare during the spawning season when fishing is closed. I distinguished these two groups because of the possibility of their having different incentives to conserve the fishery—*in-loco* stakeholders have diverse ties to local natural resources that extend beyond purely monetary motives.

The group of respondents for this study consisted of all the active professional fishermen belonging to Colony Z-11 living in one port community along the Cuiabá River in from April through August, 2016. The community is sparsely distributed and not well delimited, so I considered only the most densely populated region one hour upriver and downriver of the port for this study. I visited every domicile and interviewed everyone found living on that part of the river, and thus the respondents represent the complete subset of *in-loco* professional fishermen living in the community during the study period.

Instrument design

My first objective was to assess rates of noncompliance with pacu fishing rules among in-loco fishermen. Interview questions asked directly about people's perceptions of others' noncompliance rates in the community as well as their own noncompliance rates. Second, I focused on exploring the factors underlying noncompliance. I asked direct questions about why people think other people choose to violate rules. Then, I assessed attitudes about risk and trust as factors that impact noncompliance decisions. Attitudinal questions were taken from the English language literature, translated into Portuguese by the lead author and pretested with fishermen (N=7) for construct validity and ease of understanding before they were included in the survey instrument. Trust and trustworthiness questions were replicated from Hamm et al. (2013) and Sharp & Curtis (2014), as well as Mayer et al. (1995). Questions were selected to represent aspects of trust and trustworthiness that elsewhere in the literature have been called "procedural fairness" (Hamm et al., 2013; Tyler & Bies, 1990). Environmental risk questions were derived from Gore et al. (2006). I chose to anchor all questions and analysis on a single fishing rule, the 45cm minimum size for the pacu, in order to allow for more in-depth exploration of compliance-related attitudes in the survey instrument.

Instrument implementation

I used a voluntary questionnaire verbally administered face-to-face because most individuals within the target population were not literate and did not have reliable access to mail, internet, or land-line phones. The survey instrument began with a statement informing participants of the intent of the research, including ensuring participant confidentiality and researcher independence to mitigate effects of bias in responses (Gavin et al., 2010). Following the statement of informed consent, I asked first general questions focusing on environmental

attitudes following Gore et al. (2006). I followed these questions with projective questions about noncompliance rates and reasons (asking individuals to describe incidences of other people's noncompliance). Then, I asked a prospective question about noncompliance (inquiring about possible individuals' future rates of noncompliance). Both projective and prospective questions about noncompliance have been shown to reduce bias in responses about noncompliance (Fisher, 1999). The single question about prospective personal noncompliance was placed at the end of the interview to minimize the effects of the social desirability bias (following Catania, Binson, Canchola, Pollack, & Hauck, 1996). Demographics were assessed following the completion of the substantive parts of the survey. The total survey took approximately ten minutes to administer.

Measurement and data analysis

Respondents answered opinion and attitude questions on a five-point Likert scale (1 = "Disagree completely to 5 = "Completely Agree"). Noncompliance was assessed with a five-point frequency question (1 = "Never," 2 = "Rarely," 3 = "Sometimes," 4 = "Often," 5 = "All the time"), following the questions asked in Kuperan & Sutinen (1998). I used a simple linear regression to examine effects of continuous variables such as age on noncompliance rate. I used an ordered probit regression model to assess the effects of attitudes on reported frequency of noncompliance to avoid potential complications of treating either variable as continuous. Data were analyzed in SmallStata 14.2 (StataCorp, 2015).

IRB and nonresponse

Forty-one respondents agreed to be interviewed from April to August, 2016, and three people refused to participate. All subjects' identities were protected by a survey that coded them numerically and did not ask their names. Michigan State University's Human Subject Protection

Program deemed these methods exempt from review for the duration of the research (IRB x15-643e).

Results

Of the 41 *in-loco* professional fishermen interviewed, 17% were female and 83% male. Fewer than half had finished primary school. Most participants were unable to estimate their monthly income but all use fishing as their primary work during the open fishing season (March through September or October). During the closed season, they earn a monthly stipend from the government that is slightly above minimum wage. Most had two or more children and were over 48 years old with more than 38 years of fishing experience. Few had interacted previously with biologists who do research on the fisheries in the region, but most had interacted with enforcement officers.

Table 3-1. Demographics about participants, *in-loco* professional fishermen in one community on the Cuiabá River in the Northern Pantanal.

Participant Information	
Gender	34 Men, 7 Women
Level of Education	Mean 0.8537 (between no education and primary school); median 0 education
Age	Mean 48.088, sd 13.6963
Years Fishing	Mean 38.439, sd 17.4499
Number of Children	Mean 3.0488, sd 2.4438; median 2 kids
Previous interaction with Environmental Police	38 Yes, 3 No
Previous interaction with a scientist?	5 Yes, 36 No

1. Fisheries noncompliance rates

My first objective focused on assessing rates of noncompliance in the region. I asked all study participants (n = 41) two questions about rates of compliance to assess their views on the frequency of noncompliance in the community. Participants reported violations occurring frequently in the community. A majority (n = 25, 60.9%) agreed or agreed strongly that

violations were common. In commentaries, participants accused amateur fishers without fishing licenses of violating the law the most. Most reported that they, personally, were usually compliant with rules (34 or 85% indicated they broke the rule "sometimes," "rarely," or "never"). A small minority of participants indicated they broke the rules all the time (n = 4, 9.7%); three participants reported breaking the rules often (7.3%) and six said they never broke the rules (14.6%). The average rate of self-reported noncompliance among participants was 2.5, or between "rarely" and "sometimes." The sentiment in the community of professional fishermen is that there are others—amateurs, professionals, and tourists—violating the fishing rules often, but virtually nobody identified themselves as part of the problem.

2. Environmental risk, trust, and noncompliance risk

A range of motivations were presented as underlying noncompliance with fisheries rules, including lack of enforcement (n = 29, 70.7% agreed or agreed strongly that it was a factor) and lack of knowledge of rules (n = 3, 7.3% agreed or agreed strongly). When individuals were asked about their attitudes, most generally seemed aware of environmental problems and risks. Many seemed to negatively view aspects of the management structure and the procedural fairness in the region.

Table 3-2. Means, medians, and standard deviation of responses to Likert-scaled attitude questions.

Concept	Question	Mean response	Median	SD
Environmental risk	The fishery is in decline.	4.341	5	1.109
	The decline is caused by humans.	3.268	4	1.484
	Breaking a rule is a big deal.	3.732	4	1.225
	Each breaking of pacu size rule contributes to harm.	3.659	4	1.389
Legitimacy	The pacu size rule is correct.	2.878	2	1.503
Trust, trustworthiness and fairness	I trust biologists to help define rules.	2.707	3	1.470
	Management is successful in setting the right rules.	2.610	3	1.358
	Management respects us.	3.634	4	1.337
	Management listens to us.	2.220	2	1.295
	Management has same values as us.	3.098	3	1.158
	Management treats everyone equally.	2.415	2	1.322
	Management deceives us.	2.489	2	1.451
Enforcement risk	Enforcement will catch me if I break the rule.	3.146	4	1.459
	The fine is small, punishment not harsh.	3.537	4	1.362

3. Factors contributing to frequency of noncompliance

Frequency of noncompliance and demographics

Increase in age was a significant factor in lower frequency of noncompliance at $P < 0.10$ (coeff = -0.0227 $R^2 = 0.0736$). However, a more significant factor for lower rates of noncompliance was greater years fishing (coeff = -0.0208, $R^2 = 0.1008$, $P < 0.05$), which is correlated with age (0.6709). Education level is inversely correlated with age (-0.4640) and years fishing (-0.2784), and could impact compliance because the language of rules and rulemakers is more readily accessible to those with higher levels of education. However, level of education was the most important demographic factor predicting noncompliance in this survey in the opposite direction than one would anticipate—higher education level is related to greater rates of noncompliance (coeff = 0.4449, $R^2 = 0.1709$, $P < 0.01$). Other demographic factors, including number of children and gender, played no significant role in predicting reported rates of future noncompliance.

Environmental risk, enforcement risk, management trustworthiness, procedural fairness, and frequency of noncompliance

Of the questions assessing attitudes related to environmental risk, enforcement risk, management trustworthiness, and procedural fairness, only two measures significantly predicted frequency of noncompliance—trust in biologists to help define rules and the correctness of the rule. These two attitudes are correlated (0.515) and trust in biologists is more predictive in an ordered probit regression (pseudo-R^2 0.2410) of frequency of noncompliance than correctness (pseudo-R^2 0.0397). Nonparametric rank correlation tests returned similar results, with $P<0.001$.

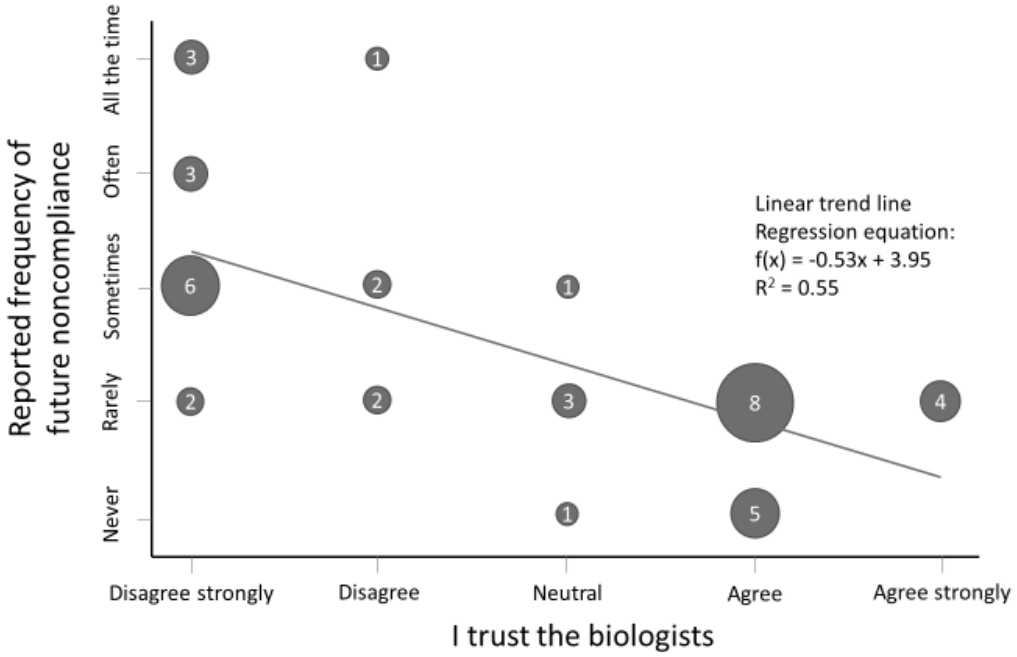

Figure 3-2. Weighted point model with trust attitudes and noncompliance rates. A linear regression line and equation are displayed on the chart to show trend, but were not used in analysis. Point size and labels indicate number of each response pair.

Taken individually, in this sample, frequency of noncompliance is significantly linearly related to age, years fishing, education level, and whether the size limit for pacu is correct. By far

the most significant factor determining the frequency of noncompliance of in-loco professional fishermen in this sample was their trust in biologists to help define the pacu size limit rule.

Discussion

This study set out to better understand noncompliance in a region where compliance has never been studied. I focused on attitudes that are rarely examined in a freshwater context, but which could be especially important to compliance due to low education levels, remoteness, and difficulty of enforcement. These conditions are common in conservation priority regions in the developing world. The objectives in this study were to focus on one rule in one community, first describing noncompliance rates, then describing attitudes relating to risk perception and trust, before exploring connections between the attitudes and rates of noncompliance. I found that in one community of Pantanal professional fishermen, noncompliance was overt and commonplace, a fact that I personally observed on many occasions. Furthermore, I found that this noncompliance exists in spite of people generally supporting environmental conservation and perceived legitimacy of laws. Finally, frequency of perceived rates of noncompliance is influenced by age, education level, years fishing, perceived legitimacy, and trust in biologists, but apparently not to attitudes relating to enforcement. Although aspects like enforcement, procedural justice, and environmental risk may be important elsewhere, the most important factor influencing noncompliance rate among the population of professional fishermen in this study group in the Pantanal was trust in the biologists setting the rules.

Noncompliance rates and factors

Rates of noncompliance

Our survey questions related to noncompliance were projective and prospective (asking about others' noncompliance and estimates of future noncompliance) to protect respondents from

potential legal consequences of reporting their own past or present rulebreaking. However, the idea that noncompliance with regulations is prevalent in the Pantanal is not particularly controversial, nor is the behavior covert. This observation was amply supported by anecdotal evidence from community members and personal experiences while living in the community during the data collection period.

Accounts that contradict the notion that noncompliance is prevalent and overt tend to focus on more severe forms of rulebreaking (e.g., using nets to catch hundreds of pounds more than the permitted weight) compared with the relatively small violations on which I focused here (Chiaravalloti, 2017). For example, the majority of undersized fish I observed were still adult fish, just not quite large enough to meet the size minima prescribed by law. This contrasts with violators who were intentionally fishing dourado, a banned fish, for weeks at a time (observed in 2017), and with others who use fishing nets (observed in 2016) and dynamite (anecdote in 2016 in a different region of the Pantanal). Respondents, in their comments, highlighted these differences between their own noncompliance and the noncompliance of those who were truly damaging the environment, and frequently attributed the behavior of others to inherent bad character. Their comments provide evidence for the fundamental attribution error (Jones & Harris, 1967; Ross, 1977), which could suggest that due to correspondence bias people attribute their own behavior to external factors whereas behavior of others reflects internal flaws. This error has been shown to be a factor in environmental decisions of hunters and may be relevant in fishermen as well (Kuentzel, 1994). Future research could explore this phenomenon and its functional relationship in diverse IUU contexts.

The noncompliance studied here may not cause extreme environmental harm. The idea that more severe forms of noncompliance may be viewed differently is one that is also in keeping

with the idea that professional fishermen have only a nominal negative impact on the environment. According to Mateus & Penha (2007), overfishing is one of a bevy of factors causing harm in the Pantanal, and possibly less important when compared with environmental damage produced by sewage and other pollution, climatic changes, and damming of upstream tributaries. Even if instances of noncompliance are commonplace in the community of professional fishermen, it does not necessarily mean that they are the instigators of widespread environmental damage to the Pantanal. However, local people's cooperation with rules is necessary for successful management off the resource as a whole.

Attitudes about management and the environment

General attitudes about environmental risks among respondents in this study suggest an interest in the environment and its conservation. The majority of environmental attitude questions I asked respondents to provide are derive from those in the literature, and responses from a community that depends on natural resources for its livelihoods and subsistence is not surprising. Some individuals, however, indicated skepticism about whether humans are the ones causing environmental harm. This attitude was not correlated with any others, but is notable—many who said the fishery is in a decline then suggested that it was primarily caused by the increasing population of piscivorous species such as the giant river otter (*Pteroneura brasiliensis*) and caiman (*Caiman yacare*). These species have been recovering from decimation in the mid-20th century due to the pelt trade, and are much more abundant than they were merely decades ago. Scientists summarily reject the contention that the fishery has been adversely affected by the recovery of predator populations.

Respondents' attitudes about management agencies portrayed the institution in a mixed light. Although very few claimed that the managers were actively deceiving them, almost none

seem to think that they had sufficient voice to influence rules. This is surprising, given that the management in the Pantanal is at least superficially a co-management system—one in which stakeholders contribute to rulemaking decisions. Furthermore, respondents augmented their responses about enforcement with anecdotes of how police sometimes invade their homes without a warrant. In a situation like that in the Pantanal, wherein one commission (CEPESCA) consists of enforcers, researchers, and legislators, individuals' views on the structure as a whole may depend on interactions with different parts.

I accessed the idea of trust by analyzing agency trustworthiness as well as asking about trust in biologists directly. Trust has been defined in the literature as a function of trustworthiness and risk (Mayer et al., 1995). Questions of procedural fairness and whether people have a voice in making rules are among those that are considered part of institutional trustworthiness in the literature. Trust, in Portuguese, is the same word as confidence (*confiança*), although some authors in the English literature have stressed the differences between these two constructs (Cao, 2015). One important question that I did not ask was who exactly is trusted to set what limits. Biologists do not directly set size limits for fish, which is something that people may or may not fully understand. Scientists make recommendations, which are then debated by lobbying groups and politicians before a rule is finally promulgated by the legislature. People in the Pantanal could be conflating scientists with politicians. Or, people could be projecting their bad interactions with enforcement agents on the scientists and the politicians who are crafting the rules. The questions asked about institutional trust do not differentiate well between the different roles the agency plays. Furthermore, the questions do not take into account well the interactions people may have had with enforcement officers and how those interactions might shape trust in other agency members. Trust in biologists was also not differentiated here from trust in science,

itself (Millstone & van Zwanenberg, 2000), which some studies have found to be in decline (Haerlin & Parr, 1999). Future research could differentiate between trust in science, trust in scientists, trust in police, trust in rulemakers, and trustworthiness of the agency as a rulemaker and a rule enforcer.

Effects of trust and risk assessment on noncompliance

The idea that people's trust in scientists affects their rates of noncompliance with a rule influenced by research fits with parallel conclusions in the literature. Trust in management more generally, both in the form of procedural justice (Sunshine & Tyler, 2003) and in institutional trust (Davenport et al., 2007; Hamm et al., 2013) has been shown in the literature to be related to compliance, although these studies focus on management as a whole, as opposed to researchers specifically. Trust in science and scientists also logically may be related to understanding of research, something that could in turn be related to education and age, depending on how educational opportunity has evolved through time. Several studies found age as a significant factor in determining compliance (Madrigal-Ballestero, Schlüter, & Claudia Lopez, 2013). Age in this study was correlated with education level and years fishing, which were more reliable predictors of noncompliance rates; both of these are also correlated with trust in biologists, which is the most significant factor that I found. Somewhat surprisingly, even though both legitimacy and trust in scientists had significant impacts on noncompliance rates, trust was a more reliable indicator. This may be because some people who choose not to comply do so not because they view the law as incorrect, but rather because they view their violations as having a minimal effect. Trust in biologists could be a more reliable predictor because it speaks not only to the correctness of the rule, but to the willingness to put trust in another actor to assess proper risks.

Management implications and scope

Collectively, the people living in the community I surveyed violate fishing rules, even though they seek to protect nature for future generations and believe strongly in environmental values. Trust in biologists is a predictive factor in these noncompliance decisions the small community of fishermen in the Brazilian Pantanal. Increasing trust in biologists may one key mechanism for decreasing rates of noncompliance. Each violation of a rule is an example of IUU fishing, and although each violation may individually be small, the collective effect of violations could be large. The exact amount of damage that violators of fishing rules cause is an empirical question not addressed in this study. However, there may be collateral effects of small transgressions of the rules, such as the promotion of a culture of violating rules and the lack of cooperation with enforcement and legislators to catch larger violators and write better rules. Reducing all types of IUU fishing is in the best interest of managers and the communities alike. In the community in which I worked, perhaps the best way to do this is to increase positive interactions with biologists to improve perceptions of procedural justice.

Davenport et al., (2007) showed that in spite of clear indications that trust in management is necessary for success, a number of barriers exist to building trust, including lack of community engagement, knowledge gaps, and competing values. The situation in the community in which I worked displays the hallmarks of these barriers. Very few individuals in the case study had interacted with biologists in the past, and this may explain lack of mutual understanding and mismatching values. Where a number of field biologists use research stations in communities, this could be simply resolved by more positive interactions between biologists and locals. Rudolph & Riley (2014) argued that gains in trust may be possible through changes in structure of procedural justice of the management system. My results provide support for the idea that

there is room for improvement on procedural justice aspects, as well. I view more interaction with researchers as a part of changes in procedural justice of the system as a whole. Encouraging people in communities to have a voice is critical for the success in a co-management system, and the fact that so many people in this case study group feel that management does not listen to their views points to a major systemic flaw. It is possible that more community engagement by biologists could help push more people to better understand their participatory rights in the management structure, thus improving perceptions of procedural justice in the community.

I must caution against asserting that trust in biologists is the primary factor in noncompliance decisions in every natural resource management system. These results are specific to one small community in the Pantanal. A confluence of factors in this case study group and in the Brazilian Pantanal may explain why trust in biologists may be more important than other factors in this region. For one, most of the people living in the Pantanal are poor, but not desperately so, because Brazil has a functional welfare system in place. Monetary gains from fishing illegal fish are not substantial portions of individual's income. This likely means that there is less pressure on people to break the law for profit, which is a much more common motivation for noncompliance in regions where poaching of ivory and abalone can bring local families amounts of money and ways of life that otherwise would be completely impossible.

The research purposefully did not explore two primary factors for non-compliance: personality factors and benefits from noncompliance. Personality factors include individual duty to comply with laws and how individuals experience guilt and shame of noncompliance, as well as predisposition to not comply with laws (low self-control; Nagin & Paternoster, 1993). The benefits of the cost-benefit calculation were ignored in this study largely because for the rule that I selected to study, benefits are small and relatively uniform no matter who is fishing. With

different rules, the benefits side of the equation may be much more important. It is also likely that people view different rules as having much different environmental risks associated with them. In spite of viewing other problems as much greater than those they are causing, professional fishermen in the region seem to value the environment greatly. Thus, even though people care deeply about the environment, they seem to view their own actions as not very harmful while actions of other people are extremely harmful. In other words, environmental risk likely did not play a part in compliance decisions not because people do not care about the environment, but rather because they think their actions are doing comparatively little damage to it. The questions in this survey offer us general information on how people view environmental risks and damage, but did not specifically address the comparative risk of violating a specific law a certain number of times. This more specific information might better elucidate the risk factors at play in individuals' noncompliance decisions. Future studies could focus on the factors that I did not in order to better understand risk calculations and to compare personality types and different rules; studies should also focus on how management interventions work to change attitudes related to trust and procedural justice, and how these changes might affect noncompliance and conservation.

Conclusion

Different kinds of laws, different kinds of fisheries, and different people require different approaches to compliance based on the factors that influence their behavior. Given the limitations of this study—small sample size, limited geographic reach, only one rule examined, and the demographic near-uniformity of the community—I hesitate to draw any sweeping conclusions and rush to judgments. However, this study in the Pantanal draws attention to the fact that in some cases, such as this one, trust in biologists can be an important factor in

compliance decisions. Among my sample of *in-loco* professional fishermen in the Northern Pantanal, trust in biologists was the primary significant attitude factor determining frequency of noncompliance with the size limit rule for the pacu. Future research could look more closely at parsing institutional trust in a way so that the effects of trust and procedural justice in the different roles (enforcement, research, and legislation) of the agency can be analyzed separately. A different set of studies may attempt to assess the severity of the overfishing problem in the Pantanal compared to other environmental problems.

The community of professional fishermen in the Pantanal, like communities around the world in conservation priority regions, historically has had little access to education, and there is a rift between the scientific elites doing research and creating laws and the local population. The prolific influence of trust in biologists on frequency of noncompliance in the Pantanal may underline the need to close this gap of understanding between scientists and locals. The onus often falls on individual researchers to close this gap, and that building trust may with local communities may be a rarely considered, but indispensable part of field work in the Pantanal and elsewhere.

CHAPTER 4

IMPLICATIONS AND FUTURE EMPIRICAL RESEARCH DIRECTIONS

The results detailed in Chapters 2 and 3 suggest that noncompliance in the Pantanal occurs because there is not enough enforcement and community members do not have a voice in natural resource management rulemaking. All those interviewed described a lack of enforcement as being a primary cause of noncompliance, even though findings did not show risk or severity of punishment to be important factors in people's decisions not to comply. At the same time, very few community members thought they had a voice in the rulemaking process, in spite of a management system that encourages involvement in that process through participation in fishermen's lobbying groups. Increasing the efficacy of enforcement and the level of participation in management in this region may be exceedingly difficult and costly due to the inaccessibility of many fishing communities. However, improving interpersonal communications between members of local communities and members of the management structure may be a different, less costly means of increasing compliance with fishing laws, thus better protecting the region's natural resources.

The results in Chapters 2 and 3 also support the assertion that a rift exists between locals and those in positions of authority, including rulemakers, enforcement officers, and scientists responsible for research behind rules. This rift is apparent in a distrust of scientists, a view that police and legislators are outsiders who do not have locals' best interest at heart, and that people have no apparent voice in the rulemaking process. These features of the divide between locals and management highlight problems with how the management system interacts with local people. For instance, nearly all survey respondents had interacted with police officers, but only while those officers were in the midst of enforcement operations. Very few, on the other hand,

had interacted with biologists, even though there are two research stations located in the study community. Communication is a well-known means of changing attitudes, including building trust. The current interaction between the locals and management structure does not actively promote communication, but the fact that biologists and police so frequently work in the community presents an opportunity to build trust and positive perceptions of the management structure, thus helping to close the rift, through improved interpersonal communication. However, important questions remain: (1) How relatively important are trust in biologists, trust in police, and trust in rulemakers for compliance decisions with different natural resource laws? (2) What types of communication can best improve trust with these different parts of the management structure? And (3) to what extent do these interpersonal trust-building exercises improve compliance compared to alternatives like improving community participation in governance or increasing enforcement efficacy?

The question of whether improving interpersonal communications between locals, police, and scientists can improve compliance is fundamentally empirical, and is complicated on several levels. First, there is a question of what trust is important for compliance, and whether trust in biologists and trust in police are independent from one-another, or independent from trust in management more generally. Next, there is the question of how to improve interpersonal communication between police and locals and biologists and locals. One aspect of this is a question of how people should speak to each other. Some evidence suggests that aggression and force are not as effective at communicating environmental risks to communities (Yuan, Besley, & Lou, 2018). This research from the science communication literature fits with more modern community policing strategies favoring building bonds between officers and community members over reactionary or random and aggressive enforcement of laws. In that vein, police

can go door-to-door meeting community members; alternately, they might organize an event for the community with food to meet people, which is likely less resource- and time-intensive. Scientists could also go door-to-door to meet or organize a community event. They could also reach out more to locals for their experience and use more local ecological knowledge in their pursuit of information on natural resource fluctuations. Exactly what people say is also of the essence—police and scientists might approach meetings with a script, but it could also be better to leave interactions unscripted and use *post-hoc* interview questions to assess the content of meetings with community members.

Individuals could be assessed both by semi-structured interviews and survey responses, which could be modeled after the questions used in Chapters 2 and 3 of this study. Importantly, these instruments must be expanded to ask about trust in police, biologists, and rulemakers separately; questions should also address trustworthiness of management authorities more generally. Survey questions should additionally be expanded to inquire about multiple different laws and rules, rather than just focusing on one. Interviews should include additional questions about the content of interactions between police and biologists and locals, and a discussion of whether those interactions were aggressive or friendly. Door-to-door and group meeting face-to-face communication interventions may impact trust in different authorities and rates of compliance differently, and must also be monitored for content to ensure that it is the type of interaction, and not specific language, that causes change in trust or compliance.

Because attitude and behavior change can vary in both magnitude and longevity, it is important to measure change both immediately after an intervention and after some time has passed. A quasi-experimental research design could be employed to gauge the change in attitudes without asking individuals the same interview questions twice. A control group could answer

survey and interview questions but would not undergo any intervention. Each other group would be assigned an intervention, either group meeting or door-to-door interaction, with either a member of the police or a scientist. Each of these groups would in turn be split into two—one being surveyed and interviewed very shortly after the intervention, and the other being surveyed and interviewed much later, to determine if any effects of an intervention could persist or if they were merely ephemeral.

Table 4-1. A brief representation of groups and surveys for a quasi-experiment to determine the efficacy of different changes in communication for improving compliance and closing the rift between locals and natural resource managers.

Group	Intervention	Survey 1 (1 week after)	Survey 2 (1 year after)
Control 1	None	X	
Control 2	None		X
Police 1	Group meeting	X	
Police 2	Group meeting		X
Police 3	Door-to-door meeting	X	
Police 4	Door-to-door meeting		X
Scientist 1	Group meeting	X	
Scientist 2	Group meeting		X
Scientist 3	Door-to-door meeting	X	
Scientist 4	Door-to-door meeting		X

The literature largely supports the notion that improving interpersonal communication can improve management outcomes and compliance. Door-to-door informal meetings have shown to be an effective way of changing beliefs (Broockman & Kalla, 2016). The informal science communication literature outlines changes to scientific understanding through interactions with scientists in the museum setting (Woods-Townsend et al., 2016). The policing literature also suggests that increased interpersonal interactions with communities can lead to positive results (Reisig, 2010). Regardless of whether individual transgressions of natural resource rules are meaningfully damaging to the environment, compliance is essential for a coherent management scheme to function. In the Pantanal and other areas of conservation priority, changes in interpersonal communication, rather than expensive and difficult to

implement increases in coercive forces, may be essential to increasing compliance and securing a natural resource management system that works to protect the natural area that are so important to so many living things.

APPENDICES

APPENDIX A

IRB EXEMPT DETERMINATION LETTER

MICHIGAN STATE UNIVERSITY

Initial IRB Application Determination *Exempt*

June 17, 2015

To: Meredith Gore
13 Natural Resources Bldg
Department of Fisheries and Wildlife
Michigan State University

Re: **IRB# x15-643e** Category: Exempt 2
Approval Date: June 17, 2015

Title: Compliance and non-compliance decision-making in the Brazilian Pantanal

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been deemed as exempt** in accordance with federal regulations.

The IRB has found that your research project meets the criteria for exempt status and the criteria for the protection of human subjects in exempt research. **Under our exempt policy the Principal Investigator assumes the responsibilities for the protection of human subjects** in this project as outlined in the assurance letter and exempt educational material. The IRB office has received your signed assurance for exempt research. A copy of this signed agreement is appended for your information and records.

Renewals: Exempt protocols do not need to be renewed. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: Exempt protocols do not require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a new initial application will be required.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants regarding the risk and benefits of the project must be reported to the IRB.

Follow-up: If your exempt project is not completed and closed after three years, the IRB office will contact you regarding the status of the project and to verify that no changes have occurred that may affect exempt status.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Harry McGee, MPH
SIRB Chair

c: ETHAN SHIRLEY

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

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APPENDIX B

SEMI-STRUCTURED INTERVIEWS INSTRUMENT—PORTUGUESE

INSTRUMENTO DE ENTREVISTA SEMI-ESTRUTURADA

Este instrumento serve-se como guia. Entrevistas semi-estruturadas são as que usam uma guia geral e deixa a conversa entre o entrevistador e a pessoa entrevistada a acontecer de uma forma mais natural, enquanto seguindo a guia geral.

Declaração de consentimento livre e esclarecido

Esta entrevista está sendo conduzida para um projeto de pesquisas cuja meta é entender melhor o pôr que que as pessoas escolhem cumprir ou não cumprir às leis, regulações, e regras sobre o meio ambiente que o governo cria. Minha afiliação é com a Michigan State University nos Estados Unidos. Este projeto de pesquisa não é ligado com nenhum ente do governo e suas respostas serão completamente anónimas e privadas. Você tem que ter pelo menos dezoito anos de idade para participar nesta entrevista. Favor de discutir comigo as respostas das perguntas que eu faço. Eu gravarei a nossa conversa para uma análise depois. Se você se sentir incomodado ou se você tiver dúvidas ou perguntas, favor de falar, e eu terminarei a entrevista. Eu lhe hei dado um numero em lugar do seu nome para assegurar seu anonimato. Por favor, não fale nada que pode identificar você nas suas respostas às perguntas da entrevista. Sua participação neste estudo é completamente voluntária e você pode pedir a qualquer hora para terminar a entrevista.

Se você tiver dúvidas ou preocupações sobre este estudo, como questões científicas, ou como participar, ou para reportar um problema, favor de contatar o pesquisador:

Ethan Shirley
Natural Resources Building
480 Wilson Rd. Room 33
East Lansing, MI 48824
UNITED STATES OF AMERICA

shirleye@msu.edu
(65) 9613-3032

Perguntas e assuntos a ser discutidos:

(1) Descreva os limites que o governo cria em relação à pesca, os quais incluem carteiras, limites de tamanho e de quantidade de captura.

(2) Descreva as multas que pescadores que não cumprem os limites enfrentam, e discuta se são justas, fortes demais, ou fracas demais.

(3) Quão importante são o meio ambiente, a natureza e a conservação para você?

(4) Como e por quem são definidos os limites da pesca?

(5) Por que existem os limites?

(6) Como que você e sua comunidade veêm a violação de regulações ambientais?

(7) Você pessoalmente conhece os pesquisadores e os políticos responsaveis para a definição de limites?

(8) Por que que alguem na sua comunidade decidiria não observar a lei de pesca?

APPENDIX C

SURVEY INSTRUMENT—PORTUGUESE

MANUSCRITO

Olá, você pode me ajudar por responder umas perguntas sobre o peixe—cinco minutinhos, preciso saber sua opinião. Pode ser?

As perguntas são anónimas e o estudo está tentando descobrir por que pessoas aqui não cumprem as regras da pesca. Não será divulgado em nenhum momento seu nome ou o local em específico.

Meu nome é Ethan Shirley, moro em Poconé faz 13 anos, sou estudante na universidade de Michigan State. Meu projeto atual é para levar as opiniões dos pescadores daqui para um grupo de advogados na UFMT que está tentando escrever umas leis do Pantanal, e acho importante incluir as opiniões das pessoas que realmente têm que viver com as consequências destas leis.

Não sou afiliado com a SEMA, nem com nenhuma agência de polícia, e suas respostas não são compartilhadas com esse pessoal. Não peço seu nome, nem seu endereço, e as suas respostas, portanto, ninguém vai saber o que você falou. Não estou gravando as suas respostas—estou apenas anotando qual opção você escolhe. Eu passarei o resultado da minha pesquisa no final do ano para o seu Moacir na colônia de pescadores aqui em Poconé.

CONSENTIMENTO LIVRE E ESCLARECIDO

Você concorda participar? Obrigado por seu tempo!

TIPO DE PESCADOR

A. Você é pescador profissional, amador, ou mais é consumidor mesmo de peixe para comer?

ENTENDIMENTO DAS REGRAS

B. Qual tamanho é a medida mínima legal de pacú para pescar, vender, ou comprar?
C. Quantos quilos de peixe você pode pescar legalmente à cada vez?

Agora vou ler algumas declarações, às quais eu gostaria que você me respondesse "concordo completamente," "concordo um pouco," "não sei" "discordo um pouco," ou "discordo completamente."

(EXEMPLO) Pacú é o peixe mais saboroso do Pantanal.

[discordo completamente] [discordo] [não sei] [concordo] [concordo completamente]

HÁ UM PROBLEMA?

(1) Pescar no Pantanal é mais dificil agora hoje em dia do que era no passado porque os peixes estão acabando.
(2) Os seres humanos são a causa da diminuição de peixe aqui.

D. Quem é que mais acaba com o peixe aqui?
E. Quando é que uma pessoa começa realmente contribuir ao problema?

O PROBLEMA É GRANDE?

(3) As violações das regras da pesca são comuns, acontecem todos os dias.
(4) Não é grande coisa se alguém não cumpre uma regra da pesca.

F. Agora, por que as pessoas não cumprem o limite de peso? Qual é o motivo para não cumprir a regra? Quem é o problema?

POR QUE AS PESSOAS NÃO CUMPREM?

(5) Muitas pessoas não cumprem as regras da pesca porque elas não sabem quais são as regras—eles não cumprem por que não sabem.
(6) Muitas pessoas não cumprem as regras da pesca porque não há fiscalização adequada—eles não cumprem porque não tem policiais para fiscalizar.
(7) Muitas pessoas não cumprem as regras da pesca porque aqui existe uma cultura de não-respeitar a lei—muitos não cumprem porque não respeitam a lei.
(8) Muitas pessoas não cumprem as regras da pesca porque elas acham que as suas ações não danificam o meio ambiente—acham que pode não cumprir porque pescar acima do limite de peso ou pegar uns peixes abaixo da medida não danifica o meio ambiente.
(9) Muitas pessoas não cumprem as regras da pesca promulgadas pela SEMA porque os biólogos da SEMA não determinam os limites de medida certos—acham que a medida deve ser menor ou o limite de peso deve ser mais, e por isso não cumprem.

G. Qual é o motivo mais importante?

O QUE VOCÊ ACHA DAS REGRAS?

(10) As medidas que os biólogos da SEMA têm determinado são as medidas certas para proteger os peixes daqui.

CONFIANÇA NA SEMA

(11) Eu confio nos biólogos para para botar as medidas certas aqui.

H. Se as regras não são as certas, e depois disser que confia completamente nos biólogos, pergunta por quê.

CONFIABILIDADE DA SEMA

(1) A SEMA tem sucesso na definição dos limites certos.
(2) Eu acho que a SEMA escuta as minhas opiniões.
(3) A SEMA trata o povo aqui com respeito.
(4) Meus valores e minha visão para a preservação do Pantanal são iguais aos da SEMA.
(5) A SEMA explica as regras e decisões.
(6) Eu acho que eu tenho uma voz e posso influenciar a definição das regras.
(7) A SEMA tem bons motivos e boas pesquisas quando cria ou muda as regras da pesca.
(8) A SEMA trata todo o mundo igual.
(9) O povo da SEMA tenta me decepcionar.

PROPENSÃO A CONFIAR

(10) É bom sempre tomar cuidado com pessoas desconhecidas.
(11) Hoje em dia, você tem que ficar experto ou se não os outros vão levar vantagem.
(12) Geralmente, a maioria das pessoas são confiaveis.

RISCO PERCEBIDO

A. Quais são os benefícios de violar as regras? Os custos e riscos?
(13) Eu acho que o peixe realmente está em risco de acabar um dia.
(14) Se eu não cumpro uma regra de SEMA, eu estou contribuindo ao acabamento dos peixes nos rios aqui, e eu arrisco acabar com os peixes para as proximas gerações.
(15) Quando eu não cumpro uma lei, o dano é minísculo.
(16) Se eu não cumpro uma regra da SEMA, sempre há fiscalização e a polícia vai me pegar.
(17) Se eu for multado por uma violação, a multa é alta.
(18) Sempre tem danos ao meio ambiente e um jeito de justificar esses danos.
(19) Não deveríamos arriscar danificar o meio ambiente.
(20) Eu nem quero saber dos danos pois não posso fazer nada para melhorar a situação e reduzir os danos.
(21) Às vezes danificar o meio ambiente é necessário para criar novas oportunidades de desenvolvimento.
B. Então existe um risco de ser prendido, mas você acha que ainda vale a pena de vez em quando não cumprir as regras por que a chance de ser prendido é tão pequena ou a multa é pequena comparada com o que ganharia de peixe acima do limite. Vale a pena arriscar as vezes? Tem vez que o benefício e maior do que o custo?

INTENÇÃO PARA CUMPRIR ÀS REGRAS

(22) Quantas vezes você acha que você vai acabar pegando peixe fora da medida este ano?
[nunca] [bem de vez em quando] [algumas vezes] [bastante vezes] [normalmente]

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