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Assessing the potential for effective collaborative resource management of Costa Rica's Central Pacific scarlet macaw population

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Assessing the Potential for Effective Collaborative Resource Management of Costa Rica's Central Pacific Scarlet Macaw Population

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MASTER'S THESIS

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Kathryn Mork
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A Thesis
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The Faculty of
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Abstract

Establishing protected areas is one of the primary methods of protecting wildlife and preserving biodiversity and habitat worldwide. However, in recent years it has been recognized that not all protected areas are successful, for reasons ranging from a lack of resources to properly manage them, to the fact that areas are often too small to sustain animal populations, with many animals ranging beyond the borders of the protected areas. These issues have been addressed in a number of ways, including encouraging community involvement in management efforts and the development of conservation corridors and buffer zones to increase habitat availability. Collaborations between community members, university researchers, government agencies charged with managing protected areas and other interested parties including local non-profits, are an intriguing option for trying to meet the needs of the largest number of people while protecting endangered resources.

This project is a case study of collaborative resource management, specifically the management of a population of Scarlet Macaws (*Ara macao*) and their habitat, in and around Carara National Park in the Central Pacific Conservation Area of Costa Rica. Because so much of the habitat for Scarlet Macaws is located outside of Carara National Park's boundaries, park staff has been working to develop partnerships with local communities and a local non-profit to improve management efforts. This thesis looks at the intersection of biogeography and human geography using a two pronged approach to assess the potential for collaborative resource management of the Central Pacific Scarlet Macaw population. I use common-pool resource theory as a framework to explore the current status of the Central Pacific Scarlet Macaw population and the local community members that live in the area. I also use value-belief-norm theory as a framework to assess the beliefs of the pilot study

project participants and the potential for support of, and active involvement in, future collaborative resource management efforts. Data gathered through background research, participant observation and responses to a questionnaire showed the Central Pacific Scarlet Macaw resource system, which includes the local community members along with the Scarlet Macaws and their habitat, shares many of the attributes associated with the emergence of cooperation. The pilot project participants expressed interest in future participation and acknowledged the importance of community involvement in conservation and management efforts of the Scarlet Macaw resource system and the environment in general. The success of such collaborative resource management strategies is contingent upon their impact on the residents of communities where outreach occurs and this research shows that outreach efforts have had an impact.

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Abbreviations and Acronyms

ACOPAC	Central Pacific Conservation Area (Área de Conservación Pacifico Central)
CITES	Convention of International Trade in Endangered Species of Wild Fauna and Flora
DGF	General Forestry Directorate (Dirección General Forestal)
IUCN	International Union for Conservation of Nature
LAPPA	The Association for Parrot Protection (Asociación para la conservación de Psitácidos Pácifico Central)
MAG	Ministry of Agriculture and Livestock (Ministerio de Agricultura y Ganaderia)
MINAE	Ministry of Environment and Energy (Ministerio del Ambiente y Energia)
MIRENEM	Ministry of Natural Resources, Energy and Mines (Ministerio de Recursos Naturales, Energía y Minas)
SINAC	National System of Conservation Areas (Sistema Nacional de Áreas de Conservación)
SLOSS	Single Large or Several Small
SPN	National Parks Service (Servicio de Parques Nacionales)
URC	Regional Conservation Units (Unidades Regionales de Conservación)

Chapter 1. Introduction

In a 2008 statement to the Conference of Parties to the Biodiversity Convention, U.N. Secretary-General Ban Ki-moon emphasized that "Nature's assets underpin the very lives and livelihoods of more than six billion people. They make our very existence possible in the vacuum of space. A failure to act will … ultimately impact all countries across the world" (United Nations Environmental Programme 2008). Establishing protected areas is one of the primary methods of protecting wildlife and preserving biodiversity and habitat worldwide. However, in recent years it has been recognized that not all protected areas are successful, for reasons ranging from the lack of resources to properly manage them, to the fact that areas are often too small to sustain animal populations, and many animals range beyond the borders of protected areas. These issues have been addressed in a number of ways, ranging from the development of conservation corridors and buffer zones to encouragement of increased community involvement in management and conservation efforts. This thesis assesses the potential for increased community involvement in resource management and biodiversity conservation efforts, specifically of a population of Scarlet Macaws (*Ara macao*) on the Central Pacific coast of Costa Rica.

I use aspects of common-pool resource theory and value-belief-norm theory as a framework to assess the Central Pacific Scarlet Macaw resource system, the impacts of an environmental monitoring project on participants, and the potential for their future involvement in collaborative conservation and management efforts as I explored the following question. Is collaborative resource management an option for effective management of Costa Rica's Central Pacific Scarlet Macaw population? The literature

review informed a number of associated questions. Does participation in data collection make participants more aware of the importance of conserving habitat? Did participants learn anything about conservation issues surrounding Scarlet Macaw or other species, or about Scarlet Macaw habitat during their participation? Do participants exhibit any of the resource user attributes associated with common-pool resource theory? Does the Central Pacific Scarlet Macaw population and associated habitat exhibit any of the resource attributes associated with common-pool resource theory? Do participants feel that they are currently involved in conservation and management efforts, or that they should be more involved? Do viable and valid indicators of Scarlet Macaw status exist? The results indicate that participants in the case study, or resource users, exhibit many of the attributes that are positively associated with successful common-pool resource governance. Furthermore, the participants expressed many of the beliefs that lead to the support of a movement, such as the conservation of the Scarlet Macaw. The participants are interested in becoming more involved and they believe that community participation is an important aspect of resource conservation and management. The Scarlet Macaw population and its habitat, the common-pool resource in this case, also exhibits most of the attributes that are associated with the emergence of cooperation. I conclude with some thoughts on the implications of these results regarding the potential for collaborative resource management in Costa Rica's Central Pacific Conservation Area and for conservation of biodiversity in general.

Tropical Forests and Biodiversity

The loss of biological diversity is one of the most serious environmental threats facing human beings. It is unlike other environmental threats because it is irreversible on any time scale relevant for human society (Dirzo and Raven 2003, Mittermeier, et al. 1998). Once

a species becomes extinct it is essentially impossible to bring it back, which can have an impact on other species in the ecosystem. Threats to biodiversity include deforestation and logging, fires, fragmentation, depletion of fauna, invasion by exotic species, and climate change (Fearnside 1999). Conserving biodiversity is recognized as a priority by scientists and non-scientists alike for a number of reasons related to the ecosystem services that humans depend on. Biodiversity is the foundation of ecosystems that, through the services they provide, affect human well-being. These services range from the provision of food, water and fuel, the regulation of climate, floods and disease, and the cultural contributions related to recreation and spirituality (Millennium Ecosystem Assessment 2005). In the 2002 Convention on Biological Diversity, world leaders agreed to reduce the rate of biodiversity loss by 2010. However, according to a 2010 article in the journal *Science*, researchers determined that "the 2010 target has not been achieved, and that world leaders have instead overseen an alarming decline in biodiversity since 1970" (Butchart, et al. 2010, United Nations Environmental Programme 2010).

Many of the highest concentrations of biodiversity are found in tropical regions (Dirzo and Raven 2003). Tropical forests, "with their very high concentrations of species, rapidly increasing human populations, rising expectations for living standards, and the globalization of the economy, are under particular threat" (Dirzo and Raven 2003). Traditionally, tropical forests have been a source of food and other resources for local peoples (Carrillo, Wong and Cuaron 2000). As humans have become increasingly sedentary, more people have become dependent on the same set of resources, which has changed the way people obtain resources and depleted them in many areas (Carrillo, Wong and Cuaron 2000). The land-cover and land-use changes associated with the degradation and destruction

of tropical forests represent the primary reason for the loss of biological diversity worldwide (Sánchez-Azofeifa, Rivard, et al. 2002, Sánchez-Azofeifa, Daily, et al. 2003).

Conventional and Alternative Conservation and Management Methods

Two of the most widely used biodiversity conservation methods are designating areas of exceptional natural and cultural value as protected areas, and implementing regulations to protect resources from unsustainable use. One influential supporter of these conventional methods is Garrett Hardin, an ecologist, who wrote a significant article in 1968 entitled "The Tragedy of the Commons" (Hardin 1968). The article, which will be discussed in more detail in the literature review in Chapter Three, supports the "fences-and-fines" approach to conservation and resource management (Neumann 1997). This conventional approach often excludes local human communities from protected areas, prohibiting the communities' use of natural resources, while viewing their concerns as incompatible with conservation goals (Borrini-Feyerabend, Kothari and Oviedo 2004). Though these command and control methods can sometimes be effective, this tradition of exclusionary and top-down resource management has contributed to a disconnect between the goals of a protected area designation and the actions of local communities. It has led indirectly to unsustainable resource use, such as poaching of wildlife, by local communities in some areas (Liu 2001).

Although establishing protected areas is one of the primary methods of protecting wildlife and preserving habitat worldwide, it has been recognized that not all protected areas are successful. Reasons range from the lack of resources to properly manage the areas, to the fact that protected areas are often too small to sustain animal populations, and many animals roam beyond the borders of such areas. Established protected areas are often successful at preserving habitat within the designated borders; however, it is common to see degraded

habitat in the areas surrounding the protected areas, leaving the protected areas isolated as islands of healthy habitat stranded in an ocean of land stripped of forest cover for agricultural activities (Naughton-Treves, Holland and Brandon 2005). Research suggests that parks need to be larger than 10,000 hectares (ha) to potentially slow long term species loss (Naughton-Treves, Holland and Brandon 2005). And in many cases, especially in developing countries, government entities do not have the resources to manage protected areas properly and are not able to enforce the regulations that accompany the protected area designation (Houseal, Ostria and Touval 1998, James, Gaston and Balmford 2001, Wilkie, Carpenter and Zhang 2001), increasing the chances of resource degradation.

In recent years, a number of alternative conservation and natural resource management techniques have been developed. These include market-oriented conservation incentives (Sánchez-Azofeifa, Daily, et al. 2003), such as Costa Rica's Private Wildlife Refuge program which provides tax and technical assistance incentives to property owners in exchange for adhering to government-approved management plans restricting land and resource use (Langholz, Lassoie and Schelhas 2000); community-based natural resource management efforts that recognize the importance of including communities in the planning and management of protected areas and conservation (Abrell, et al. 2009, Brewer 2002, Wells and Brandon 1992); and the development of conservation corridors and buffer zones to increase habitat availability (Sánchez-Azofeifa, Daily, et al. 2003). Many of these alternative methods are currently being used in conjunction with the establishment of protected areas. Community-based, or collaborative, natural resource management and conservation efforts are the focus of this research, in a case study of Costa Rica's Central Pacific Scarlet Macaw population.

Protected Areas and Biogeography

Throughout the mid 20th century, a discussion on how best to conserve biodiversity developed as scientists noticed increasing losses of species and habitat. The crux of the argument concerned the development of protected areas: Is it better to conserve many small areas of habitat, or fewer large areas of habitat? What are the impacts of the surrounding "oceans" of developed land on these "islands" of protected habitat? Is it really possible to protect species that are dependent on this habitat? These questions indicate a need to look more closely at the areas surrounding islands of protected habitat. The field of biogeography is the subfield of geography that deals with these issues. Biogeography is "the study of the past and present geographic distributions of plants and animals and other organisms" (MacDonald 2003, 1). Biogeography is important to biodiversity conservation and management because it is a discipline that looks at where species occur, why they are there, and how humans impact species distributions.

Early naturalists Charles Darwin and Alfred Wallace conducted extensive fieldwork around the world during the 19th century and began noticing geographic patterns in species distribution (Quammen 1996). In 1967, Robert MacArthur and E.O. Wilson took biogeographic studies in a mathematical direction and wrote the influential *Theory of Island Biogeography*. This seminal book in the field of biogeography provided a "theoretical construct linking species-area relationships on islands to dispersal and extinction processes" (MacDonald 2003). By the 1970s and 80s, scientists and conservationists, such as geographer Jared Diamond, realized that the *Theory of Island Biogeography* was also applicable in protected area development and management.

In a 1972 article, Diamond pointed out that: "The governments of some tropical countries…are attempting to set aside some rainforest tracts now for conservation purposes. If these plans succeed, the rainforests, instead of disappearing completely, will be broken into 'islands' surrounded by a 'sea' of open country in which forest species cannot live" (Diamond 1972, 443). During the 1970s, several researchers, with Diamond among the most well known, established a theoretical framework for fragmentation research derived from MacArthur and Wilson's work (Whittaker, et al. 2005), and developed recommendations for how to design reserves and/or protected areas. Among other ideas, they theorized that one large protected area is better than several small, and that a round protected area is better than an elongated protected area (Diamond 1975). Other researchers disagreed with these design principles, especially that a single large reserve is better than several small. The Single Large or Several Small (known as SLOSS) debate continued throughout the 1970s and 1980s and has not yet been resolved (Tjorve 2010). An important outcome of this process was the recognition that protected areas were not going to be able to protect all biodiversity and other approaches needed to be used in combination with protected area designations.

The size of a park is an important component in determining a park's role in the protection of biodiversity. Though small parks can have significant local importance, as mentioned previously, research suggests that only parks greater than 10,000 ha have the potential to slow long-term species loss (Naughton-Treves, Holland and Brandon 2005, Terborgh and van Schaik 1997). Additionally, many areas of high endemism[1] and/or species richness[2] have no legal protection and land in such areas is increasingly being transformed to

[1] Endemism - a species that has arisen evolutionarily in the same place where it's presently found and is found nowhere else (Quammen 1996)

[2] Species richness – the number of different species in a given area (MacDonald 2003)

other uses, especially agriculture (Naughton-Treves, Holland and Brandon 2005, Rodrigues, et al. 2004). Carara National Park, which is at the core of the case study associated with this research, only includes 5,500 ha of land, however the adjoining wildlife refuges and protected zone add another 5,000 ha of protected land (CCSA Costa Rica 2005), and there is potential for increased extensions of habitat with the cooperation of private land owners.

The islands of protected land are not necessarily isolated islands and many species regularly venture out of protected areas and onto surrounding lands. The protected areas are often not large enough to provide all that the species need and flora and fauna do not respect the regulatory, non-physical boundaries of protected area designations. Community members must become involved in management efforts to allow different species to cohabitate in areas outside of the boundaries of protected area. This thesis specifically looks at the potential for increased collaborative resource management of a Scarlet Macaw population, both in the areas that encircle the islands of protected areas and the protected areas themselves, in the Central Pacific region of Costa Rica.

Beginning in the mid-20th century, members of the Costa Rican government supported conservationists in their efforts to develop a system of protected areas in the country (Evans 1999), which eventually led to 25% percent of the country's land being placed under protected status (Sánchez-Azofeifa, Rivard, et al. 2002). Many of these protected areas are surrounded by agricultural development, leaving only islands of protected land, some of which are still being logged illegally (Miller 2010). In a study looking at deforestation around protected areas in Costa Rica, Sánchez-Azofeifa et al found that in the 10-km buffer zone surrounding Carara National Park, only 10% of the landscape can be classified as forest cover (2003).

This study isn't so much about the design of protected areas and the SLOSS debate, but about how to improve conservation efforts with what currently exists – designated protected areas and the people in adjoining communities. However the SLOSS debate and protected area design are important, because they can have an impact on the current status of species and habitat. Endangered flora and fauna live outside the boundaries of protected areas, and therefore their conservation requires that local community members be aware of how they impact different species. The intersection of biogeography and human geography and the recognition of the importance of community involvement leads us to study what causes people to cooperate in groups when they potentially stand to gain more from acting as rational individuals rather than from collective action.

Social Dilemmas and Common-Pool Resources

Social dilemmas are problems that pit an individual's narrow interests against the broader interests of the collective (Van Vugt and De Cremer 1999). Social dilemmas impact the distribution of common-pool resources, such as irrigation water, and the provision of public goods, such as a public radio station, because the choices made by individuals have an impact on the collective. Common-pool resources differ from public goods in that the consumption of a common-pool resource is rivalrous, whereas consumption of a public good is non-rivalrous (Apesteguia and Maier-Rigaud 2006). In other words, the use of a common-pool resource by one individual results in less of that resource being available for another individual. On the other hand, the use of a public good by one individual does not mean that there is less available for another individual. Individuals are each better off when using resources (public good or common-pool), such as watching public television or withdrawing irrigation water, without making any contributions or considering the impact on other users

(Kollock 1998). However if everyone acted in this way, the resource would not be provided or properly maintained and everybody would suffer (Kollock 1998). In the case of a common-pool resource, if one user takes most of the irrigation water, they profit with properly hydrated crops, but other farmers in need of the water suffer. Thus, choices made by individuals have an impact on the collective. This research considers the management and conservation of the Costa Rica's Central Pacific Scarlet Macaw and its habitat as a common-pool resource dilemma. Habitat is an important aspect of the resource system that surrounds a species, as destroying habitat such as a nesting tree impacts the resource and will be included in the analysis of the Scarlet Macaw resource system. Wildlife is a common-pool resource, and will be considered as such in this thesis, because it is difficult to control access and because the harvest or poaching of an individual leaves fewer available for use by other resource users (Altrichter 2008). However, if the use of wildlife was not extractive, such as a species being "used" for tourism, a species could be considered a pure public-good.

Around the same time that Hardin was focusing on "command and control" solutions to the common-pool resource dilemmas illustrated by the "tragedy of the commons," political scientist and economist Elinor Ostrom started to move in a different direction with her research. Her graduate work during the late 1960's focused on water management in California and she started exploring collective action as a management option. During the 1980s, her research centered on community-based common-pool resource management (Schlager 2004), which can be seen as an alternative to Hardin's "fences-and-fines" methods, and will be used as part of the underlying framework to assess the potential for community-based collaborative resource management in this case study. Ostrom and her research team developed a set of common attributes of sustainable common-pool resource management

after extensively reviewing examples of successful resource governance. These common attributes will be examined carefully and used to assess the Central Pacific Scarlet Macaw resource system as a common-pool resource in Chapter 5.

Thesis Goals

In recent years, there has been much discussion about how to include local communities in resource management and conservation along with the benefits associated with such inclusion (Salafsky and Wollenberg 2000). This project is an exploratory case study of the potential for collaborative resource management of Costa Rica's Central Pacific Scarlet Macaw resource system. Because so much of the habitat for Scarlet Macaws, a well-known avian inhabitant of Carara National Park, is located outside of the park's boundaries, park staff members have been working to develop partnerships to improve management efforts. Over the last few years, partnerships between park staff at Carara National Park and university researchers have resulted in several projects focused on Scarlet Macaw conservation. In the same time period, a local community-based non-profit was formed to manage Scarlet Macaw conservation efforts, but has had variable success due to limited resources. This research explores combining aspects of common-pool resource theory and value-belief-norm theory as a framework for assessing the potential for effective collaborative resource management in the area and is the result of a pilot project conducted in partnership with staff at Carara National Park.

In collaboration with the staff of Costa Rica's Carara National Park and the Association for Parrot Protection (Asociación para la conservación de Psitácidos Pácifico Central, LAPPA), a local non-profit organization, I helped implement a collaborative

mapping and monitoring project of Scarlet Macaw nests in an effort to engage local community members in resource management and conservation efforts. The primary goals of this pilot project were to explore the current knowledge, beliefs and behaviors of the participants related to conservation and natural resource management; examine the impact of the mapping and monitoring project on the participants' knowledge, beliefs and behaviors; and assess the potential for collaborative resource management.

Informing Resource Conservation Geography and Management

This case study will help Carara National Park managers assess the potential and benefits of increased community involvement in management efforts. On a broader scale, this case study will contribute to the body of work that supports increased community involvement and collaborative efforts between managers, citizens and university researchers. Additionally, it explores a framework, which draws from common-pool resource theory and value-belief-norm theory, for assessing the potential for collaborative resource management of a resource system. This research joins numerous Costa Rican case studies that examine community-based or collaborative resource management (Basurto 2008, Campbell 2002, Snider, et al. 2003, Vaughan, Nemeth and Cary, et al. 2005), however few examine the interface of biogeography and human geography as related to common-pool resource management. Influential Costa Rican conservationist Mario Boza and several colleagues noted that "Costa Rica is a laboratory, not ecotopia" (Boza, Jukofsky and Wille 1995), and this research continues this tradition by examining this interface in Costa Rica as an applied research project. Additionally, this project could prove to be a model for future collaborative and participatory resource management efforts between community members, park staff, non-profits and university researchers.

Chapter 2. Case Study Background

In this section I address aspects of Costa Rica's history that provide context to the current problem of biodiversity loss as well as the current status of the Central Pacific Scarlet Macaw population. Costa Rica has a long history of scientific research and is well-known as a top ecotourism destination because of high levels of biodiversity and an extensive system of protected areas (Wallace and Smith 1997). The Central Pacific Scarlet Macaw population was chosen as a case study for this research because of Huxley College of the Environment's collaboration with Carara National Park (located in the Central Pacific Conservation Area (ACOPAC)) and because the Scarlet Macaw serves as an indicator of the larger biodiversity issues and common-pool resource dilemmas that we face as a society.

Costa Rica: Conservation History

Costa Rica is located on the Central American isthmus between two continents, North and South America, and two large oceans, the Pacific and Atlantic Oceans (see Figure 1). Costa Rica has a land area of only 19,600 square miles, about the size of West Virginia, and contains three mountain ranges (the Central, Guanacaste, and Talamanca) as well as five distinct major natural areas (Central Valley, Northern Wet Caribbean, Dry Pacific, Southern Wet Pacific, and Southern Wet Caribbean) (Evans 1999). Elevation plays a large part in the environmental changes between the different natural areas, and elevation in Costa Rica ranges from sea level to 6,000 meters (Evans 1999). Costa Rica's unique geographic location and varying physical geography encourage high levels of biodiversity. Though Costa Rica was eventually discovered to be an excellent location for coffee and banana plantations, Costa Rica is most known for its high levels of biodiversity. The country is home to at least

87,000 species, representing approximately 6.2% of the known species in the world (Convention on Biological Biodiversity 2009). This abundance of biodiversity includes 9,000 species of vascular plants (4% of the world's total), along with hundreds of species each of amphibians, birds, reptiles and mammals, and tens of thousands of insect species (Evans 1999). However, in the last century, hunting, poaching, extensive deforestation and the conversion of primary forest lands to agricultural uses have endangered many species in Costa Rica.

Figure 1: Geographic location of Costa Rica

When Christopher Columbus first arrived in what is now Costa Rica in 1502, he believed that the area contained gold and other precious metals (Wilson 1998). However, within a few years it became apparent that Costa Rica was not rich with precious metals and did not have any other obvious worthwhile exportable products. The lack of gold or other precious metals in Costa Rica meant that fewer colonists were interested in the area because there was no guaranteed method of getting rich quick. Instead, beginning in the mid-16th century, small groups of colonizers moved to Costa Rica to farm the land (Wilson 1998). Though Costa Rica's low population and isolation from the more developed areas of Central America initially limited the environmental impacts, the arrival of coffee and banana plantations in the 19th century led to government policies that allowed extensive deforestation (Evans 1999). By the 1980s, Costa Rica was losing 4% of its forested land annually, more than any other country in the Western Hemisphere (Evans 1999). The forested area decreased from a 90% share in 1950 to only 25% forested share by 1990 (Evans 1999), due mostly to conversion to agricultural uses – such as banana plantations and cattle ranches – allowed by the intense agricultural development policy of the 1950s, 60s and 70s (Camacho, et al. 2001).

Reforestation has exceeded deforestation since 1986, leading to a net gain in forest cover over the last decades (De Camino, et al. 2000). By 1997, forest cover had increased to an estimated 40% forested share (United Nations Forest and Agriculture Organization 2002). These changes are attributed to a variety of factors, including slowing population growth, increased education and environmental awareness, international funding for conservation efforts, and changes in the Costa Rican government's approach to forest policy (Snider, et al. 2003). "The Costa Rican government's approach … evolved from laissez-faire to direct intervention during the 1970s and 1980s. This interventionist state of forest policy involved

the creation of the national parks (where timber harvesting and land conversion are strictly prohibited); regulations controlling timber harvesting on private lands; a prohibition on exporting logs; and subsidies for reforestation, forest management, and forest preservation" (Snider, et al. 2003, 20).

In Costa Rica, the negative impacts of forest destruction were recognized as far back as 1775 when a Spanish governor issued a proclamation to limit controlled burning because too much land was being cleared and it was causing soil sterility (Evans 1999). Early conservation policies in Costa Rica included declaring Poás volcano "protected" in 1913 (though there were no provisions for enforcement or monitoring) and passing two water laws in 1923 with the goal of protecting watersheds and stopping agricultural waste from being deposited in rivers (Evans 1999). However, it was not until in the second half of the 20th century that conservation came to the forefront of forest policy and the Costa Rican government began to develop an extensive system of protected areas and policies to protect natural resources (Evans 1999). The Wildlife Conservation Law of 1956, which stated that the conservation of wildlife was of "fundamental interest" to the public, and the Forestry Law of 1969, which many conservationists consider the turning point in the conservation history of Costa Rica, were early steps on the way to the extensive protected area system that now exists in the country (Evans 1999).

Costa Rica's National Parks

Since the 1970s, Costa Rica's government has made an impressive effort to conserve biodiversity and manage its diverse ecosystems through the creation of an extensive system of protected areas and the enactment of several important conservation laws (Sánchez-

Azofeifa, Daily, et al. 2003). Costa Rica's 1969 Forestry Law established that "national parks" would be created "for the conservation of flora and fauna" and also "to offer opportunities for recreation, tourism, and scientific research" (Evans 1999, 72). The country's first national park, Poás Volcano, was established in 1971. Since then, Costa Rica has developed an extensive widespread network of protected areas that include national parks and reserves, largely through the efforts of Costa Rican conservationists working at times with international non-governmental organizations and other international experts.

The responsibility for managing Costa Rica's national park and other protected area systems has moved around within the Costa Rican government since the Forestry Law of 1969 established a National Parks Department within the General Forestry Directorate (Dirección General Forestal, DGF) within the Ministry of Agriculture and Livestock (Ministerio de Agricultura y Ganaderia, MAG) (Evans 1999). In 1977, the National Parks Act separated the National Parks Department from the DGF and made the National Parks Service (Servicio de Parques Nacionales, SPN) its own division within MAG (Evans 1999). In 1986, SPN was transferred to the newly established Ministry of Natural Resources (Ministerio de Recursos Naturales, Energía y Minas, MIRENEM), and a system of conservation units (Unidades Regionales de Conservación, URCs) was developed based on the geographic locations of parks and reserves, with the goal of including input from local community members and local park personnel in the management strategy for each park and decentralizing the park administration (Evans 1999). In 1994 MIRENEM was changed to the Ministry of Environment and Energy (Ministerio del Ambiente y Energia, MINAE) and SPN was replaced with the National System of Conservation Areas (Sistema Nacional de Áreas de Conservación, SINAC) (Evans 1999). MINAE is responsible for:

> issuing national environmental policies, regulations, and administrative procedures for all aspects related to the following areas:…forests, protected areas, wildlife and biodiversity, biological corridors, marine resources management and conservation within protected areas, watersheds, wetlands… (International Network for Environmental Compliance and Enforcement/United Nations Environment Programme 2006)

When SINAC was formed, the URCs were replaced with a set of 11 Conservation Areas, including the Central Pacific Conservation Area (Área de Conservación Pacifico Central, ACOPAC) (the location of this case study), that were based on geographic characteristics. SINAC has the responsibility for managing national forests, parks, monuments and biological reserves, and each of the Conservation Areas is managed by a director to oversee conservation in that area.

Costa Rica's park system continues to face conservation challenges, though protected area designations, such as national parks, have contributed to the preservation of the nation's internationally acclaimed biodiversity. Two of the major conservation challenges faced by the Costa Rican government, and other governments worldwide, are: assessing and monitoring the country's biodiversity using limited financial resources; and preventing further loss of biodiversity and important habitat. Biodiversity conservation, according to Abel et al (2011), "… begins inside of our protected areas, governments, and non-governmental organizations but will be finished, for the good or the bad outside of them" (xii). Costa Rica's government is working to address these challenges using several methods, including a partnership with the National Biodiversity Institute to inventory the biodiversity contained within the country's borders, support for environmental education and public awareness projects (Instituto Nacional de Biodiversidad 2009), and the development of biological corridors and buffer areas. However, financial and personnel resources are limited.

This thesis proposes community-based and/or collaborative natural resource management as part of the solution to these challenges and assesses the potential for collaborative resource management in a case study of the Central Pacific Scarlet Macaw resource system.

Scientific Research and Education in Costa Rica

Since the 19th century, interest in Costa Rica as a site for natural science research has come from around the world. In his book, *The Green Republic: A Conservation History of Costa Rica*, Sterling Evans attributes the initial interest after years of disinterest in the country to two factors: international demand for coffee and an interest in building a canal across the Central American isthmus (1999). Early natural science researchers included professional anthropologists, geographers, biologists, physicians and engineers, many of whom traversed the country exploring Costa Rica's landforms and collected specimens of the many exotic species of plants and animals, bringing attention to the extent of biodiversity in Costa Rica (Gomez and Savage 1983).

Costa Rica has also long valued public education for its citizens. In 1860, the Costa Rican government created a secondary school and started recruiting foreign scientists to staff it, followed by a second secondary school in 1875 (Eakin 1999). This effort to bring higher education to Costa Rica was an important step in the development of modern science in the country and for conservation efforts in the following century.

Information derived from scientific studies, such as the number and variety of species in a certain region, provides evidence of the importance of conservation to policymakers making decisions on what areas to focus on and how to best manage biodiversity. In Costa Rica, conservation efforts built an extensive national park system and encouraged the

development of a lucrative ecotourism industry (Eagles, McCool and Haynes 2002, Evans 1999). In fact, 25.6% of Costa Rica's land area is set aside in national parks and reserves (Convention on Biological Biodiversity 2009) and in 2010, about 14% of the country's gross domestic product (GDP) was projected to have come from travel and tourism products and services (World Travel & Tourism Council 2010).

Biological field stations that host researchers and students from Costa Rica, as well as from different parts of the world, are located throughout the country (Gomez and Savage 1983). These field stations and visiting scientists were not unanimously seen as purely positive for Costa Ricans. Evans notes that in the past, foreign researchers (specifically from the Organization for Tropical Research, a consortium of six U.S. universities with field stations in Costa Rica) have been accused of "scientific imperialism" because they came to Costa Rica to show locals what to do and how to conduct research in a tropical area, rather than including local knowledge and expertise in the research (Evans 1999). However, as evidenced by the increasing number of articles on community involvement in resource management in Costa Rica (Basurto 2008, Campbell 2002, Snider, et al. 2003, Vaughan, Nemeth and Cary, et al. 2005), the scientific imperialism that was common during the 20th century in Costa Rica is being replaced by more collaborative approaches.

Central Pacific Scarlet Macaw Population

The Scarlet Macaw is a member of the parrot family and is found in fragmented areas of habitat throughout most of Central America (Marineros and Vaughan 1996). The species is not currently included on the International Union for Conservation of Nature's (ICUN)

Red List of Threatened Species (International Union for Conservation of Nature and Natural Resources 2011), a world-recognized indicator of the level of threat of extinction a species is facing. However, the Scarlet Macaw is listed in Appendix 1 of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES). Appendix 1 includes species that are the most endangered among CITES-listed animals and plants, and CITES prohibits international trade in these species (except when the purpose of import is not commercial) (The CITES Appendices 2010). Between 1990 and 1994, Central Pacific Scarlet Macaw population counts indicated that the population was declining at an alarming rate; however the population stabilized following increased management efforts between 1995 and 1997 (Arroyo, et al. 2004).

Figure 2: A Central Pacific Scarlet Macaw in a nest cavity (photo by Brandon Ivey)

The Scarlet Macaw is one of the fauna most associated with Costa Rica. The Central Pacific region is one of two primary range areas in Costa Rica, with 430 Scarlet Macaws estimated to inhabit the 560 km² of the Central Pacific Conservation Area (ACOPAC, one of the 11 conservation areas in Costa Rica) (Guittar, Dear and Vaughan 2009, Marineros and Vaughan 1996, Vaughan, Nemeth and Cary, et al. 2005). The largest portion of forested habitat in ACOPAC and therefore a vital resource for the macaws survival is the 5,500 ha Carara National Park (Vaughan, Nemeth and Cary, et al. 2005). Scarlet Macaws nest and

feed mostly in the primary and secondary forests of Carara National Park, but also at a nearby privately owned reserve (Punta Leona Reserve), as well as on forest fragments on privately owned agricultural land and at Guacalillo Mangrove Reserve on the coast (see Figure 3) (Myers and Vaughan 2004). Three flyways, or routes, (see Figure 3) of Scarlet Macaws from their primary roosting grounds in Guacalillo Mangrove Reserve to their nesting and feeding grounds have been identified through extensive observation of their daily routines (Vaughan, Nemeth and Cary, et al. 2005). Macaws from the Central Pacific population generally fly as singles, pairs, triplets (parents with one offspring), or quadruplets (parents with two offspring) (Vaughan, Nemeth and Cary, et al. 2005). Scarlet Macaws migrate daily in-part to find food. Studies on the Central Pacific Scarlet Macaw populations in the early 1990s observed macaws feeding on fruits, flowers, barks, leaves and shoots of 28 plant species (Marineros and Vaughan 1996). Conserving species of trees that macaws use for feeding and nesting is an important aspect of conserving Scarlet Macaw habitat.

Threats to Scarlet Macaws in the region include loss of habitat due to land change for agricultural and tourism uses, as well as poaching of Scarlet Macaw chicks for the black market pet trade (Arroyo, et al. 2004, Guittar, Dear and Vaughan 2009). The effect of these threats is worsened by the Scarlet Macaws' naturally low rates of reproductive success and loss of nest cavities due to "a high rate of Neotropical tree turnover" (Guittar, Dear and Vaughan 2009, 387). A study of a 52 acre Peruvian floodplain forest found that only 10-20% of Scarlet Macaw pairs bred and 33% of nests failed (Munn 1992). Calculations of recruitment rates, or the number of new individuals added each year to the population, of the Central Pacific Scarlet Macaw population between 1990 and 1992 varied from 6.2% to 10.2% recruitment each year (Marineros and Vaughan 1996).

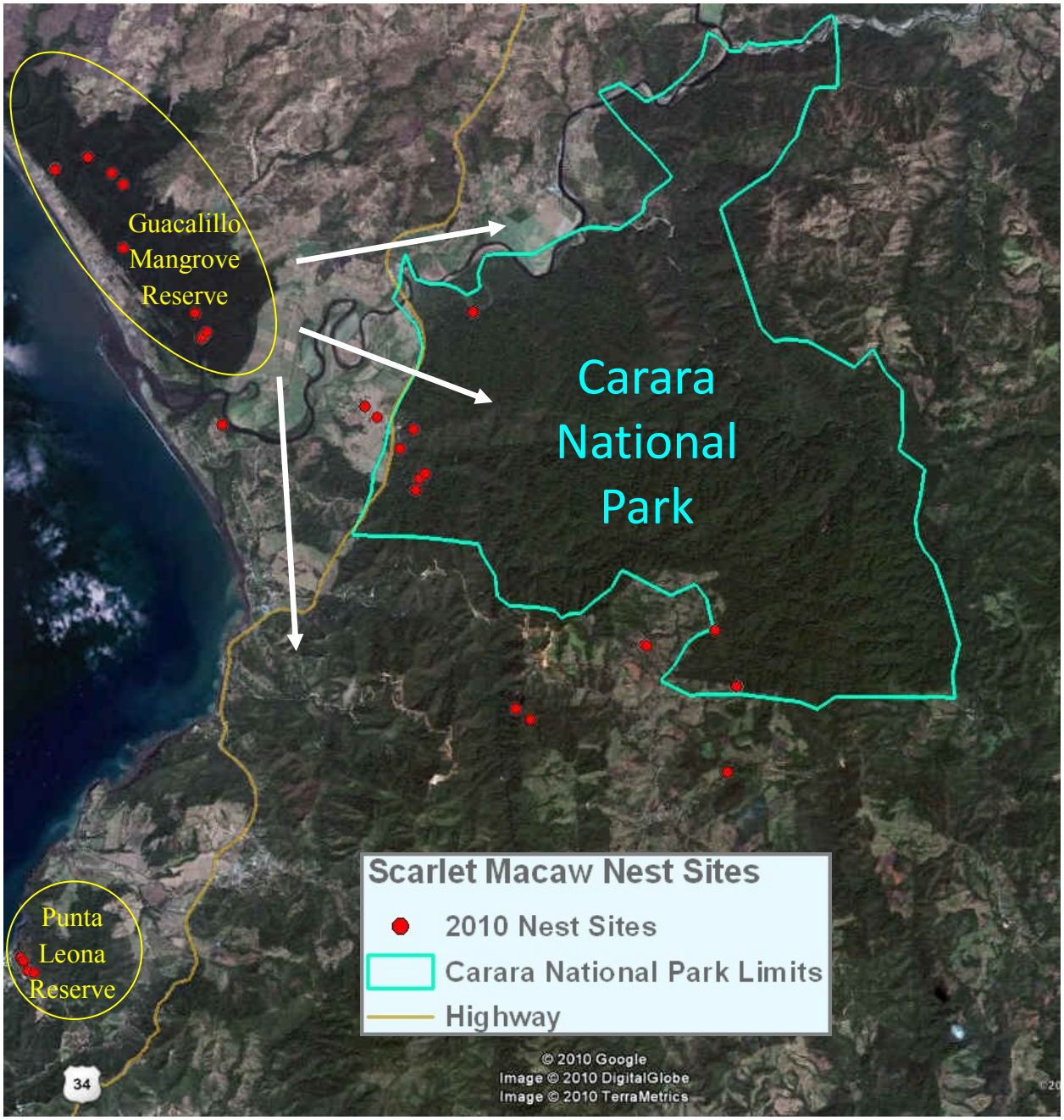


Figure 3: Pilot project study area on Costa Rica's Central Pacific coast. The red dots represent the locations of the Scarlet Macaw nests that were mapped and monitored by project participants. The white arrows represent the Scarlet Macaw flyways (adapted from (Vaughan, Nemeth and Cary, et al. 2005))

As mentioned, the habitat for many species is limited to terrestrial islands of protected areas surrounded by degraded habitat. Some species, such as birds, are able to access satellites of additional habitat by flying over inhospitable habitat or using protected corridors. In the case of the Central Pacific Scarlet Macaw population, the majority of individuals migrate on a daily basis between Carara National Park and two smaller reserves, though nest cavities can also be found on private land. The SLOSS debate (Single Large or Several Small) centered on whether a single large or several small protected areas were better able to protect habitat and species, and though this debate has faded with no definitive conclusion, the Central Pacific Scarlet Macaw population is an example of how a single large *and* several small protected areas can contribute to the resurgence of a species. As species capable of flying and one that requires different habitat types, the Scarlet Macaw is also able to increase the size of its habitat by flying to satellites of protected habitat that contain other important resources such as food and resting sites. In this example, Carara National Park is the single large protected area (though at only 5,500 ha, it would not usually be considered a large protected area), and the smaller Guacalillo Mangrove Reserve and Punta Leona Reserve can be considered the several small (that contain varied habitat types).

The fragments of habitat that were designated as protected combined with an increase in management efforts during the mid-1990s, including the establishment of the local non-profit LAPPA, helped the Central Pacific Scarlet Macaw population rebound and maintain a consistent population. However, the vision for the Central Pacific population is to increase it from the current approximately 430 individuals to 1,000 individuals by 2020 (Arroyo, et al. 2004). In order to achieve this goal, more effort needs to be exerted to protect Scarlet Macaws and their habitat. Involving community members in resource management and

conservation efforts such as by encouraging the protection of nesting trees on private agricultural land, contributes to an increased habitat area by allowing species to use land inhabited by humans.

Central Pacific Scarlet Macaw Management

As mentioned previously, Costa Rica's Ministry of Environment and Energy (MINAE) has the legal responsibility for protecting wildlife in Costa Rica. Within MINAE, the National System of Conservation Areas (SINAC) is responsible for protecting biodiversity within the parks, and often outside of parks as well. Park staff members at Carara National Park (which is under the authority of SINAC) are intricately involved in the management of the Central Pacific Scarlet Macaw population and use a variety of tactics to protect both the macaws and their habitat. These tactics include: environmental education programs in local schools, monitoring nests, tracking and apprehending poachers, and partnerships with a local non-profit and other researchers. However, with only 4-10 park rangers (varies depending on available funding), and given that the macaws range daily outside of the park, or off the island so to speak, to the coast and the private lands surrounding the park, it is impossible for the rangers to adequately protect and monitor the macaws and it is essential to have the support and involvement of local community members.

In addition to park rangers, LAPPA (The Association for Parrot Protection), a local non-profit, participates in Scarlet Macaw management and conservation efforts. LAPPA was formed in 1995 following a meeting between stakeholders, including local community members, government officials, scientists and ecotourism professionals, to discuss the future of the Central Pacific Scarlet Macaw population (The Association for Parrot Protection 2006, Arroyo, et al. 2004). Meeting participants identified poaching of macaw chicks for the pet

trade as the primary threat to the Scarlet Macaw population, and noted "habitat loss and ignorance of the bird's status" as secondary factors (The Association for Parrot Protection 2006). The participants were unanimously supportive of forming a local non-profit with three goals: "a. increase the Central Pacific Scarlet Macaw population, b. improve the economic status of the local human communities so they support natural resource conservation; and c. make the Central Pacific region an attractive tourist destination" (The Association for Parrot Protection 2006). LAPPA's goal for the Central Pacific Scarlet Macaw population is to increase the population to 1,000 individuals by 2020, which would be considered a biologically stable population (Arroyo, et al. 2004).

The formation and goals of LAPPA are an indication of support for community involvement in conservation and resource management efforts. Currently, the organization is led by a Carara National Park ranger and a local nature guide. Unfortunately, LAPPA personnel note that limited resources and personnel have reduced conservation efforts by LAPPA (The Association for Parrot Protection 2006), increasing the need for an assessment of the potential for increased community involvement in collaborative management and conservation efforts of the resources in and around Carara National Park.

The management efforts of the Central Pacific Scarlet Macaw population have been supported by an abundance of research conducted on the Central Pacific Scarlet Macaw population during the last 10 years. The research has included foreign and domestic researchers (mostly from universities) (Arce, et al. 2010, Guittar, Dear and Vaughan 2009, Myers and Vaughan 2004, Vaughan, Nemeth and Marineros 2003, Vaughan, Nemeth and Cary, et al. 2005), and has provided important information on topics such as the movement and behavior of Scarlet Macaws during the post-fledging dependence period (Myers and

Vaughan 2004); the response of the Central Pacific Scarlet Macaw population to conservation practices in Costa Rica (Vaughan, Nemeth and Cary, et al. 2005); and information about predators of Scarlet Macaw nest cavities from photo nest monitoring (Arce, et al. 2010). The results of such research are useful for management planning, and there is occasional collaboration between university researchers and Carara National Park staff, however there is little evidence of community members having the opportunity to collaborate on the research side of conservation efforts.

The Scarlet Macaw is one species of many in Costa Rica, but serves as an indicator of the larger conservation and management issues facing not only Costa Rica, but the entire world, and is therefore a good fit for this research. Moreover, the existence of LAPPA provides a precedent for community participation in conservation and management efforts as well as collaboration between park staff and university researchers in Costa Rica, and in the Central Pacific Conservation Area specifically, allowing me to complete the project with limited funding and time. The focus of the assessment is on the beliefs of the resource users, and the attributes of the resource and resource users that are common with the emergence of cooperation, and does not fully address the institutional structures that impact the Scarlet Macaw resource system. A full assessment of the institutional structures was beyond the scope of this research due to limited resources.

Chapter 3. Literature Review

The increased rate of biodiversity loss over the last 300 years – several hundred times the rate expected based on the geological record – emphasizes the need to protect habitat, particularly habitats that are rich in species and contain endemic species (Dirzo and Raven 2003). Conventional methods of conserving biodiversity, such as "fortress conservation" or "fences-and-fines" methods (Brockington 2004, Stoll-Kleemann and O'Riordan 2002), have been increasingly reappraised in recent years in an effort to improve conservation efforts (Wells and Brandon 1993). This chapter is a literature review of biodiversity conservation efforts via conventional methods, such as protected area designation, and via alternative methods such as protective buffer zones and the establishment of biological conservation corridors, along with community involvement in management efforts. Within the discussion of different approaches to biodiversity conservation, this section will look at common-pool resource theory and discuss how it can be used as a framework to assess the potential for collaborative resource management. The section will wrap up with a look at value-belief-norm theory and how it can be used as a complimentary framework to (Van Vugt and De Cremer 1999) common-pool resource theory to assess the potential for the support of a movement, such as conservation and involvement in collaborative resource management projects.

Tragedy of the Commons

Social dilemmas are problems that pit an individual's narrow interests against the broader interests of the collective (Van Vugt and De Cremer 1999). Social dilemmas impact the distribution of common-pool resources, such as fisheries, and the provision of public

goods, such as a police force, because the choices made by individuals have an impact on the collective. In the literature, three metaphorical stories, the Prisoner's Dilemma, the problem of providing public goods, and the Tragedy of the Commons, have been the center of research into social dilemmas (Kollock 1998). This research centers around the management of a common-pool resource facing a similar scenario as outlined in the Tragedy of the Commons. In this case, the Scarlet Macaw and its associated habitat is the common-pool resource.

"The Tragedy of the Commons" is one of the most frequently cited works in the social sciences (Van Vugt 2009). It was written by Garrett Hardin and published in *Science* in 1968. According to Hardin's article, a "tragedy of the commons" occurs when a shared resource, or common-pool resource, is exploited and overused by members of the community associated with that resource (Hardin 1968). Hardin suggested that in a society that believes in the freedom of the commons, each individual will act as a rational being and pursue his own best interest (Hardin 1968), usually at the detriment of the collective. He used the illustration of cattle herdsmen managing a communal pasture. A rational herder would place as many cattle as possible in the commons to gain the most profit for himself because the negative impact on the pasture of each additional cow will be shared by all the herdsmen while the benefit of the additional cow will be enjoyed by the individual alone. The rational herder negatively impacts the rest of the herdsmen to gain the most benefit for himself. (Hardin 1968)

Resources such as fisheries and irrigation water are seen as common–pool resources which can be used by anyone, yet are owned by no person or entity. Hardin's description of a communal pasture as a commons has been critiqued and corrected as an open-access

resource, rather than a common-pool resource, but it remains a well cited explanation of overconsumption of common-pool resources (Lant, Ruhl and Kraft 2008). Open-access resources are resources where no one has defined rights to use them and therefore restrictions cannot be placed on their use (Feeny, et al. 1990, Weddell 2002). A common-pool resource, like a public good, is non-excludable, but unlike a public good it is a rival good: the use of the resource by one person means there is less of it available for others (Apesteguia and Maier-Rigaud 2006). When the users of the same resources compete and create an unsustainable situation, as Hardin demonstrates with cows overgrazing in the commons, the tragedy of the commons emerges. Hardin highlighted several methods for avoiding a tragedy of the commons in his article. One of the methods is mutual coercion. Society as a whole makes decisions that members may dislike as individuals, such as taxation, in order to avoid losing out to the less conscientious in society. Most people would prefer that each person face the same taxes or punishment than to be the only ones to pay taxes just because they have higher moral standards than others. According to Hardin, "We institute and support taxes and other coercive devices to escape the horror of the commons" (Hardin 1968, 1248). Another option that Hardin suggests for avoiding the tragedy of the commons is to enclose or privatize an entity so that it is no longer a commons. The threat of a tragedy of the commons disappears because the land no longer constitutes a commons. This type of "fortress conservation" in protected area management uses a top-down approach to keep wildlife in the protected area and humans out, actively protecting parks using "police and other armed forces that respond only to orders from their commanders" (Terborgh 2004, 168). Supporters of this approach believe that all people, whether indigenous or not, pose a threat to the species (Terborgh and van Schaik 1997).

Hardin's model, along with similar models that held that devices such as coercion were necessary for cooperation because individuals are rationally self-interested and will not voluntarily cooperate, influenced policy decisions during the second half of the 20th-century, including those related to natural resource management (Schlager 2004). Developing countries such as Honduras, Nepal and Tanzania reacted, often with the assistance of international aid organizations, by nationalizing resources that had been held by local communities (Schlager 2004). However, state-centered policy programs have not proven particularly successful at protecting important natural resources (Dietz, Ostrom and Stern 2003) such as fish stocks and forests over the past two decades, and questions were raised by policy scholars during the 1980s about the general application of models based on the tragedy of the commons (Schlager 2004). Besides pointing out the incorrect usage of the term "common-pool resource," critics of Hardin's work claim the tragedy of the commons scenario is oversimplified in two main ways (Dietz, Ostrom and Stern 2003). First, Hardin claimed that only centralized government and private property arrangements could manage common-pool resources for the long-term, and second, he believed that resource users were "trapped in a commons dilemma, unable to create solutions" (Dietz, Ostrom and Stern 2003). Of course Hardin's suggestions for avoiding a tragedy of the commons are not the only possible solutions.

Though the control type methods addressed by Hardin are commonly used to avoid the tragedy of the commons, alternative methods exist. Hardin acknowledges that "Education can counteract the natural tendency to do the wrong thing," however he doesn't think that education is a viable solution because "the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed" (Hardin 1968, 1245). Additionally,

Hardin assumes that people always act in their own best interest without taking into account the interests of the whole, and therefore must be controlled by regulations. However, close community bonds and education have the power to overcome the "every man for himself" mentality and often result in a more collaborative management approach of common resources. The literature provides extensive examples of communities, whether based on location or a common interest, willing to work together to manage common resources to benefit the whole rather than any one individual (Kay 2006, Klooster 2000, Macnab 2002).

Community involvement, often in the form of community-based resource management, is one potential alternative to Hardin's "fences-and-fines" method of protecting biodiversity. The argument for community-based resource management maintains that community involvement "in and sometimes control over conservation undertakings, is critical to their success" (Campbell 2002, 31) and a community-based resource management project is "only valid and sustainable when they have the dual objective of protecting and improving local livelihoods and ecological conditions" (Naughton-Treves, Holland and Brandon 2005, 92).

Communities and Protected Areas

During the 20th century as more people began to worry about the loss of open space and of natural and cultural resources, an increased effort was made by countries around the world to protect areas that contained high levels of biodiversity and important natural and cultural resources (Eagles, McCool and Haynes 2002). Protected areas represent "the heart of the world's political and economic commitment to conserve biodiversity and other natural and related cultural resources" (Borrini-Feyerabend, Kothari and Oviedo 2004, 1). However,

experience has shown that it takes more than designating an area as "protected" to truly protect it (Liu 2001). Researchers came to realize that the support, involvement and knowledge of local communities are valuable in resource management efforts, including the protection of endangered species and biodiversity (Keen and Mahanty 2006, Sims and Sinclair 2008). The literature on protected area management and local, community and/or indigenous involvement in resource management is extensive. This review is limited in scope to the benefits of community involvement in management efforts for the conservation of biodiversity and habitat near protected areas, and does not delve deeply into the important literature on the potential of empowerment for participants, nor the potential negative impacts of community resource management projects.

Conventional protected area management approaches during the last 100 years have viewed people and nature as separate entities (Borrini-Feyerabend, Kothari and Oviedo 2004, Campbell 2002, McNeely 2007). More recently, world experts – conservation organizations especially – are increasingly recognizing the rights and roles of local people in using and managing natural resources (Agrawal and Gibson 1999, Campbell 1998). A growing body of research has shown that solutions to environmental problems, such as the loss of biodiversity, should involve the public (McKenzie-Mohr 2000, Stem, et al. 2003) and that hands-on participation in scientific research, especially for young people, increases a participant's interest and understanding of the subject matter (Paris, Yambor and Wai-Ling Packard 1998).

The ecosystem services provided by the natural environment, such as biodiversity contained within a protected area, are not limited to the communities immediately surrounding a protected area. Therefore the responsibility for managing and conserving biodiversity needs to be shared by more than just local community members, it must also

include spatially distant, but close in terms of impact, community members who in some cases have more of a direct effect on these natural resource than other stakeholders. Most community based conservation literature uses the term "community" in one of three ways: "as a spatial unit, as a social structure, and as a set of shared norms" (Agrawal and Gibson 1999). The "community" associated with this case study includes aspects of all three of these options.

Community-based Natural Resource Management

A range of community partnership models exist under the term "community-based resource management." These range from participatory action research, where non-scientist citizens set the agenda and use science to move the agenda, often with the help of professional scientists (Cooper, et al. 2007), to collaborative research and monitoring projects where community members are involved in monitoring efforts, but do not necessarily organize them (Danielsen, Burgess and Balmford 2005, Kremen, Merenlender and Murphy 1994). In this research the term "collaborative resource management" can be defined as resource management and conservation efforts (including research projects, monitoring efforts, and management planning) that involve more than a single entity. In other words: resource management that involves collaboration between different stakeholders, such as community members and park staff, or a non-profit and university researches, or all of the above. The pilot project for this study is an example of the collaborative research and monitoring project model, but the framework that was used to assess the project could be used for other community-based resource management models. This section will look at the broader idea of community-based natural resource management.

Proponents of community-based resource management see it as an opportunity to empower locals, improve planning and decision making, include local knowledge, make political decisions more acceptable, and reduce conflicts (Diduck 1999, Parkins and Mitchell 2005, Sims and Sinclair 2008, Sinclair and Diduck 1995). Many community-based resource management programs are based on the idea that community members have more to gain or lose from the resources and that they have better knowledge about the resources and can manage them more efficiently (Altrichter 2008). Moreover, conserving biodiversity is not just important within park boundaries.

Animals do not recognize human-made boundaries, they range where they need to, making it important for communities that are located in wildlife habitat to be involved in protecting and managing biodiversity. In the Central Pacific Conservation Area in Costa Rica, Scarlet Macaw habitat areas include several protected areas, along with unprotected agricultural land, rivers, recreation properties (privately owned tourist destinations) and areas along the Pacific Ocean beaches. Community members living near the protected areas, as well as those who work on the hotel properties, own the agricultural land or visit the area and could potentially impact local wildlife. In the case of the Scarlet Macaw, it nests in places that meet its needs: a large tree with a nesting cavity and proximity to food sources, whether this is on a private farm, in a national park or at a vacation resort. Local community members can have an important positive or negative impact on a species through their actions such as chopping down a tree on their land that contains a nest, or protecting the tree. Community members must be involved in management and conservation efforts because they share habitat with the macaws.

One critique of community-based resource management and conservation efforts recognizes the potential of community based management programs, but sees a failure in the implementation of such programs, especially with community members actually leading the efforts (Berkes 2004). In their research looking at the role of tropical protected areas worldwide, Naughton-Treves et al (2005) point out that involvement of local communities has become increasingly common; however this shift to community-based resource management has forced the participating community members to take the majority of the economic burden and responsibility for management. They also note that while community-based management validates the importance and capabilities of local community involvement, local community members are not the only stakeholders when it comes to environmental management (Naughton-Treves, Holland and Brandon 2005). These critiques offer valid points that should be considered when researching community involvement in management and conservation efforts; however, most critics recognize the potential for positive outcomes of community-based resource management if programs are properly planned and managed, and community members are interested in helping to lead the effort (Berkes 2004, Bradshaw 2003). And community based resource management programs can and should be integrated with government management efforts to take advantage of the assets, such as financial resources or local knowledge, available from each.

Some of the benefits of community-based resource management efforts in avoiding a tragedy of the commons are illustrated by Paul Macnab's research on the Bonavista Bay, Newfoundland fishing community. In response to the degrading condition of the Bonavista Bay fishery during the 1980s (brought to the attention of the Canadian government by local fishermen), the Atlanta Groundfish Moratorium was enacted in 1992, leaving 40,000

fishermen and fish processors out of work. Around the same time, Bonavista Bay was selected as the site for a new national marine conservation area in an effort to conserve some of the remaining fisheries (Macnab 2002). In an effort to record local knowledge from area fishermen in preparation for the conservation area, Macnab implemented a Community GIS project. He used paper charts at varying scales and requested that the fishermen add the local names for areas and indicate areas for each type of fishery (groundfish, lobster, etc). The fishermen worked together on these activities, proofing each other's work and assisting those who were less comfortable with the charts. This information was then digitized and used during meetings with local and federal government officials and was important in making decisions on what areas should be protected. (Macnab 2002)

In this case, the Community GIS was important in collecting and displaying the local knowledge and concerns of the local fisherman in order to communicate this information to the different government agencies charged with designating a protected area. Though the information was useful for determining the best location for a national marine conservation area, it would have been even more useful had the Community GIS been implemented earlier. Perhaps the collapse of most of the fisheries could have been avoided had the managers had access to the local knowledge of the fishermen and had the fishermen had a better understanding of how the fisheries were being degraded.

Other recent approaches to protecting biodiversity that require community involvement include the establishment of biological corridors and buffer zones. A biological corridor can be defined as "geographic space that provides connectivity between landscapes, ecosystems and habitats, natural or modified, and ensures the maintenance of biological diversity, ecological and evolutionary processes" (Project for the Consolidation of the

Mesoamerican Biological Corridor 2002). Biological corridors seek to provide connections between protected areas to allow species to move between habitat areas. Though Carara National Park is not part of a biological corridor, biological corridors are being developed throughout Central America (the Mesoamerican Biological Corridor is a prominent corridor being developed in Central America that will connect areas along the Caribbean half of Costa Rica) and it is possible that a biological corridor could be developed in the Central Pacific Conservation Area.

Buffer zones surround protected areas and are "governmental wildlands (forest reserves, wildlife refuges, and other protected areas) or private lands where sustainable uses of natural resources are promoted" (Church 1996). Sustainable uses can include "nature tourism, wildlife management, and controlled extraction of timber" (Church 1996). In Costa Rica, many conservation areas include clusters of land that are assigned to different management categories, such as biological reserve, with one or more core areas, such as a national park. Carara National Park, the core area of this project, is surrounded by several conservation areas: a wildlife refuge and protected zone to the east, and a different wildlife refuge to the north. Additionally, the Guacalillo mangrove, a protected estuary important to the Scarlet Macaws, lies a few of miles west of Carara National Park. Buffer zones and biological corridor linkages are important for "allowing seasonal movements of altitudinal and other intra-tropical migrants as well as to permit gene flow among protected areas" (Powell, Barborak and Rodriguez 2000, 39) and necessitate involvement of the community members that live near protected areas. These streams of community-based conservation perspectives not only inform this case study, but intersect with one of the most influential theories in conservation scholarship: common-pool resource theory.

Alternative Common-Pool Resource Governance

Research on common-pool resource management since the 1980s, especially economist Elinor Ostrom's influential work, provides an opportunity to further explore an alternative approach to Hardin's "fences-and-fines" methods. In 1985, the U.S. National Research Council formed a panel of scholars "to investigate and report on self-governing institutional arrangements devised by appropriators to coordinate and limit their use of common-pool resources" (Schlager 2004, 150). Ostrom, winner of the 2009 Nobel Prize in economics, was a participant in the panel and went on to develop her well-known common-pool resources research program in the following years (Schlager 2004). There are many examples where social groups have successfully managed their use of a commons through cooperation and developing self-governing institutions (Dietz, Ostrom and Stern 2003, Schlager 2004), and Ostrom and her co-researchers isolated a set of attributes that were shared by communities that had a history of successfully managing common-pool resources (Kollock 1998).

Ostrom's lists of attributes for resources and resource users that support the emergence of cooperation are a major component of the framework I used to look at the potential for common-pool resource management in the Central Pacific Conservation Area of Costa Rica. The attributes are divided into three categories: resource attributes, resource user attributes and institutional arrangements (Figure 4). I focused on the resource attributes and resource user attributes that were identified by Ostrom. The institutional arrangement attributes are a set of design principles that Ostrom suggests characterize successful institutional arrangements that sustain common-pool resources and help gain the compliance of generations of appropriators (Schlager 2004). These design principles are the next step in

the development of a more collaborative approach to resource management assuming that the potential for common-pool resource management exists in the Central Pacific. However, the design principles are not the focus of this research due to the limited time and resources available to fully assess the current institutional arrangements in the Central Pacific Conservation Area. The following lists of resource and resource user attributes (Figure 4) that are associated with the emergence of cooperation inspired two general questions that were first mentioned in the introduction: Do participants exhibit any of the resource user attributes associated with common-pool resource theory? Does the Central Pacific Scarlet Macaw population and associated habitat exhibit any of the resource attributes associated with common-pool resource theory? These questions will be addressed in Chapter 5 when I discuss the results.

Resource Attributes	**Resource User Attributes**	**Institutional Arrangement Design Principles**
1. Feasible improvement: *Resource conditions are not at a point of deterioration such that it is useless to organize or so underutilized that little advantage results from organizing.* 2. Indicators: *Reliable and valid indicators of the condition of the resource system are available at a relatively low cost.* 3. Predictability: *The flow of resource units is relatively predictable*. 4. Spatial extent: *The resource system is sufficiently small, given the transportation and communication technology in use, that appropriators can develop accurate knowledge of external boundaries and internal microenvironments.*	1. Salience: *Appropriators are dependent on the resource system for a major portion of their livelihood or other important activity.* 2. Common understanding: *Appropriators have a shared image of how the resource system operates (Resource attributes 1, 2, 3, and 4 on the left) and how their actions affect each other and the resource system.* 3. Low discount rate: *Appropriators use a sufficiently low discount rate in relation to future benefits to be achieved from the resource.* 4. Trust and reciprocity: *Appropriators trust one another to keep promises and relate to one another with reciprocity.* 5. Autonomy: *Appropriators are able to determine access and harvesting rules without external authorities countermanding them.* 6. Prior organizational experience and local leadership: *Appropriators have learned at least minimal skills of organization and leadership through participation in other local associations or studying ways that neighboring groups have organized.*	1. Clearly-defined boundaries*: Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.* 2. Congruence between appropriation and provision rules and local conditions*: Appropriation rules restricting time, place, technology and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material and/or money.* 3. Collective-choice arrangements*: Most individuals affected by the operational rules can participate in modifying the operational rules.* 4. Monitoring*: Monitors, who actively audit CPR conditions and appropriate behavior, are accountable to the appropriators or are the appropriators.* *5.* Graduated Sanctions*: Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness/context of the offense) by other appropriators, by officials accountable to the appropriators, or both.* *6.* Conflict-resolution mechanisms*: Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials*. *7.* Minimal recognition of rights to organize*: The rights of appropriators to devise their own institutions are not challenged by external government authorities.* *8.* Nested enterprises: *Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organized in multiple layers of nested enterprises (for CPRs that are part of larger systems)*.

Figure 4: Attributes that support the emergence of cooperation (Ostrom 2002)

Pro-environmental Behavior

The previous section looked at the resource and resource user attributes that are positively associated with successful common-pool resource arrangements. This section looks at what factors lead to the support of a movement, in this case, the environmental movement, and more specifically the conservation and management of biodiversity. This is an important aspect of determining potential for increased community involvement and research and conservation efforts. If community or an individual does not support a movement, they will not be willing to be involved in that movement. If the community members that are associated with the Central Pacific Scarlet Macaw resource system do not support its conservation, they will not get involved in conservation and management efforts and in fact may negatively impact the population by participating in activities such as poaching.

There is a large body of psychological research on environmental attitudes that has focused on values, which are viewed as "underlying determinants of more specific attitudes, behaviors and beliefs" (Schultz, et al. 2005, 451). Recent psychological research has examined the differences between various types of value-based environmental attitudes and developed psychological models to explain the link between values and environmental behavior (Schultz, et al. 2005). Stern, et al (1999) developed a value-belief-norm theory of support for social movements that identifies a set of values, beliefs and norms that are the basis of pro-environmental behaviors, such support of a movement (see Figure 5 for an updated version). Value-belief-norm theory focuses on the development of pro-environmental behaviors resulting from awareness of harmful consequences to valued objects (such as tropical forests or the Scarlet Macaw) (Schultz, et al. 2005). "Individuals who accept

a movement's basic values, believe that valued objects are threatened, and believe that their actions can help restore those values experience an obligation (personal norm) for pro-movement action that creates a predisposition to provide support" (Stern, et al. 1999, 81).

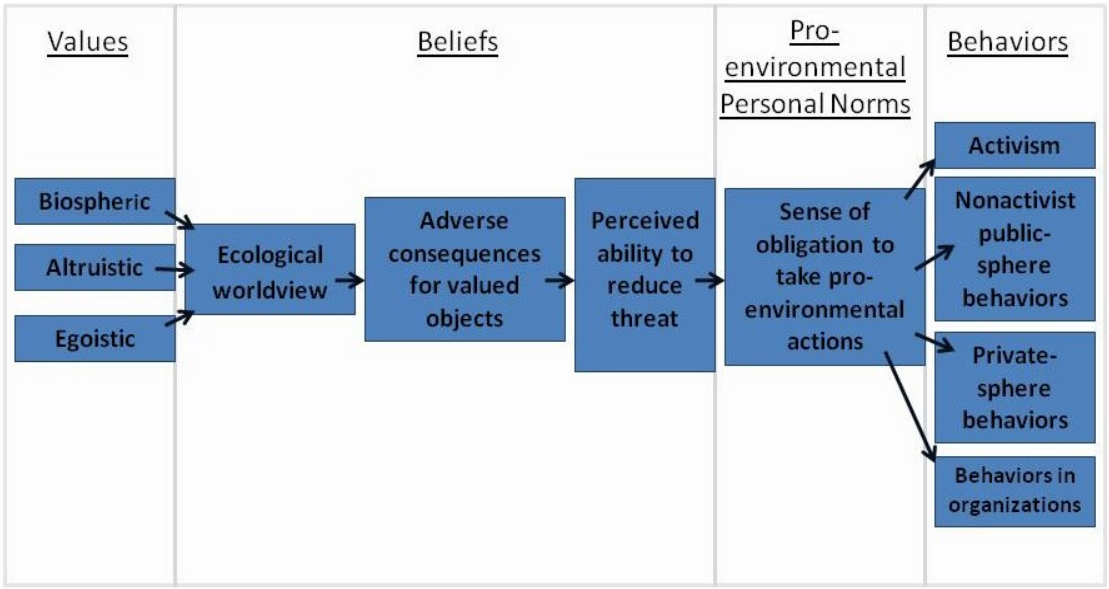


Figure 5: Model of value-belief-norm theory (Stern 2000)

I will use variables from the value-belief-norm model, focusing mostly on the beliefs, as part of a framework for assessing the potential for collaborative management of the Central Pacific Scarlet Macaw resource system. If project participants express some of the beliefs associated with pro-environmental behavior in the model, then the model suggests that there is increased potential for support of a movement, such as protecting the Central Pacific Scarlet Macaw population.

Chapter 4. Case Study Methods and Data

This chapter describes the methods I used to collect and analyze data from project participants about the potential of collaborative resource management of the Central Pacific Scarlet Macaw population. An exploratory case study approach with mixed-methods using primarily qualitative methods was employed. Exploratory studies are usually done to increase a researcher's understanding, to look at the feasibility for a more extensive study and to develop methods to be used in future studies (Babbie 2004). A case study is the "Intensive study of an individual, group or place over a period of time" with the research typically done in situ (Hays 2005, 226). In this project, a case study approach was used to explore the impacts of participation in a pilot collaborative mapping and monitoring project on participants and the potential for increased collaborative efforts in the future. Case studies are often used to take an in-depth look at a particular issue as it applies in a particular case. The case in this study is the Central Pacific Scarlet Macaw population and habitat contained within the Central Pacific Conservation Area, and centered on Carara National Park. As it is a case study and a small pilot project, the results will not be generalizable, however, the project could be useful for management decisions in that specific area and could be a model for assessing the potential for collaborative resource management of other resource systems.

Mapping and Monitoring Project Design:

In collaboration with staff at Carara National Park and based on management needs, a mapping and monitoring project was designed and implemented to generate data on the locations and habitats of the Central Pacific Scarlet Macaw population to assist with

management efforts, and to allow me an opportunity to gain a more in-depth understanding of the resource users associated with the Scarlet Macaw population.

Twelve participants were divided into two sections of six participants and each section participated for five consecutive days. On the first day of each section, the volunteers arrived and listened to a brief PowerPoint presentation that explained the basic objectives of the project. Participants received a written disclosure regarding the objectives of the project but the research objectives were not emphasized during the course of the project in an effort to obtain sincere answers from – and observation of – the participants without them feeling self-conscious about being observed. Following the presentation, each participant was given a questionnaire that contained questions for each of the five days of the project (see Appendix A) and asked to respond to the questions for the first day. Next, the participants listened to presentations on the physical characteristics and breeding habits of Scarlet Macaws, as well as the basic operation of GPS units and other data collection tools. Adrian Arce, the primary Carara National Park collaborator, gave the presentation on the biology and ecology of Scarlet Macaws and discussed the safety issues for the project. I presented an overview of GPS units and gave a hands-on lesson on how to use the units. The first afternoon and the following four days, the volunteers collected geographic locations using the GPS units, observed the nests and wrote down their observations. After the first day, the participants were asked to answer the day's assigned questions in the questionnaire either during lunch or in the evening.

Figure 6: Participants using field equipment (photo by Brandon Ivey)

Sampling

Purposeful sampling was used to select participants who lived near Carara National Park. Purposeful sampling is a sampling method where subjects are selected because of a particular characteristic, in this case location and age range. Patton (1990) proposed 16 categories for purposeful sampling that are now widely used. One of Patton's categories is convenience sampling, which involves selecting the cases on the basis of convenience (Hays 2005). Though convenience sampling can save time and money, it also yields the least reliable data because the cases were not selected randomly (Patton 1990). In this case, convenience sampling was used because we did not have the resources to compile a complete group of possible volunteers from which to take a random sample.

As this project was a collaborative effort with Carara National Park personnel, the recruitment of participants was done by Carara park rangers. Local secondary and university

students were recruited to participate as volunteer data collectors and to be the subjects for the exploration of the potential for their involvement in collaborative resource management and conservation efforts. Local student participants (who lived within 5 miles of the park border) were identified and contacted through acquaintances of Carara National Park staff and asked if they were interested in volunteering for a mapping and monitoring project during their one month school break. Seven local students agreed to participate. In an effort to get at least 10 participants, additional participants who lived more than 20 miles away were also recruited through personal contacts of the park staff. From these efforts, five additional volunteer university students were recruited, four studying environmental management and one studying tourism.

Since the participants were chosen using a convenience sample rather than random sampling, the data is expected to be rich in validity but will lack reliability and will not be suitable for generalizations. However, I have no reason to believe that the participants, especially the local participants, are not representative of their age group in the surrounding communities. The volunteers were divided into two sections according to their availability and each section participated for a total of five days. None of the participants were financially compensated for their participation; however food, lodging and transportation costs were covered by project funding sources.

Data Collection Procedures:

The methods used for data collection were questionnaires (with both open- and closed- ended questions) and participant observation. The questionnaire included pre- and post-project open-ended questions that assessed the participants' knowledge about Scarlet

Macaw ecology (see Appendix A questions 2-4 for examples). These questions and the pre- and post-test structure were modeled after the questions asked in a study by Vaughan et al in their research on the effect of an environmental education on schoolchildren, their parents and community members in the same area of Costa Rica (Vaughan, Gack, et al. 2003). Interview questions from a research project on community conservation in Belize (Hartup 1994) provided a model for several of the other open-ended questions, as did the questions used by Stern et al in the national study that they used to test value-belief-norm theory (Stern, et al. 1999). The closed-ended Likert Scale questions were based on a modified version of the New Environmental Paradigm (NEP) (Dunlap, et al. 2000). NEP was developed by Dunlap and Van Liere during the 1970s as a tool to measure the "beliefs about humanity's ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity's right to rule over the rest of nature" or ecological worldview (Dunlap, et al. 2000, 427).

Questionnaire Design:

A questionnaire was chosen as one of the data collection methods to give participants an opportunity to express themselves and think through their answers without the pressure of other project participants or researchers directly questioning their responses. The questionnaire was designed to explore the knowledge, attitudes, behaviors and values of secondary school and university students related to conservation and natural resource management in general and related to a specific protected area in Costa Rica, and assess the potential for their involvement in future collaborative resource management efforts. The questionnaire included a combination of open- and closed-ended questions (see Appendix A for questions). Open-ended questions allow the respondent to provide their own answer to the

question, whereas closed-ended questions require the respondent to select an answer from a list provided by the researcher (Babbie 2004). The closed-ended questions consisted of a set of 12 questions based on a modified New Environmental Paradigm (Dunlap, et al. 2000) asked on the first and last days of the project that used a Likert scale that ranged from "Strongly Disagree" to "Strongly Agree." These closed-ended questions sought to evaluate the participants' initial attitudes and beliefs about conservation and their involvement in conservation efforts, compared with their attitudes and beliefs following participation in the project. The same set of closed-ended questions were asked on the first and last days of each of the sections in an attempt to see if participation in the project had any impact on the participants' attitudes toward conservation.

Between one and seven open-ended questions were asked on a daily basis to give participants an opportunity to explain their thoughts about conservation and whether or not they felt that they and their families and friends should be more or less involved in conservation and resource management efforts. The answers to the open-ended questions also provided material to use in my evaluation of whether resource users (community members, or the project participants in this case) of the Central Pacific Scarlet Macaw population shared any of the attributes that Ostrom identified as common attributes of successful common-pool resource regimes. Several of the open-ended questions were modeled after questions used in other conservation research (Hartup 1994, Vaughan, Gack, et al. 2003) and all of the questions sought to assess the participants' current knowledge or explore their beliefs and attitudes about conservation issues, particularly management and conservation issues surrounding the Scarlet Macaw. The open ended questions sought to get a more in-depth understanding of participants' knowledge about Scarlet Macaws and their feelings

about who participates and/or should be participating in conservation and management efforts. Additionally, the participants were asked to draw a map of Scarlet Macaw habitat/range in the Central Pacific Conservation Area. This activity sought to provide another opportunity for participants to express their knowledge of Scarlet Macaws and allowed analysis of participants' understanding of Scarlet Macaw habitat as a part of the resource system. In most cases the daily questions were answered by participants and I was present to address any confusion regarding the questions.

The questionnaire was written in English, translated to Spanish and edited by a professional translator to ensure the questions had the same meaning in Spanish as I intended in English. A limited pilot of the questionnaire was completed prior to the implementation of the project by two Costa Rican secondary students who did not participate in the project. These students reported that they were able to understand the format and content of the questions without difficulty.

Participant Observation:

Participant observation was used to better understand participants' knowledge of Scarlet Macaw habitat and ecology, and attitudes toward conservation and the potential for future involvement in management efforts. This was accomplished by watching and listening to participants interact during the project, with each other, with national park staff and with myself. According to Robin Kearns (2005, 196) "Participant observation for a geographer involves strategically placing oneself in situations in which systematic understandings of place are most likely to arise."

The participants were observed during the day while mapping nest locations and monitoring nest activity, and during lunch and dinner breaks. The participants either returned to their family homes or rented lodging during the evenings and I did not interact with them during these times. During my observations I occasionally made notes in the notebook that I carried, though I was careful not to be obvious that I was writing down observations. I was also using the notebook to write down Spanish vocabulary words and descriptions of photographs that I was taking, so the participant observation note taking was discreet. However, for the most part I relied on recollection and writing detailed field-notes during the evenings after the project work was done for the day.

In this study, I was an observer-as-participant. I was seen as somewhere between an insider and outsider. My role was known as one of the organizers of the mapping and monitoring project. I am not Costa Rican; however I do speak some Spanish and I was a student, as were all of the volunteers. Additionally, not all of the participants knew each other prior to the project, so I was not intruding into an already established and bonded group. I was able to gain access to this group of participants through my collaboration with the park staff. The park ranger who did most of the recruiting was known to many of the participants as he had worked in the park for many years, and often visited local elementary schools as part of the park's environmental education efforts. Though he was older than all of the participants, in many cases he knew family members of the participants, and the participants knew of him through this connection.

Data Analysis Procedures:

The methods used for data analysis were mostly qualitative. Analysis of the

questionnaires and my participant observation notes involved an initial read through of the data to look for common themes, and then the development of a set of codes. Because the questionnaires were completed in Spanish, prior to coding the answers I translated all of the responses into English with the assistance of a native Spanish speaker. The codes were based on my initial reading of the data, and then further refined based on themes from the literature review (chapter 3). In subsequent reviews of the data, I looked specifically for themes related to Ostrom's suggested common-pool resource and resource user attributes and Stern's value-belief-norm theory variables. I used these codes as a method of organizing the data, so that I could return later and find appropriate quotes to support my results, and to look for patterns that might be significant in assessing the potential for collaborative resource management. Additionally, I quantified the responses to the set of closed-ended Likert scale questions.

Chapter 5. Results/Discussion

This chapter examines the results of the data collected during the participatory mapping and monitoring pilot project and my background research on the Central Pacific Scarlet Macaw population as a common-pool resource system. I begin by providing a brief overview of the demographics of the primary participants in the mapping project. I then review the resource and resource user attributes that Ostrom identified as common with the immergence of cooperation in the context of the pilot project participants' written responses from their workbooks, along with my field observations and background research on the Central Pacific Scarlet Macaw resource system. I explore each of the attributes the participants address and what the impact of participation in this project was on the participants' knowledge of Scarlet Macaw habitat and ecology. Next, I use variables from value-belief-norm theory (P. C. Stern 2000) to assess participants' beliefs about conservation issues and the potential for future involvement. I end the section with a discussion on what these results mean for potential collaborative resource management of the Central Pacific Scarlet Macaw population.

Demographics

The 12 participants were between the ages of 13 and 25, of Costa Rican nationality, and were either secondary or university students on winter break from classes. There were five male participants and seven female participants. Five of the participants lived more than twenty miles from the park boundary, two lived in a town approximately three miles from the park boundary and five lived in a town that bordered the park. Three of the participants, two

of which were sisters, had an immediate family member who works as a nature guide at Carara National Park and the surrounding areas.

Common-Pool Resource Attributes

Elinor Ostrom and her research team looked at successful common-pool resource governance examples and developed a set of attributes that described the resources and resource users. This section examines each individual attribute from the resource user and resource lists. It assesses if resource users associated with Costa Rica's Central Pacific Scarlet Macaw population, and the Scarlet Macaw population as a resource, meets any of the conditions, or could meet any of the conditions that are associated with the emergence of cooperation.

Resource attributes:

1. Feasible improvement: Resource conditions are not at a point of deterioration such that it is useless to organize or so underutilized that little advantage results from organizing.

In the case of the Central Pacific Scarlet Macaw population, the population size is estimated at around 430 individuals (Guittar, Dear and Vaughan 2009). The Scarlet Macaw is not currently included on the International Union for Conservation of Nature's (ICUN) Red List of Threatened Species (International Union for Conservation of Nature and Natural Resources 2011), a world-recognized indicator of the level of threat of extinction a species is facing. Scarlet Macaws are listed in Appendix 1 of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES). Appendix 1 includes species that are the most endangered among CITES-listed animals and plants, and CITES prohibits international trade in these species (except when the purpose of import is not commercial)

(The CITES Appendices 2010). The Central Pacific Scarlet Macaw population increased by 37 individuals between 1995 and 1996, and scientists suggest that this increase may have resulted from intense management efforts during 1995-1996 (Vaughan, Nemeth and Cary, et al. 2005). The intense management efforts included "raids of suspected poachers' homes by park guards and a local judge, confiscation of poached chicks and tree-climbing gear, arrests of poachers, newspaper articles denouncing specific macaw poachers, artificial nest-box construction and placement, and active nest protection (Vaughan, Nemeth and Cary, et al. 2005). Research shows that organization has proven successful for management of the Scarlet Macaw as a resource in the past, however, the level of intense organization was unsustainable due to limited resources and inconsistent conservation efforts since 1997 (Vaughan, Nemeth and Cary, et al. 2005). The mapping and monitoring project associated with this research reaffirmed that the Central Pacific Scarlet Macaw population is not overly deteriorated. During the 10 days of the mapping and monitoring project (5 days for each group); the project participants mapped 40 active nest cavities. This does not necessarily mean that all of those nest cavities will fledge chicks, but it is a good indication that the population is flourishing.

2. Indicators: There are indicators of the condition of the resource system that are viable and valid and can be available at low cost.

Vaughan, Nemeth and Cary, et al monitored the size of the Central Pacific Scarlet Macaw population from 1990 until 2003 (2005). The study involved counting the flocks of Scarlet Macaw during their daily flights to and from their nocturnal roosting area, and the data from these counts were used to assess the number of macaws in the area from year to year. The mapping and monitoring project that is associated with this research is another example of a

low cost and valid method of monitoring the condition of the resource system (Scarlet Macaw population and habitat). Though the project certainly required personnel and technical resources (GPS units, data sheets, etc), community volunteers could stay in their personal homes and pack food for the day to limit the amount of financial resources for a similar project. This would allow monitoring to continue at a relative low cost.

3. Predictability: The flow of resource units is relatively predictable.

In the previously mentioned study of the Central Pacific Scarlet Macaw population size, Vaughan, Nemeth and Cary, et al found that the number of macaws observed from his observation locations remained fairly consistent, with a slight increase over the 14 years of the study. When the counts began in 1990, they counted about 200 macaws, about 220 in 1994, 220 in 1998 and 250 in 2002 (Vaughan, Nemeth and Cary, et al. 2005). This long-term research of Scarlet Macaw population size verifies that the number of resource units (Scarlet Macaws) is relatively predictable.

4. Spatial extent: The resource system is sufficiently small, given the transportation and communication technology in use, that appropriators can develop accurate knowledge of external boundaries and internal microenvironments.

The Scarlet Macaw population on the Central Pacific occupies 560km² of land composed of forest, cattle pasture, annual or perennial crops, and human dwellings (Vaughan, Nemeth and Cary, et al. 2005). This is a large resource system and it would be difficult for resource users to develop accurate knowledge about all the microenvironments within the Scarlet Macaw resource system (which includes habitat); however, it is possible for resource users to develop knowledge of the resource boundaries. For example, three primary flight patterns of the Central Pacific Scarlet Macaw population, from the Guacalillo mangroves, where the macaws usually roost, to the areas they use for nesting and feeding, were determined from

extensive observations (Vaughan, Nemeth and Cary, et al. 2005). The resulting map of nest sites (see Figure 3, page 23) from the mapping and monitoring project provides an illustration to further educate resource users of the boundaries of the resource system.

Resource user attributes:

1. Salience: Appropriators are dependent on the resource system for a major portion of their livelihood or other important activity

If a person's livelihood depends on a resource that will negatively impact them if it becomes less prevalent (extinction of a species), they are more motivated to protect it (Altrichter 2008). Costa Rica is a top ecotourism destination because of high levels of biodiversity and the extensive system of protected areas (Wallace and Smith 1997). The Central Pacific Scarlet Macaw is one of two Scarlet Macaw populations in Costa Rica and a major draw to the area. In 2010, approximately 14% of Costa Rica's gross domestic product (GDP) was projected to have come from travel and tourism products and services (World Travel & Tourism Council 2010). In the town of Quebrada Ganado, which is located within 5 miles of the Central Pacific's Carara National park, "eighty percent of the working population is involved in tourism at local resorts, hotels and restaurants" (Vaughan, Gack, et al. 2003, 14). Three of the twelve mapping and monitoring project participants have a family member who works as a nature guide in and around Carara National Park.

2. Common understanding: Appropriators (resource users) have a shared image of how the resource system operates (resource attributes) and how their actions affect each other and the resource system

In order for resource users to work together to manage a resource, they must have a shared understanding of that resource. From analysis of the mapping and monitoring project participant's answers to the questionnaire, it was evident that the participants had a good

understanding or acquired a good understanding of several of the suggested resource attributes:

Scarlet Macaw Ecology:

All of the participants started the project with some basic knowledge of Scarlet Macaw biology and ecology. All of the participants were able to correctly answer questions on the first day of the project about the nesting and feeding habits of Scarlet Macaws. When asked what they had learned midway through the project, nine of the participants noted the specific species or other characteristics of the trees that Scarlet Macaws nest in, and two participants mentioned that they learned that macaws nest at the borders of forested areas to improve the chances of the chick's first flight. On the last day of the project, ten of the twelve participants included additional details, as compared to the first day of the project, when answering the questions about the nesting and feeding habits of macaws.

On the first day of the project, in response to a question about the predators of Scarlet Macaws, six of the respondents mentioned humans as the only predator, two said other fauna were the only predator and two included both humans and other fauna as predators. On the last day of the project, Day 5, nine respondents included humans and other fauna as predators, two mentioned just humans and one mentioned just other fauna. This shows that most of the participants were particularly aware of the negative impacts that humans are having on Scarlet Macaws, and that some of the participants are so focused on this aspect that they were unaware that in addition to human predators, the Scarlet Macaws also face natural predators. However, by the end of their participation in this project, most of the

participants were more aware of the dangers to Scarlet Macaws of both human and natural predators.

Spatial Extent of Scarlet Macaw Habitat:

The participants were asked on the first day, and again on the last day, to: "Please draw a map of Scarlet Macaw range/habitat in the Central Pacific Conservation Area. Include whatever you think is necessary to portray the habitat." Many of the maps from the first day were general drawings showing the Pacific Coast of Costa Rica or the entire country with an area on the Pacific coast circled. Almost all of the participants included more details in the second map as compared with the first map. These additional details ranged from an increase in labels on specific areas where the group had recorded the nest sites (names of towns, mangroves, etc), to illustrations showing macaws in nesting cavities (See Figures 7 and 8 for samples of participants' responses). Many of the details depicted in the drawings, especially the drawings from Day 5, demonstrate that participants were aware that Scarlet Macaws live in the some of the same areas as humans. Several of the participants who drew actual nest locations on their maps had these locations very near the names of towns or farms. The fact that human and Scarlet Macaw habitat overlaps was further emphasized during the course of the project when all of the participants visited at least one nest sight that was within 100 meters of a house.

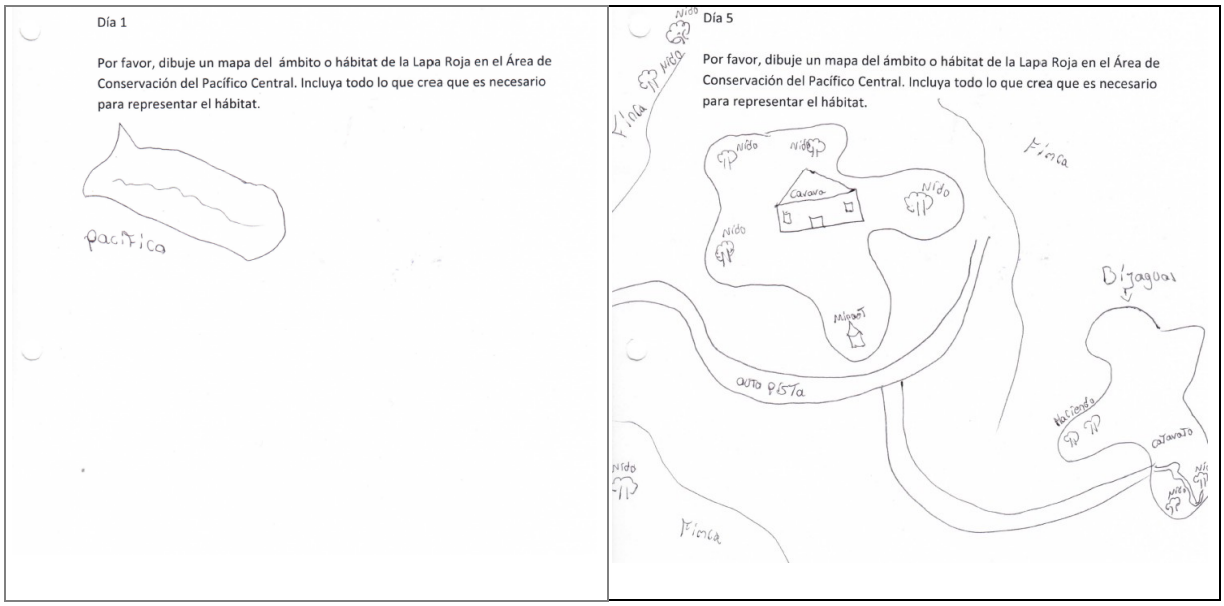


Figure 7: A participant's habitat drawing on Day 1 and Day 5

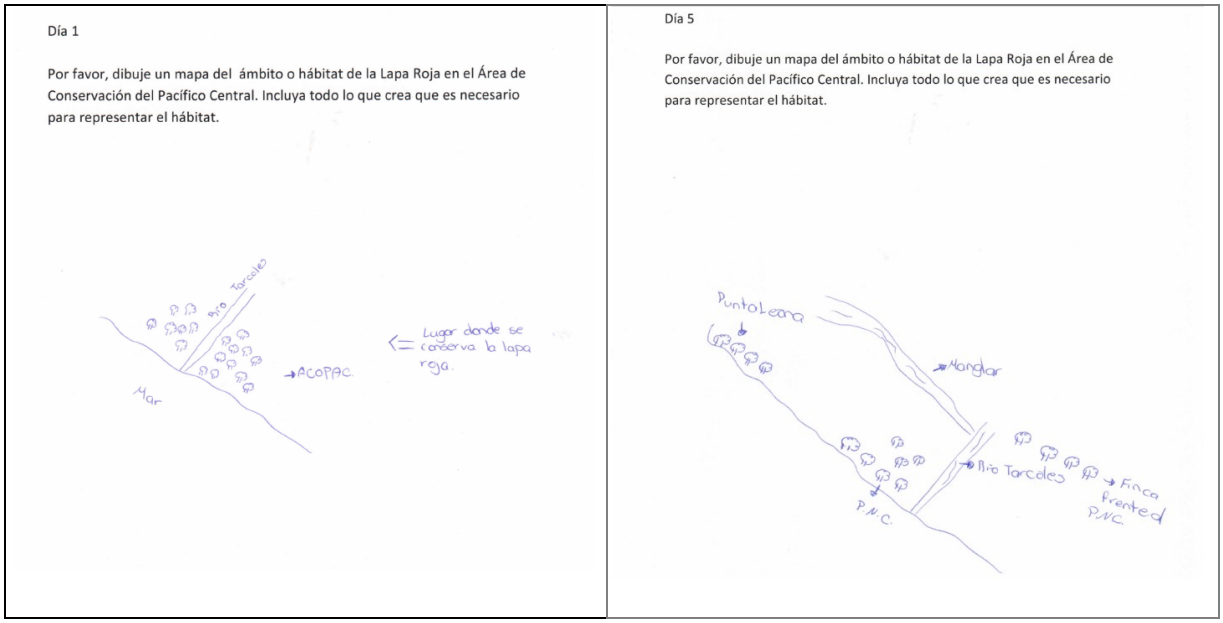


Figure 8: A participant's habitat drawing on Day 1 and Day 5

3. Low discount rate: Appropriators use a sufficiently low discount rate in relation to future benefits to be achieved from the resource

When the benefit gained from using a resource in the present does not outweigh the benefit of conserving the resource for the future, there is more of an incentive to protect it (Altrichter 2008). Scarlet Macaw chicks can be sold on the black-market for the pet trade for an average of $240 per chick (Dear, Vaughan and Morales 2010), however I have not come across a valuation of the Central Pacific Scarlet Macaw population in its natural state and therefore cannot fully evaluate the discount rate.

4. Trust and reciprocity: Appropriators trust one another to keep promises and relate to one another with reciprocity

From my participant observations during the mapping and monitoring project, I found the participants quickly bonded with fellow project participants, to the point that I did not at first realize that some of them did not know each other prior to participation in the project. They worked together to learn the technical aspects of the project and helped each other in the field. For example, at one point in the project, participants were mapping nests in a swampy area. It was difficult to walk and some participants were having more difficulty then others. I noticed several instances where struggling participants were assisted by the participants who were not having such a difficult time. It is too early to assess participant's ability to keep promises and relate to one another with reciprocity; however their actions in the field show that they were able to work cooperatively.

5. Autonomy: Appropriators are able to determine access and harvesting rules without external authorities countermanding them

This attribute is not fully shared by the resource users of the Central Pacific Scarlet Macaw population. Resource users can help develop and be involved in management practices

through participation in LAPPA and projects similar to the mapping and monitoring project associated with this research, however national law regulates the treatment of wildlife, such as the Scarlet Macaw. Also, access to many areas of Scarlet Macaw habitat (such as roosting sites) is mediated by the national park service, a government institution.

6. Prior organizational experience and local leadership: Appropriators have learned at least minimal skills of organization and leadership through participation in other local associations or studying ways that neighboring groups have organized

When asked who leads the Scarlet Macaw conservation effort and who else participates, all of the project participants mentioned MINAE, Carara National Park or the name of one of the park rangers, and many also mentioned LAPPA and community members. The formation of LAPPA during the mid-1990s is an indication of support for community involvement in conservation and resource management efforts, and an example of prior organizational experience and local leadership. Additionally, in the case of a collaborative resource management, there is the potential for collaborations with others, such as national park staff or university researchers, who possess more developed leadership and organization skills.

Conservation Beliefs

From the first day of the project, the participants' responses in their workbooks and actions in the field showed that they were interested in and supportive of wildlife and forest conservation. Several of the university students were more knowledgeable about broader conservation issues since they were taking environmental management courses, but the secondary students were definitely aware of many of the issues and all participants were generally engaged in the project. The variables in Stern's value-belief-norm theory (P. C. Stern 2000) – especially beliefs related to an ecological worldview, awareness of consequences for valued objects (biodiversity), and perceived ability to reduce threat – were

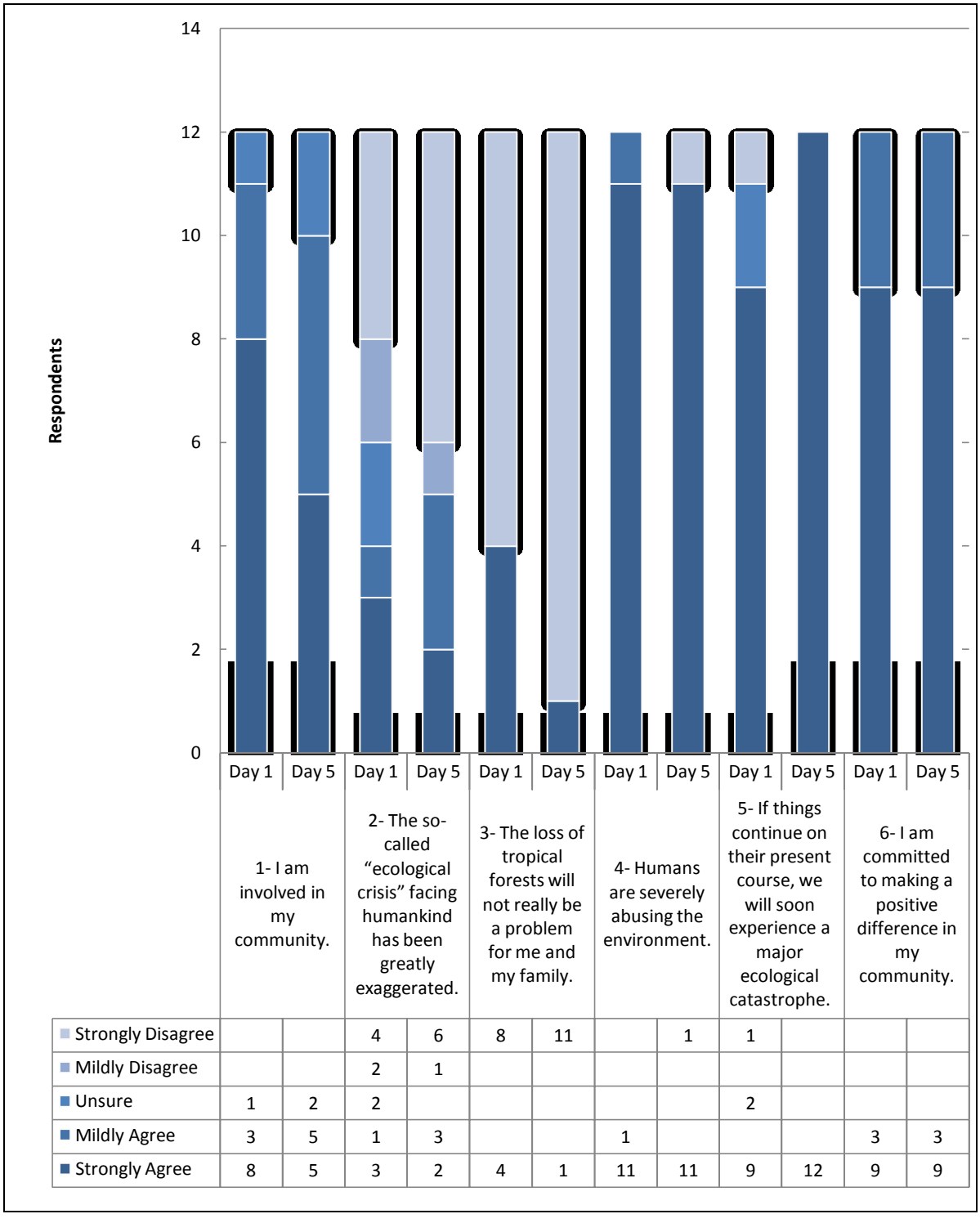
used as part of a framework to assess if there is potential for pro-environmental behaviors, such as becoming more involved in protecting and managing the Central Pacific Scarlet Macaw population.

The pre- and post-project responses to a set of Likert scale questions (see Table 1 and Table 2 for the questions and the full set of the responses), which were based on a modified New Environmental Paradigm (Dunlap, et al. 2000) measurement of "ecological worldview" and questions from Stern et al (1999), were used to look at participants' beliefs about conservation on a broad scale. Several of the open-ended questions looked at participants' beliefs about conservation at more of a local scale.

One of the goals of the project was to assess the impact of participation in the collaborative project. Due to the small sample size and short time frame, a significant impact was not expected; however the Likert scale questions did show some movement from Day 1 to Day 5 and provided data on participants' beliefs about conservation issues. For example on Day 1, eight of the twelve participants strongly disagreed and four strongly agreed with statement number three: "The loss of tropical forests will not really be a probably for me and my family." However by Day 5, eleven out of twelve participants strongly disagreed and one strongly agreed with the same statement. A similar movement was seen for statement number five: "If things continue on their present course, we will soon experience a major ecological catastrophe." On day one, nine out of twelve participants strongly agreed, two were unsure and one strongly disagreed. However, by Day 5, all twelve strongly agreed with the statement. Most of the other statements did not show significant movement, but there were some significant findings. For example, on Day 1 ten out of (there was one missing response), and on Day 5 eleven out of twelve of the participants, strongly agreed with

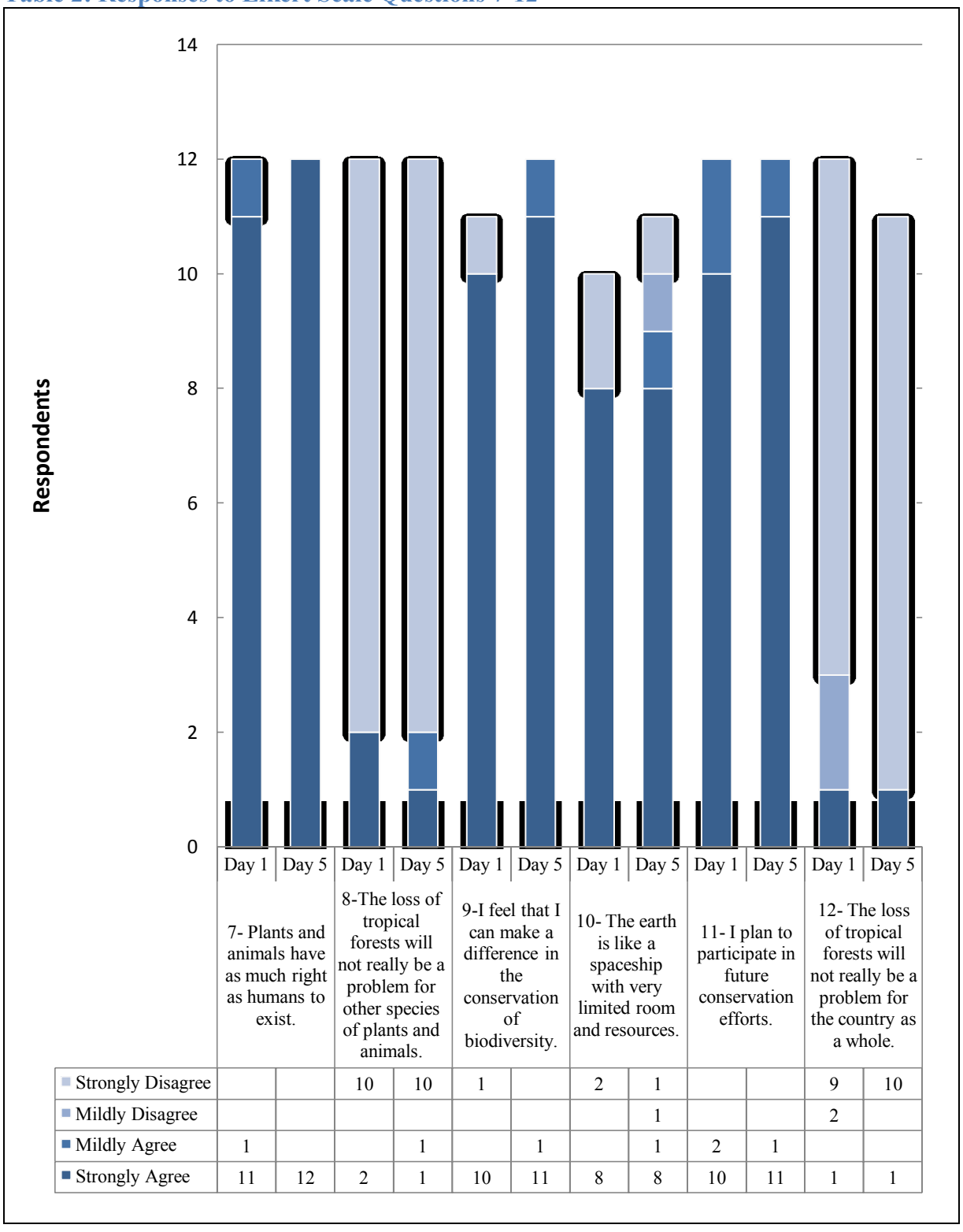
statement number nine: “I feel that I can make a difference in the conservation of biodiversity.” Similarly, ten out of twelve on Day 1 and eleven out of twelve on Day 5 strongly agreed with statement number eleven: “I plan to participate in future conservation efforts.”

Table 1: Responses to Likert Scale Questions 1-6



	1- I am involved in my community.		2- The so-called "ecological crisis" facing humankind has been greatly exaggerated.		3- The loss of tropical forests will not really be a problem for me and my family.		4- Humans are severely abusing the environment.		5- If things continue on their present course, we will soon experience a major ecological catastrophe.		6- I am committed to making a positive difference in my community.	
	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5
Strongly Disagree			4	6	8	11		1	1			
Mildly Disagree			2	1								
Unsure	1	2	2						2			
Mildly Agree	3	5	1	3			1				3	3
Strongly Agree	8	5	3	2	4	1	11	11	9	12	9	9

Table 2: Responses to Likert Scale Questions 7-12



	7- Plants and animals have as much right as humans to exist.		8-The loss of tropical forests will not really be a problem for other species of plants and animals.		9-I feel that I can make a difference in the conservation of biodiversity.		10- The earth is like a spaceship with very limited room and resources.		11- I plan to participate in future conservation efforts.		12- The loss of tropical forests will not really be a problem for the country as a whole.	
	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5	Day 1	Day 5
Strongly Disagree			10	10	1		2	1			9	10
Mildly Disagree								1			2	
Mildly Agree	1			1		1		1	2	1		
Strongly Agree	11	12	2	1	10	11	8	8	10	11	1	1

Development of Common Understandings

The following excerpts were written by participants in their workbooks on the first day of the project in response to the prompt, "Please describe your beliefs about forest conservation in Costa Rica:"

> Costa Rica is a privileged country in terms of the variety of species of flora and fauna, where great efforts are made for the conservation and protection of the forests; however, these efforts are limited due to the lack of financial resources and the lack of consciousness and the irrational exploitation of resources by man. -*University student*
>
> Forest conservation is good but a part of them [the forests] are being lost and the marshes are being lost because the local town people are cutting them with much frequency. –*Secondary student*
>
> Costa Rica, due to the great biodiversity and the great quantity of natural riches, has undertaken the labor, through private and state institutions, to protect such resources, because due to contamination, illegal logging, indiscriminant hunting and the extraction of plants and animals, many natural resources have been lost. –*University student*

These excerpts show the range of conservation issues the participants were aware of and their beliefs concerning these issues coming into the project, including: financial limitations, lack of consciousness/awareness about conservation issues, exploitation of resources by humans, and the need to conserve for the intrinsic and economic value of the biodiversity.

The participants expressed different reasons for why forests are or should be conserved, some mentioned the need to conserve forests for tourism or for the benefits that humans take from the forests, but at some point or another most participants took a more altruistic view and mentioned that forests and/or Scarlet Macaws should be conserved because they are beautiful, or because it is our duty as humans.

> Despite the image that the country tries to project, no real consciousness about the importance of conservation [of the forest] exists in the population, not only for tourism (as is often understood), but because they [the forests] are one of the primary

> sources of resources and raw materials and of health. It is necessary to understand the planet as a single system to understand that the loss of forests (and other ecosystems) will directly affect human beings, and any damage caused will have negative consequences in the short, medium and long term, which human beings are just beginning to understand –*University student*
>
> Forests must be conserved because they are the thing of all people and also they are the source of life for animals. –*Secondary student*
>
> I think the macaws are in danger of extinction; we should protect the forests more because the future depends on us. – *Secondary student*

When pilot study participants were asked again on the last day of the project about their beliefs about forest conservation in Costa Rica, many of the participants focused on the management issues surrounding forests and the Scarlet Macaw:

> The conservation of the forests in Costa Rica is very bad because today there are many poachers of the Scarlet Macaw. In Costa Rica there is much deforestation because our country cuts many trees for wood and therefore there is a loss of many forests. –*Secondary student*
>
> I think that there needs to be more conservation programs because the loss of forests is increasing. And there should be more guards in the Guacalillo mangroves. –*Secondary student*
>
> The status [of conservation] is somewhat unknown, the actual number of species is not known with certainty, only approximations, "estimates." The loss of forests is increasing daily due to lack of control, monitoring and real effective application of the laws. In many aspects conservation is just starting, we require changes to the management strategies and more involvement from communities. – *University student*

The above excerpts demonstrate that the participants were aware of the issues facing the Central Pacific Scarlet Macaw resource system and engaged in thinking through management options.

Awareness of Consequences of the Loss of Biodiversity

Awareness of adverse consequences for valued objects is a variable in the value-belief-norm theory. Some of the participants directly expressed an awareness of the consequences of the loss of forests and biodiversity:

> It is necessary to involve all of society by raising awareness of forest conservation. The loss of forests does not cause an isolated effect, rather it affects the whole system which directly impacts humans. –*University student*

> …it is necessary that the population in general should be conscious of the importance of protecting natural resources because in the future the forests and thousands of species could disappear due to the lack of protection. – *University student*

> [Scarlet Macaws] require … [protection] as they are a species that, like all organisms, have an ecological role that is difficult to substitute. – *University student*

Participants also expressed awareness of consequences through their responses to some of the previously mentioned Likert scale questions. For example, statements three and five (see Table 1 above), which were the two that showed movement in the above section, are linked to participants awareness of consequences resulting from the loss of forests and the degradation of ecosystems.

Perceived Ability to Reduce Threats to Biodiversity

Another of the beliefs from the value-belief-norm theory that suggests support for a movement is a perceived ability to reduce threats. Several of the participants in the pilot project expressed thoughts about the ability of communities to reduce threats to biodiversity through involvement in protection efforts or by changing behaviors (such as by ceasing deforestation):

> Currently the Ara macao is in danger of extinction, so immediate protection is necessary. Additionally, due to deforestation the macaws are losing their nests which interrupts their reproductive cycle. Associations such as LAPPA and Carara National Park bring together efforts to protect the scarlet macaw by involving communities bordering the park and areas where the scarlet macaw can be found. – *University student*
>
> Forest conservation is good but a part of them are being lost and the marshes are being lost because the local town people are cutting them with much frequency. – *Secondary student*

All of the participants agreed that community members should be involved and either are or should be influential in the management of Scarlet Macaws.

> …some of the nests are found in neighboring properties of the park, these should be protected and ensured of their permanence in order to improve the status of the macaw and increase their population numbers. Therefore the members of the neighboring communities greatly influence and should involve themselves in the fight and collaborate for the protection of the macaw. –*University student*
>
> …everyone should participate since the macaw is an endangered species due to man, therefore the participation of communities reduces their risk of extinction. – *University student*
>
> Members of the community are influential. People should help in all possible ways so the macaw is not in danger of extinction. –*Secondary student*

Several of the participants stated that their families are currently involved in management efforts and all of the participants expressed interest in participating in a similar project in the future:

> My family is involved in the management of macaws, by protecting them, not permitting the cutting of trees that they [the macaws] live [in], and being careful that they aren't stolen. –*Secondary student*
>
> I would return because I am very interested and because I learned a lot of things about the Scarlet Macaw. –*Secondary student*

> …thanks to my experience, a certain interest has been awoken in my family for the protection of many species and in this case the macaw–*University student*

Interestingly, many of the participants included themselves as part of their families or the larger community rather than discussing their personal involvement or their personal responsibility in management efforts. For example when asked who is in charge of Scarlet Macaw management and who else participates, many mentioned the importance of communities and local people, but none of the participants mentioned themselves directly, though at other times it was obvious that they considered themselves part of the community.

Potential for Effective Collaborative Resource Management

The Central Pacific Scarlet Macaw resource system shares most of the resource and resource user attributes identified by Ostrom (2002) as common with the emergence of cooperation. As far as the resource attributes are concerned, the Central Pacific Scarlet Macaw population and the associated habitat fulfill all of the suggested attributes, especially "Feasible improvement." The resource system is certainly not to a point of deterioration where it is hopeless to try and improve it. The top-down protective measures that the Costa Rican government has implemented over the last 40 years have allowed the Scarlet Macaw population to remain viable; however there is space for improvement. The management goal for the Central Pacific population is to increase the population from an estimated 400 to 1000 by 2020 (Arroyo, et al. 2004). Though I was unable to fully evaluate several of the resource user attributes due to the short time frame of the project, I was able to address most of them. Ostrom does not identify a particular percentage of resource or resource user attributes that are necessary, nor does she state that sharing these attributes guarantees successful common-pool resource management.

Several of the results from the pre- and post-project Likert scale questions showed a shift in participant answers from the first day to the last day of the project toward a greater awareness of the consequences of the loss of forests and degradation of ecosystems. This may be indicative of the potential for participation in such a project to impact ones beliefs. This change could be attributed to the participants being more aware of the importance of conservation issues after participating in a conservation project and discussing conservation issues with other participants during the course of the project. Regardless, it also shows that most of the participants are aware that there are consequences to the loss of tropical forests and of biodiversity.

Responses to the Likert scale questions also suggested that participants felt that they are involved in their communities. Current community involvement could indicate that these participants would be willing to continue to be involved or increase their involvement in a collaborative management effort. And in fact, all of the participants either strongly (eleven) or mildly (one) agreed that they can make a difference in the conservation of biodiversity. This response is an indication of the perceived ability to reduce threats to biodiversity, which is one of the behaviors associated with supporting a movement. This behavior was further supported by several of the textual excerpts seen in the preceding section, which highlighted participants' beliefs that community members (including themselves) can make a difference.

It was evident from discussions with the project participants and Carara National Park staff that some community members from surrounding towns are involved in resource management and conservation efforts. Over the years, Carara National Park and LAPPA, a local non-profit, have been involved in coordinating community members to guard the nest sites and facilitating participation in annual Scarlet Macaw counts. However, it was also

evident that these efforts had not completely stopped the negative impacts to Scarlet Macaws and that many community members were not involved in the conservation efforts. Some were even involved in the poaching of chicks. As we mapped the locations of nest sites, on several occasions we found evidence of recent poaching activity, such as ropes or wood steps attached to a tree and used to climb it.

This awareness of the need for all community members to participate may be an important signal for the future of community resource management in the Central Pacific region of Costa Rica. If these younger participants believe that everyone should be involved in conservation efforts, perhaps they will be more inclined to continue to be involved themselves and to encourage their families and friends. In fact, when they were directly asked whether they would participate again, all of the participants indicated that they would like to participate again and most felt that their families and friends would also be interested in participating.

Limitations

In this section, I address some of the limitations of this research and the associated mapping and monitoring project. First, due to the collaborative nature of the mapping and monitoring project, convenience sampling was used rather than a more rigorous and random sampling method. Second, the sample size was too small to allow for any statistical analysis, or to make the results generizable. However, this was a pilot study and a larger sample could be assessed in the future. Third, due to limited financial resources, the mapping and monitoring project was restricted to a limited time period (five days with each of the two sections of project participants and a few extra days with my park collaborators). This short

time period made it difficult to see any long-term impacts on the participants resulting from their participation (such as in the pre- and post-project answers to questions in the questionnaire), and limited my ability to fully assess them as resource users of the Scarlet Macaw resource system. The limited resources also meant that it was necessary to focus the assessment on the resource and resource user attributes of common-pool resource theory, and leave an assessment of the design principles for the management structures associated with successful common-pool resource management regimes to a future study. Because I focused on the resource and resource user attributes, my analysis was limited to agency and largely ignored the interface between resource users and institutions (structure). The analysis was too small in scope to address how institutions may limit agency.

Chapter 6: Conclusion

If not for the extensive system of protected areas that exist in Costa Rica along with the regulations protecting wildlife and forests, even more of the Central Pacific Scarlet Macaws' habitat almost certainly would have been destroyed, and more of the species lost. However, many species cannot thrive in small islands of protected habitat that are surrounded by degraded habitat, even with 25% of the land area designated as protected areas. Community participation in management and conservation efforts is essential to expand the reach of protected areas. Community participation can lead not only to additional habitat areas on private land (such as the trees on agricultural land where Scarlet Macaws build their nests), but also to better protection of a species which could then lead to an increase in the population size. The intersection between biogeography and human geography, or the intersection of where plants and animals are distributed and where humans live, necessitates the involvement of community members in management efforts in order to have the most chance for the successful conservation of species.

In this research, I explored the potential for collaborative resource management in a case study of the Central Pacific Scarlet Macaw population. I helped to implement a pilot mapping and monitoring project to explore the current knowledge, beliefs and behaviors of the participants related to conservation and natural resource management. I looked at collaborative resource management as a complimentary strategy to the conventional establishment of protected areas and regulations to protect biodiversity. In this section, I consider the results of the assessment and address how these results fit into the literature on community involvement in common-pool resource management. I discuss what the results

mean in terms of future efforts to implement collaborative resource management projects in the area and end with suggestions for future research.

Aspects of common-pool resource theory and value-belief-norm theory were combined and used as an assessment framework. One branch of the assessment framework looked at the attributes of resources and resource users, as established by Elinor Ostrom, which are associated with the emergence of cooperative behavior leading to collaborative resource management, an alternative solution to Garrett Hardin's "fences-and-fines" methods for resolving common-pool resource dilemmas. The framework goes beyond solely looking at the attributes of resources and resource users that are associated with cooperative behavior, to include the beliefs of resource users about conservation issues and their ability to make a difference. The opportunity for participants to share their beliefs adds another dimension to the assessment and allows a more complete picture of the resource system.

SLOSS and Central Pacific Scarlet Macaw Resource Attributes

The SLOSS, or the single large or several small, debate centered on whether a single large or several small protected areas were better able to protect habitat and species, and though this debate has faded with no definitive conclusion, the Central Pacific Scarlet Macaw population and associated habitat is an example of how large *and* small protected areas can contribute to supporting a species. The resource attributes of the Central Pacific Scarlet Macaw resource system were more promising than "SLOSSers" would expect because in this case it is not single large or several small, but instead it is both. As a species that requires different habitat types, the Scarlet Macaw is able to increase the size of its habitat by flying to satellites of protected habitat that contain other important resources such as food and

resting sites. In this example, Carara National Park is the large protected area (though at only 5,500 ha, it would not usually be considered a large protected area), and the smaller Guacalillo Mangrove Reserve and Punta Leona Reserve can be considered the several small areas that contain varied habitat types, along with a network of even smaller habitat areas on private land. In reality, the SLOSS debate is no longer of much concern. Many of the protected areas have already been established and now the focus needs to be on looking at ways to include community members in management efforts, whether through collaborative research and monitoring projects, and/or through biological corridors (that often cross over private land) and buffer zones that expand habitat and require the cooperation of community members in order to be successful.

Collaborative Resource Management and "Fences and Fines"

This brings us back to Ostrom and Hardin. While Hardin sees "fences-and-fines" as the primary method of managing common resources, Ostrom recognized that command and control is not the only answer and that cooperation and community involvement can lead to effective governance. The Central Pacific Scarlet Macaw population was able to rebound to the degree that it has since the early 1990s because managers combined the command and control methods of protected areas and regulations with education programs and encouragement to stop poaching. This project sought to further support the decentralization of resource management and the empowerment of participants through hands-on involvement in a mapping and monitoring project. I do not claim that this project had a huge empowering effect on the participants, but I think if a more participatory approach was taken where participants were able to have a part in designing and implementing similar research projects, the potential for empowerment exists. Encouraging community or collaborative resource

management programs helps to further decentralize forest and wildlife management, which can potentially have a positive impact on biodiversity conservation efforts.

Emergence of Cooperation

According to Edella Schlager, a former student of Ostrom's and a fellow common-pool resource scholar, "the attributes of common-pool resources and of appropriators should not be considered necessary or sufficient for appropriators to engage in collective action to create or change institutional arrangements. Rather, the attributes should be thought of as conditions positively related to the emergence of collective action" (Schlager 2004, 153). The results of the assessment indicated that collaborative resource management is emerging in Costa Rica's Central Pacific area. "Salience" and "Common Understanding" were two of the resource user attributes that were especially evident in the Central Pacific. With tourism being such an important sector of the economy, and the Scarlet Macaw such a well known species that lives on the Central Pacific coast, the livelihoods of locals are intertwined with the status of Scarlet Macaw and its' habitat. At the same time, having a livelihood dependent on a resource may lead one to become knowledgeable about that resource, which was evident in "Common Understanding" attribute. Most of the participants did have a good initial understanding of Scarlet Macaw ecology, and during the course of the project they were engaged participants who took the time to learn more about the Scarlet Macaw and its' habitat. As far as the resource attributes, "Feasible Improvement" and "Indicators" were two that were especially important to this project. If a species is past the point of rehabilitation, it arguably is not worth using valuable resources trying to save it when those resources could go farther helping a less degraded species. In the case of the Central Pacific Scarlet Macaw, there is opportunity to increase the population size, but the current population is stable. The

size and status of the population had been assessed using indicators such as annual counts and nest observations. The pilot mapping and monitoring project associated with this research is another option for an ongoing indicator of the health of the Scarlet Macaw population and its' habitat.

Not only did the Central Pacific Scarlet Macaw resource system share many of the resource user and resource attributes which are common with the emergence of cooperation, but LAPPA, a local non-profit, is already working to organize community involvement in conservation efforts. Though LAPPA has struggled to maintain a consistent level of effort, the non-profit is an encouraging sign of the potential for effective resource management in the area. Also, many of the pilot study participants expressed beliefs that value-belief-norm theory, proposed by Stern et al, suggests lead to pro-environmental norms which then lead to support of a movement, such as the conservation of Scarlet Macaws. This important indication of support, especially from the young pilot project participants, gives one hope that collaborative resource management programs can succeed as an important complimentary strategy to protected area designations.

Impact of Participation

Though the time frame of the project was short and the sample size small, I did see some movement in the participants' responses to the Likert scale questions. The most visible movement was an increase in the awareness of the negative impacts of further ecological degradation. The increase in awareness that "valued objects are threatened," is one aspect that value-belief-norm theory holds can create "a predisposition to provide support" (Stern, et al. 1999). This provides further positive support of the potential for collaborative

management in the Central Pacific area of Costa Rica. The fact that the pilot project participants were fairly young provides additional hope that their awareness of the negative impacts of the loss of biodiversity could lead them to help lead the efforts for its protection.

The assessment of the "Common Understanding" attribute of common-pool resource theory in the context of the pilot project also showed an awareness that valued objects are threatened. In this case the valued objects were the Scarlet Macaw and its' habitat. Though the participants were already aware of some of the threats to the Scarlet Macaw resource system, a few of them mentioned additional threats to the macaw on the last day that they had not mentioned on the first day. Participation in the project increased their common understanding of the Scarlet Macaw and its' habitat, which signals that such a project has potential for increasing the chances for effective common-pool resource management through collaborations between communities, park staff and university researchers.

Future Research

Opportunities for future research on the topic of the Central Pacific Scarlet Macaw population and the communities that share its habitat are plentiful. Repeating the mapping and monitoring project with a larger sample size, over a longer time period, and perhaps with a more diverse group of participants has the potential to generate a more reliable assessment for the potential of collaborative resource management of the Central Pacific Scarlet Macaw population as well as an opportunity to look at the impacts of participation in a project such as the one piloted in this study. Involving participants in the design of a research project, rather than just as data collectors, would provide an opportunity for participants to develop or utilize the leadership and organizational skills that are associated with successful common-

pool resource management. **"**To date, there are very few examples of partnerships between formal researchers and local stakeholders in which the latter are driving the research process at local level" (Probst and Hagmann 2003, 4). Broadening the research to include an analysis of the current institutional arrangements of the Central Pacific Conservation Area as compared to the design principles for institutional arrangements developed by Ostrom might provide additional insight into what arrangements could be changed or created to encourage long-term collaborative resource management and contribute to increasing the Scarlet Macaw population to the envisioned 1,000 individuals by 2020.

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Appendix A: Participant Questionnaire

Fotografia: Adrián Arce Arias

Proyecto de localización y observación de las Lapas Rojas

Cuaderno de ejercicios

Enero 2010

Bienvenido al Proyecto de Localización y Observación de la Lapa Roja, y gracias por participar. Las preguntas contenidas en este cuaderno de ejercicios no son una prueba. No hay respuestas correctas o incorrectas. Estamos interesados en comprender lo que sabe acerca de la conservación y cuáles son sus opiniones sobre determinados temas. Por favor, tómese el tiempo para escribir todo lo que pueda en cada uno de los temas. Algunas de las preguntas requieren respuestas cortas, y otras requieren respuestas más detalladas.

Nombre de participante: _____

Fecha: _____

Día 1

1. Por favor, describa sus creencias acerca de la conservación de los bosques en Costa Rica.
   (*Por ejemplo el estatus, la pérdida de bosques, y la conservación*)
   Please describe your beliefs about forest conservation in Costa Rica.
   (*For example*: *status, forest loss, preservation)*

2. ¿Dónde construyen sus nidos las Lapas Rojas?
   Where do Scarlet Macaws nest?

3. ¿Qué comen las Lapas Rojas? ¿Dónde se encuentra este alimento?
   What do Scarlet Macaws eat? Where is this food found?

4. ¿Las Lapas Rojas tienen depredadores? Si es así, ¿cuáles son los principales depredadores de las lapas rojas?
   Do Scarlet Macaws have predators? If so, what are the main predators of Scarlet Macaws?

5. ¿Las Lapas Rojas necesitan ser protegidos? ¿Por qué o por qué no?
   Should Scarlet Macaws be protected? Why or why not?

6. Por favor, dibuje un mapa del ámbito o hábitat de la Lapa Roja en el Área de Conservación del Pacífico Central. Incluya todo lo que crea que es necesario para representar el hábitat.
   Please draw a map of Scarlet Macaw range/habitat in the Central Pacific Conservation Area. Include whatever you think is necessary to portray the habitat.

Por favor, marque con una "X" el casillero que más se acerque a su opinión sobre cada pregunta.
Please put an "X" in the box that most closely matches your opinion about each question.

	Totalmente de acuerdo **Strongly Agree**	Medianamente de acuerdo **Mildly Agree**	Indeciso **Unsure**	Ligeramente en desacuerdo **Mildly Disagree**	Muy en desacuerdo **Strongly Disagree**
1. Estoy involucrado en mi comunidad. **I am involved in my community.**					
2. La llamada "crisis ecológica" con la que se enfrenta la humanidad se ha exagerado mucho. **The so-called "ecological crisis" facing humankind has been greatly exaggerated.**					
3. La pérdida de los bosques tropicales no será realmente un problema para mí y mi familia. **The loss of tropical forests will not really be a problem for me and my family.**					
4. Los seres humanos están abusando gravemente del medio ambiente. **Humans are severely abusing the environment.**					
5. Si las cosas siguen su curso actual, pronto experimentaremos una catástrofe ecológica muy seria **If things continue on their present course, we will soon experience a major ecological catastrophe.**					
6. Me he comprometido a hacer una diferencia positiva en mi comunidad. **I am committed to making a positive difference in my community.**					
7. Las plantas y los animales tienen tanto derecho como los seres humanos a existir. **Plants and animals have as much right as humans to exist.**					
8. La pérdida de los bosques tropicales en realidad no será un problema para otras especies de					

plantas y animales. **The loss of tropical forests will not really be a problem for other species of plants and animals.**					
9. Siento que puedo colaborar en la conservación de la biodiversidad. **I feel that I can make a difference in the conservation of biodiversity.**					
10. La tierra es como una nave espacial con espacio y recursos muy limitados. **The earth is like a spaceship with very limited room and resources.**					
11. Planeo participar en futuros esfuerzos de conservación. **I plan to participate in future conservation efforts.**					
12. La pérdida de los bosques tropicales no será realmente un problema para el país en su conjunto. **The loss of tropical forests will not really be a problem for the country as a whole.**					

Día 2

7. ¿Quién lidera el esfuerzo de conservación de la Lapa Roja? ¿Quién más participa?
   Who leads the Scarlet Macaw conservation effort? Who else participates?

8. ¿Los miembros de las comunidades locales influyen en la administración de la Lapa Roja? Por favor describa cómo y discuta si hay otras formas en las que los miembros de la comunidad deberían ser influyentes.
   Are local community members influential in Scarlet Macaw management? Please describe how and discuss if there are other ways community members should be influential.

Día 3

9. ¿Qué aprendió hoy sobre el hábitat de la Lapa Roja?
   What did you learn today about Scarlet Macaw habitat?

Día 4

10. ¿Usted o su familia están involucrados en la administración o en la conservación de la Lapa Roja? ¿Cómo?
    Are you or your family involved in Scarlet Macaw management or conservation? How?

11. ¿Si los miembros de las comunidades locales no participan en la conservación y la administración de la Lapa Roja, deberían participar? ¿Tiene alguna idea de cómo podrían participar más y tener más influencia?
    If local community members are not involved in Scarlet Macaw conservation and management, should they be involved? Do you have some ideas of how they could be more involved, and more influential?

12. ¿Volvería a participar de este proyecto voluntariamente? ¿Por qué o por qué no?
    Would you volunteer to participate in this project again? Why or why not?

13. ¿Cree que a su familia y amigos les gustaría participar? ¿Por qué o por qué no?
    Do you think your friends and family would want to participate? Why or why not?

Día 5

14. Por favor, describa sus creencias acerca de la conservación de los bosques en Costa Rica.
    (*Por ejemplo el estatus, la pérdida de bosques, y la conservación*)
    Please describe your beliefs about forest conservation in Costa Rica.
    (*For example*: *status, forest loss, preservation)*

15. ¿Dónde construyen sus nidos las Lapas Rojas?
    Where do Scarlet Macaws nest?

16. ¿Qué comen las Lapas Rojas? ¿Dónde se encuentra este alimento?
    What do Scarlet Macaws eat? Where is this food found?

17. ¿Las Lapas Rojas tienen depredadores? Si es así, ¿cuáles son los principales depredadores de las Lapas Rojas?
    Do Scarlet Macaws have predators? If so, what are the main predators of Scarlet Macaws?

18. ¿Las Lapas Rojas necesitan ser protegidos? ¿Por qué o por qué no?
    Should Scarlet Macaws be protected? Why or why not?

19. Por favor, dibuje un mapa del ámbito o hábitat de la Lapas Roja en el Área de Conservación del Pacífico Central. Incluya todo lo que crea que es necesario para representar el hábitat.
    Please draw a map of Scarlet Macaw range/habitat in the Central Pacific Conservation Area. Include whatever you think is necessary to portray the habitat.

20. ¿Qué aprendió sobre el hábitat de la Lapas Roja en este proyecto?
    What did you learn about Scarlet Macaw habitat during this project**?**

Appendix B: Human Subjects Review Exemption

CORRECTION (title only)

WESTERN WASHINGTON UNIVERSITY
Office of Research and Sponsored Programs

MEMORANDUM

TO: Kathryn Mork, Environmental Studies Department, MS 9085

FROM: Geri Walker, Office of Research and Sponsored Programs, MS 9038

DATE: January 21, 2010

SUBJECT: Human Subjects Review – Exemption Approval

Thank you for submitting a human subject research exemption request for your research project "Impact of a Participatory Mapping and Monitoring Project: A Case Study of the Central Pacific" for review by the Human Subjects Review Committee (HSRC). The HSRC has reviewed the materials you submitted and found the project described falls into category #2 (research involving survey or interview procedures). This category is exempt from full HSRC review per 45 CFR Part 46.101(b)(1).

If the involvement of human subjects changes over the course of the study in a way that would increase risks, please submit a revised protocol. If you have any questions, please feel free to call Ken Clark at 650-4403.

cc: Troy Abel, Faculty Advisor, Environmental Studies Department
Graduate School