Re-interpreting the Impacts of Indigenous Hunting: A Participatory Geographic Analysis of Miskito Wildlife Use in Eastern Honduras

By Marc-André Dunn, B. Sc.

A thesis submitted to the

Faculty of Graduate Studies and Research

in partial fulfillment of the requirements

for the degree of Master of Arts

Department of Geography and Environmental Studies

Carleton University
Ottawa, Ontario, Canada
December 17, 2004

Abstract

Subsistence hunting was investigated in two Miskito communities in eastern Honduras by a participatory research team, that included eight local investigators, who collected data on game captured. Over 72 days, 58 hunters caught approximately 1,610 kg of game. The most important species was the collared peccary (*Tayassu tajacu*), making up roughly 35% of the total harvest. The type and quantity of game captured is affected by the timing of agricultural tasks, wage labour and holidays; ethnozoological knowledge; access to different technologies; cultural preferences and species' ecological characteristics. The overall hunting zone was delimited and divided into four sub-zones based on differences in habitat, the type of game caught and frequency of use. Miskito wildlife use is highly complex, making the application of quantitative models to evaluate its sustainability problematic without consideration of spatial patterns, the local socio-cultural context and the role of local people in conservation.

Résumé

Cette thèse présente une enquête participative sur la chasse autochtone dans deux communautés Miskito dans l'est de l'Honduras, effectuée par l'équipe de recherche composée de sept chercheurs locaux. Durant 72 jours, 58 chasseurs ont récolté près de 1,610 kg de gibier, avec le pécari à collier (*Tayassu tajacu*) l'animal le plus chassé, composant 35% du poids total. Le type et quantité de gibier capturé sont affectés par l'occasion du boulot agriculturel, d'emploi rénuméré et des fêtes; les connaissances écologiques locales; la connaissance des conditions écologiques locales; l'accès aux nouvelles technologies; les préférences culturelles ainsi que l'écologie du gibier. Le

territoire de chasse des Miskito a été délimité et divisé en quatre zones, selon les facteurs suivants : les différences dans l'habitat prédominant, les types d'animaux chassés et la fréquence d'usage. La chasse de subsistence est une activité complexe, ce qui rend difficile l'application de modèles quantitatifs pour évaluer la durabilité d'une telle pratique, sans considérer les modèles spatiaux, le contexte socio-culturel et le rôle des communautés dans la conservation de la faune.

Resumen

Esta tesis presenta una investigación participativa de los patrones espaciales de la cacería indígena, hecha en dos comunidades Miskitas en el este de Honduras por un equipo de investigación compuesto por ocho investigadores locales. En 72 días, 58 cazadores cosecharon aproximativamente 1,610 kg de carne silvestre y el animal más cazado fue el quequeo (*Tayassu tajacu*), correspondiendo al 35% del peso total. El tipo y cantidad de animales cazados están afectados por la ocasión de trabajo agricultural, del ganar dinero y de días feriados; los conocimientos ecológicos locales; el accesso a tecnologías nuevas; tendencias culturales y la ecología del animal de caza. El territorio de caza de los Miskitos fue delimitado y se divide en cuatro zonas, según diferencias en el hábitat predominante, tipos de animales cazados y la frecuencia de uso. La cacería de subsistencia es una actividad muy compleja, lo que hace difícil la aplicación de modelos cuantitativos para evaluar su sostenibilidad sin considerar los patrones espaciales, el contexto socio-cultural local y el papel de las comunidades mismas en la conservación de la fauna silvestre.

Preface and Acknowledgements

The following thesis describes research that I conducted in the Honduran Moskitia between June and November, 2003. To acknowledge the tremendous knowledge of plants, animals and geography that the Miskito possess, I have included within the text different Miskito terms in italics. I have included in an appendix a more complete list of Miskito and local Honduran names for the many different trees, crops and wildlife that make up the way of life for people in the communities of Kuhrpa and Tukrun. I have also inserted, in italics throughout the text, comments made to me, in Spanish, by local residents during my stay, with translations given in brackets. Finally, all references to monetary value are given in Canadian dollar amounts (CAD). At the time of this study, the exchange rate was approximately one Canadian dollar to twelve Honduran Lempiras.

There are so many people to whom I feel greatly indebted for helping me along this journey. Firstly, I would like to dedicate this thesis to my mother, Grace Courey, who pushed me this far. I would also like to dedicate this to the wonderful people of Kuhrpa and Tukrun, departamento de Gracias a Dios, Honduras, without whom this project would not have been possible. *Tinki pali.* Finally, I would like to signal the hard work of the eight local investigators who made this research a success: Macario Cruz, Germán Prado, Edgardo Prado, Francisco Zelaya, Cresencio Flores, René Barrios, Lucio Mena and Teofilo Moncado. *Tinki manis.*

Many thanks are due to the people who helped me establish myself in Honduras. Special thanks to MOPAWI, namely Carlos Molinero, Adalberto Padilla, Osvaldo

Mungia and Snyder Paisano, who provided important information and valuable logistical support, as well as Margarita, Sara and Glenda for helping manage my affairs while in the field. Various institutions facilitated my work, namely the Honduran History and Anthropology Institute (IHAH), the Department of Protected Areas and Wildlife (DAPVS) of AFE-COHDEFOR and the Río Plátano Biosphere Project (BRP). In La Moskitia, thanks to the municipality of Wampusirpi, mayor Nacel Kiapa, Edicin Cruz, Rodolfo Prado and Herminio Flores. Many thanks to Maria Prado de Kiapa for keeping my belly full. Finally, thank you to the Prado, Cruz Zelaya and Ferrera Rivas families for adopting me for a few months.

In Canada, I would like to thank Dr. Derek A. Smith for all his support, Hazel Anderson for her patience and Golda Markel for her smile. As well, thanks to friends and family for their support: Roger, Cito, Jane, Stef, Johnny, Jeremy, Oliver, Chendo, Moeser, Scotty, Mike, Lisa, Annie, Marcelo, Sacha, Jesse, D., Kumari, Rosa, and especially Jeff and Manu for supplying friendship and food for me at the end.

This project was made possible thanks to a generous grant from the Canadian International Development Agency (CIDA) "Innovative Research Awards." I also want to thank Dr. and Mrs. Ken Torrance for their financial support. Finally, the author gratiously acknowledges financial support for this master's degree from the Natural Sciences and Engineering Research Council of Canada (NSERC), Carleton University and the Norman Pollock Memorial Scholarship for Latin American studies.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1
Introduction

This thesis presents the results of field research that investigated subsistence wildlife use in two Honduran indigenous Miskito communities from a geographic, ethnographic and ecological perspective. The broad purpose of this study is to demonstrate the importance of examining hunting's spatial patterns in understanding the impact of this activity on the rain forest environment. The Miskito hunting zone can be divided into four distinct sub-zones, based on the dominant habitats found in each sub-zone, game animals caught, frequency of use and distance from the community. Understanding how hunters use these different sub-zones provides insight into the interrelation of local practices and hunting patterns, information that can be used to develop more effective wildlife management frameworks in indigenous regions of tropical Latin America. More broadly, results show that understanding the spatial dimensions of natural resource use, as well as their cultural significance, is important for any long-term conservation effort.

1.1 The Resource Extraction Conservation Model, the Importance of Wildlife Management and "The Hunt for Sustainability"

In the past decade, tropical conservation discourse has shifted towards promoting protected area frameworks that give forest-dwelling peoples usufruct rights over the natural resources found within them (Anderson 1990; Browder 1989). This has been largely brought about by three decades of unsatisfactory results from "no touch"

protected areas designed after North American and European models. Inherent to the extractive protected area model is the recognition of the right of people that inhabit these areas to continue making a living from forest products as they have done in the past (Baker 1989). The shift towards extractivism represents a welcome change because most of the world's last remaining tropical forest tracts continue to be inhabited by indigenous groups (Herlihy 1997; Wilcox and Duin 1995). Today, parks and reserves are found in many parts of the tropics that permit a wide variety of harvesting activities, from the selective cutting of lumber to rubber tapping to subsistence hunting (Brandon, Redford and Sanderson 1998; Freese and Saavedra 1991: 433). The challenge for conservationists therefore lies in finding ways to ensure the long-term use of these resources, while avoiding major negative impacts on tropical biological diversity (Brandon, Redford and Sanderson 1998: 6-8).

Wildlife is an important natural resource for people inhabiting rain forest regions: wild animals are harvested from their surrounding environment for food, religious adornment, clothing, and other products (Redford and Robinson 1991). Despite significant social change, many neotropical indigenous cultures continue to depend on game as a primary source of protein (Stearman 2000). However, rapid population growth among groups has created a greater demand for these products (Stearman 2000: 238-240), while uncontrolled deforestation and widespread habitat conversion are greatly reducing the tropical wildlife supply (Alves 2002; Heckadon-Moreno 1997; Laurance and Williamson 2001; Skole et al. 1994; Smith and Schultes 1990). Moreover, forest fragmentation is increasingly isolating game populations that, in the past, likely relied significantly on the immigration of individuals from unhunted areas to renew themselves

(Peres 2001: 1499-1500). As a result, there is an ever-increasing risk that over-hunting "empties" remaining forests of game (Redford 1992). Considering current estimates that up to 90% of tropical plants depend on vertebrate animals to reproduce (Wehncke et al. 2003), a forest devoid of animals would likely effect important ecological change. Given the large role played by proper rain forest function in global climatic stability (Clark 1992), developing conservation frameworks that ensure stable wildlife populations over the long term is an important priority.

The concern about tropical wildlife populations has led conservationists to turn their attention to the sustainability of subsistence wildlife use by forest-dwelling peoples (Robinson and Bennett 2000). Consequently, scientists have developed quantitative models to evaluate hunting (Milner-Gulland and Akçakaya 2001; Robinson and Redford 1991). However, these models provide a very narrow understanding of a much broader cultural activity. Nevertheless, few recent conservation-oriented studies have attempted to investigate the impacts of tropical hunting from a wider-ranging perspective that includes cultural practices and resource use patterns. Consequently, tropical wildlife management, an area that draws from both social and natural sciences (Anderson 2002), is becoming increasingly dominated by positivistic interpretations of hunting with a decreasing importance placed on the local social context in which the activity occurs. Especially problematic is the failure of current wildlife management models to adequately include local actors in the conservation process.

1.2 Seeking New Directions: Participatory Research and The Spatial Patterns of Hunting

Local involvement in the management of tropical biodiversity has become a foundation for extractive protected area models, based on the argument that communities have an overarching ability and interest to regulate the resources they use (Agrawal and Gibson 1999: 631-633). Recently, in the neotropics, a small but growing number of cases have shown that, when given the opportunity, communities themselves can play an important role in developing and implementing wildlife management plans that are successful in curbing local wildlife depletion (Bodmer and Puertas 2000; Hill and Padwe 2000; Leeuwenberg and Robinson 2000). From these studies, it has become increasingly clear that effective management of hunting in forested tropical regions requires: (1) a greater understanding among conservationists of the cultural reality in which local people find themselves and (2) that forest peoples feel that the wildlife management discourse represents their needs and interests (Leeuwenberg and Robinson 2000: 392-394).

This thesis attempts to address the issues described above through the study of spatial patterns of wildlife use by Miskito hunters in eastern Honduras. Despite recognizing the importance of considering geographic variables in understanding hunting, very few studies have explicitly examined the spatial dynamics of this resource extraction activity. The location where a game animal is caught is not simply the result of random encounters with wildlife. Instead, it is a result of complex interactions between both anthropogenic and environmental variables that influence hunting. Hunters make choices relative to other economic activities as well as different strategies used when hunting, each resulting in different locations where game will be caught. Moreover, game are not

found equally throughout the hunting area, but instead are concentrated in specific areas based on ecological productivity and habitat preferences. Thus, spatial patterns would likely emerge over time that can be interpreted and understood within the context of the many variables that influence wildlife use.

Three major research questions have guided this research. Firstly, what are the different characteristics of current Miskito hunting, such as: who hunts; how and when hunting occurs; what animals are hunted, in what quantities, and what technologies are used; what type of knowledge is applied by hunters to catch game; and how do these different factors influence hunting yields? Secondly, where is game caught and what characteristics influence the location of the catch; what environmental factors influence its location? And finally, what does this information tell us about the impact of this resource extraction activity on local wildlife, its long-term sustainability and management? To address these questions, four months were spent in two Miskito communities along the Río Patuca in eastern Honduras, with the following specific objectives: to conduct a census of local hunters; to document local hunting practices by participating in outings with hunters; to produce a map of the local hunting zone with community members; to document hunted wildlife by community members and to conduct interviews with hunters of past successful catches by focusing on seven important game species.

My research has attempted to further involve local people through the application of a participatory research methodology. Eight local investigators, from both study communities, were hired and trained. This reflects a strong conviction that local people have the knowledge and capacity to understand and conduct sound scientific research

(Jackson 1993; Smith 2003). Over and above this is the belief that communities throughout the neotropics should have a greater stake in the decisions taken to manage and control the use of resources that are a part of their everyday lives.

Ultimately, it is hoped that this research will contribute knowledge to the growing area of tropical wildlife conservation and management. The results of this thesis indeed demonstrate the importance and utility of frameworks that are sensitive to forest-dwelling cultures and advocate community-based conservation that builds on local peoples' knowledge and value systems.

Chapter 2
Neotropical Hunting, Indigenous Resource Use and Miskito Society: A Review of Relevant Literature

Anthropologists, ecologists and, to a lesser extent, geographers have studied neotropical wildlife use from their respective disciplines' viewpoint, resulting in a variety of interpretations of the nature of the activity as well as how this knowledge should be applied to wildlife conservation. This chapter reviews the most important findings regarding indigenous hunting in order to synthesize a broad vision to guide this thesis. First, theoretical constructs and understandings of neotropical hunting are reviewed, providing a basis for the study of spatial patterns of hunting as a central theme of this research. I then provide an overview of studies documenting indigenous hunting, with a discussion of their implications to current understandings of its impacts on neotropical environments. Finally, I review research conducted among the Miskito of Central America to provide background information on the study area for this thesis, with a particular emphasis on natural resource use.

2.1 Geographic Understandings of Hunting: From Early Theories to Modern Methodologies

Geographers have long investigated how people relate to the natural resources that they use, and debates have taken many different directions over time. While a complete overview of such a complex topic would not be practical, a focus on the most closely related issues provides a basis for understanding the conceptual framework on which this thesis is based.

2.1.1 Early Geographical Perspectives, Cultural Ecology and the Cultural Landscape

Geography has traditionally examined the human-environment relationship from both physical and social sides (Brunhes 1925: 55; Pattison 1963: 214). This was a primary concern among German geographers at the end of the nineteenth century (Unwin 1992: 91). Led by Friedrich Ratzel, many German scholars interpreted the physical environment as the primary determinant in the historical progression of human societies (Brunhes 1925: 61). While the impacts of these studies were observable for decades to follow (Elkins 1989: 28), their deterministic interpretations were later replaced, in different academic fields, by possibilism, recognizing the importance of the physical environment but rejecting any direct causal influence on the evolution of human societies (Brunhes 1925: 56; Dickinson 1969: 209; Pattison 1963: 214-215).

Cultural ecology is the branch of geography concerned with the relationships between culture groups and environments. Cultural practices, beliefs and preferences are seen as intimately related to the surrounding environment. Cultural ecology was also an important field in anthropology, where cultures were seen in light of adaptations to the limitations imposed on them by the surrounding environment and available resources (Steward 1955: 91). However, while anthropologists often compared functional elements the human-environment relationship among different cultures (ibid: 92-97), geographic interpretations were strongly rooted in the specific physical context (i.e., the landscape) in which a given culture was found (Unwin 1992: 98).

A very prominent geographer in the early to mid-twentieth century concerned with human-environment relationships was Carl O. Sauer. Sauer saw this relationship as

dynamic, where cultures are not only influenced by the surrounding environment but are also important geomorphic agents acting upon them over time (Sauer 1987: 156-160; Unwin 1987: 98). Sauer's interpretations were largely historical, with the environment seen as a physical artefact of human use over time, referred to as the "cultural landscape" (Sauer 1987: 159-162; Speth 1987: 11). Cultural landscapes are constantly changing with time, a result and a reflection of larger changes that all cultures undergo through history (Sauer 1925).

Another important cultural ecology geographer was Bernard Nietschmann. Nietschmann (1973: 4) viewed human-environment relationships as highly complex and interrelated systems. His work was somewhat of a departure from previous theories, in that cultures and environments were not seen as isolates acting on each other, but instead as intimately connected through elaborate feedback mechanisms and circular relationships operating at many different levels. Nietschmann theorized that a tropical subsistence economy, which might include hunting, fishing, agriculture, and other activities, is an example of a human-environment system, defined as: "The assemblage of technologies and strategies with which humans modify and exploit energy relationships in order to tap and control biotic systems in the supply of energy and materials for human sustenance and maintenance" (ibid: 5). Subsistence systems are regulated by how people culturally perceive and use the resources available to them (Nietschmann 1973: 8). Systems are at once self-maintaining through well-established technologies and strategies, while at the same time constantly transforming through contact with different worldviews, economies, and forms of knowledge (ibid; Steward 1955: 82-83).

Current geographic understandings of the human-environment relationship have

come a long way since the academic discipline's beginnings more than a century ago. Much of the more recent research in this broad area has examined how human-nature relationships are linked to current environmental problems, particularly natural hazards and disasters (Emel and Peet 1989: 49). Most notably, investigation has placed a greater emphasis on the broad socio-historical context within which a given human-environment relationship evolves. Political ecology provides one prominent example, where the focus is on how cultural ecologies at the community-level can be influenced by larger social, economic and political structures (Dodds 1994; Paulson, Gezon and Watts 2003). Moreover, power relations that exist between groups of people, often based on ethnicity, social status and gender, are shown to heavily influence how land and resources are negotiated and used (Page 2003: 358; Paulson, Gezon and Watts 2003: 207-208). Another field that has emerged from cultural ecology, particularly among scholars of indigenous groups, is ethno-ecology, concerned with peoples' folk knowledge of environmental processes (Alcorn 1989; Berlin and Berlin 1983; Nazarea 1999; Toledo 2002). How people perceive, understand and classify the resources they use is shown to play an essential role in how they relate to their surroundings.

While current understandings of cultural ecology have only enriched our understandings of the complex relationship between people and their surrounding environment, scholars warn of straying too far from the distinct ecological reality of the unit of study (Page 2003; Vayda and Walters 1999). An important challenge for cultural ecology therefore lies in finding an adequate means of representing this relationship within a defined area, given what we already know, in order to understand the role it can play in the conservation and management of resources, such as wildlife, over time.

2.1.2 The Study of Spatial Patterns as a Conceptual Approach to Hunting

This thesis argues that in order to gain a complete picture of Miskito wildlife use, it must be examined as part of the complex relationship between the people who use game animals and their surrounding environment. Hunting is one of many activities that make up a larger, constantly changing subsistence system, rooted in the cultural practices and preferences of those using wildlife resources, but also affected by ecological processes that regulate the availability of game as well as by broader socio-economic and political contexts (Dodds 2001: 94-97; Linares 1984: 964; Nietschmann 1973: 105-114). Cultural landscapes play an important role in this relationship because they are constantly modified by peoples' land-use practices, which, in turn, often affect the distribution and abundance of game populations.

This thesis attempts to understand the cultural ecology of Miskito hunting through the study of its spatial patterns. The location of a given hunt is the result of complex interactions between hunters' preferences and the strategies used to procure game, influenced by the relative location of communities, farmlands and rivers, as well as the time of year, the animal hunted and the number of hunters, and other variables. Furthermore, game resources tend to be concentrated in areas where ecological conditions result in their relative abundance, areas where hunters will indeed exploit often (Nietschmann 1973: 176). Patterns therefore emerge over time that can give important information regarding the nature of this activity and how it is practiced under different circumstances. These, in turn, can help further understand impacts on local game populations. Spatial patterns, however, can only be understood within the context

of the many economic activities and cultural practices that influence wildlife use, hence the use in this thesis of an ethnographic approach that examines hunting as well as its place within local subsistence systems.

2.1.3 The Participatory Research Methodology: Approaching Human-environment Relationships from the Inside

A participatory research methodology was employed for this project. Participatory research refers to a suite of approaches that seek to further involve local people in the research process. Local people often possess exceptional knowledge of ecological processes (Alcorn 1989; Berlin and Berlin 1983; Reichel-Dolmatoff 1996) as well as of geographic space (Herlihy 2003; Smith 2003). By assigning an active role to local people in the collection of data, participatory research attempts to integrate ethno-ecological knowledge into the production of information. "Local investigators" work closely with academics in conducting research that is both scientifically rigourous and socially relevant, thereby giving local people a voice in research that directly concerns them (Jackson 1993: 53; Herlihy and Knapp 2003: 303; Smith 2003: 335).

A fundamental element of participatory research is the recognition that local knowledge systems are of equal value to western science (Park 1997: 8-9). Local investigators are important collaborators, well versed in the research project, its objectives and results. Thus, the approach seeks to do away with more traditional researcher-researched dichotomies, recognizing that local people are highly capable investigators in their own right (Herlihy and Knapp 2003: 304; Hill et al. 1997: 1341-1342; Smith 2003: 340).

Indigenous peoples, both in the developed and the developing world, have a long history of economic and political marginalization (Bryceson, Manicom and Kassam 1982; Fals-Borda 1987; Jackson 1993). Participatory research is an attempt to reverse this by promoting a more equitable exchange of knowledge between outside researchers and local people. In this sense, participatory research is an educational process, where participants come to see each others' realities from the inside (Park 1993: 3). From a researcher's perspective, the approach opens new doors to understanding local peoples' relationships to the land, as well as the challenges and constraints with which this relationship is faced. From a local perspective, people develop a greater consciousness of their ability to understand and solve the problems they face, a first step towards action and change (Chambers 1994: 1253; Freire 1971).

Thus, in theory, participatory research gives local people an opportunity to use their wisdom and knowledge for both their own benefit and the benefit of science (Herlihy and Knapp 2003: 304-305). Local people are key stakeholders in wildlife management, such that their active participation in any conservation framework is vital for its long-term viability (Houseal, Ostria and Touval 1998: 29). Thus, it is hoped that participation stimulates local empowerment, imparting a strong sense of ownership of communal hunting knowledge and resources, a first step towards building strong community-based wildlife management institutions (Agrawal 1995: 432; Berkes et al. 1989).

In this thesis, various participatory approaches were employed. A population census and interviews were conducted with the active involvement of local investigators. Furthermore, local investigators maintained a registry for hunts occurring in both

communities. Finally, investigators facilitated the creation of maps documenting hunting lands.

2.2 Understanding the Impacts of Subsistence Hunting

To understand the impacts of subsistence hunting, policy-makers concerned with the conservation of tropical biodiversity have turned to ecologists and anthropologists. By nature, the two fields examine the relationship very differently, the former from a purely positivistic, wildlife-centered perspective whilst the latter from an ethnographic, human-centered perspective. While both interpretations are beneficial, the study of the spatial patterns of hunting can greatly improve current understandings because it demonstrates that hunters utilize specific areas within their surroundings to catch certain species and that the impact of hunting on local wildlife populations not only depends on the frequency at which game is caught, but also upon where different species are hunted.

2.2.1 Wildlife Management and the Ecological Study of Hunting

Ecologists usually approach the subject of hunting within the context of wildlife management theory. Wildlife management is a pragmatic science that seeks to understand and minimize the impacts of human practices, whether direct or indirect, on wildlife populations (Anderson 2002: 4). Consequently, research is often directed towards understanding wildlife population dynamics to maintain managed species at levels that assure their proper ecological functioning over time (ibid). According to

wildlife management theory, a given game species can be continually harvested within a given area, without depleting populations, so long as harvests do not exceed a defined threshold level, referred to as the maximum sustainable yield (MSY) (ibid: 412). At hunting rates above the maximum sustainable yield, game populations are assumed to be no longer able to renew themselves sufficiently and continued harvesting eventually depletes the resource.

Tropical wildlife population dynamics have always been somewhat of a mystery for ecologists, where high interspecific competition, complex social behaviour, and other factors often result in erratic densities (Robinson and Redford 1986: 665-666; Robinson and Redford 1991: 418-419). In addition, overall understandings of tropical ecology continue to be relatively limited. In 1991, John G. Robinson and Kent H. Redford, two ecologists specializing in tropical wildlife management, developed a model for evaluating the sustainability of tropical hunting. The model assumes, for mammals at least, that individual species' "optimal" densities (that is, when there is little hunting, food is abundant and there is little interspecific competition) can be predicted based on their body size and diet preferences (Robinson and Redford 1986). At optimal densities, populations are growing at their fastest rate (referred to as maximum biological production). Thus, according to the "Robinson and Redford hunting sustainability model" (hereafter referred to as the sustainability model), if a species is harvested at levels beyond its rate of maximum biological production, the rate at which it will grow under optimal conditions, it can be safely assumed that hunting is not sustainable and, over time, will cause local depletion.

The sustainability model is intended to serve as a quick and simple means to

assess whether a given hunting regime will eventually deplete game populations. However, because the model provides an indirect estimate of a game species' MSY, based on optimal conditions that do not exist in nature, hunting rates lower than production rates cannot be assumed to be sustainable (Robinson and Redford 1991: 428; Alvard et al. 1997: 982). While the sustainability model has become the standard for tropical wildlife managers in Africa, Asia and Latin America (Whitfield 2003), it has very important limitations (Milner-Gulland and Akçakaya 2001). Most notably, the model assumes that maximum production rates, calculated using average species density estimates, are equal throughout the tropics. However, important differences in both rain forest form and function have been identified at small and large scales, likely resulting in varying production rates across space (Condit et al. 2002; Emmons 1984; Peres 2000; ter Steege and Hammond 2001). Furthermore, by calculating the harvest rate as the number of individuals caught within a given hunting zone, the model infers that hunting is distributed more or less evenly within that area. The sustainability model therefore does not adequately account for spatial variation in hunting, in both the way people use wildlife resources and the way these resources are distributed, that can potentially bias calculations.

The ecological approach to understanding the impacts of neotropical subsistence hunting involves the use and development of highly quantitative and predictive models to manage hunted populations over long periods of time. While there are clear benefits to using these models (ease of use, facilitates comparison, etc.), they pay little or no attention to past practices or to the cultural context in which hunting occurs. Subsistence hunting is part of a larger system where people are in constant interaction with many

different parts of their natural environment in the procurement of materials necessary to live; where cultural change is constantly re-defining how and where people harvest game from their surroundings (Ventocilla 1992: 85). Local people, when faced with fluctuations in game abundance, will likely respond by deliberately modifying hunting patterns in a variety of different manners. Hence, viewing models as ends in themselves risks reducing subsistence hunting to a stand-alone activity, thereby ignoring the complexity in which it is situated and potentially missing the broader implications of this resource extraction activity.

2.2.2 The Nature of Indigenous Conservation: The Anthropology of Hunting

Anthropologists have been quite active in the study of subsistence hunting in tropical areas, particularly among societies inhabiting the Amazon River basin (Hames and Vickers 1983), with research taking a wide variety of directions, including addressing questions regarding the evolution of human societies (Chagnon and Hames 1979; Gross 1975). One area of particular interest has been the relationship of neotropical indigenous hunting to resource conservation (Alcorn 1993; Stearman 2000). This issue is at the centre of current struggles among indigenous groups throughout the neotropics to assert their rights to their traditional lands and resources (COICA 1989; Houseal et al. 1985; Nietschmann 1995a; Wilcox and Duin 1995).

A major part of the indigenous conservation debate involves resolving notions of the "ecologically noble savage," that indigenous peoples live in harmony and balance with nature and therefore possess an intrinsic ability to conserve natural resources

(Redford 1991: 46). Much of this notion stems from the observation that hunting, like many parts of traditional subsistence systems, is often well adapted to the natural fluxes of tropical environments to maximize production from that environment, local knowledge is substantial, and wildlife is often not depleted (Alcorn 1984; Berlin and Berlin 1983; Stearman 1995: 211).

Generalizing the complex relationship between indigenous groups and wildlife as innate conservationism is highly problematic. Firstly, indigenous hunters often select game based on the maximum return available, with little importance given to other factors, such as protecting individuals with higher reproductive potential (females and juveniles) (Alvard 1995a). Thus, acts of "ecological nobility" are probably unrealistic, especially considering the demands of subsistence livelihoods (ibid: 802). Secondly, belief in the ecologically noble savage creates a dangerous "ideological trap", based more on western perceptions than empirical investigation (Redford 1991: 48). As Bruce Braun notes:

> (The) romanticization of the ecological Indian is fraught with problems, not least its demand that the Native fill a slot in a Eurocentric primitivist imagination. Although Native communities occasionally fill this slot for strategic reasons, they always do so at the risk of being declared not authentically indigenous at a later time if they happen to step outside its bounds, as they inevitably must (2002: 32).

The optimal foraging theory offers another anthropological description of indigenous conservation, based solely on the ecological economics of wildlife use (Alvard 1995a; Beckerman 1983; Good 1995; Hill and Hawkes 1983; Stearman 1995). According to the theory, a hunter will only catch a given game species when the ratio of benefits to costs is equal or greater than the average returns for all hunted species

(MacArthur 1972). Hence, the larger the game species, the greater the probability that it will be hunted when encountered. While this model likely gives a realistic perspective into the decision-making process involved in hunting a game animal, it is problematic in that it ignores the importance of cultural attitudes and preferences in regulating the use of specific game, such as food taboos (Linares 1984: 964; Nietshmann 1973: 106), as well as the many other intangible, non-economic benefits of hunting, such as maintaining cultural identities and relieving stress (Hill and Padwe 2000: 96; Smith 2005). Furthermore, the theory implicitly discounts the ability of indigenous people to recognize the long-term benefits of resource conservation (Alcorn 1995: 803). Nevertheless, the optimal foraging theory has served as the model for various studies that seek to understand game depletion among indigenous groups.

In recent years, anthropological studies have documented game depletion in various settings in the neotropics. In certain cases, depletion has come about as a result of the establishment of semi-permanent settlements among groups that traditionally practiced a nomadic lifestyle (Baksh 1995; Good 1995; Stearman 1995). Important large game species are first depleted near the community (Baksh 1995: 197; Good 1995: 114-115; Mittermeier 1991: 105), prompting groups to either seek game elsewhere or to turn to smaller animals for their protein supply (Good 1995: 115; Stearman 1995: 218). It is not uncommon to describe game depletion as a linear progression from the community with areas devoid of animals growing in a circular manner around the settlement over time (e.g., Mittermeier 1991: 105).

It appears that anthropologists align themselves in two camps: an optimistic view depicting indigenous groups as key players to long-term rain forest conservation (Alcorn

1993, 1995) and a less optimistic view depicting hunting as a destructive activity that will empty the forest of game without adequate control measures (Redford 1992; Redford and Stearman 1993). However, subsistence hunting is a complex, dynamic and distinct cultural activity, whose primary goal is human sustenance, not game depletion nor conservation (Nietschmann 1973). Indeed, when the needs of sustenance come into conflict with the survival requirements for specific game species, there is a strong risk for depletion. However, generalizing this tendency for the many different game species that inhabit the rain forest, as if hunters were on a virtual warpath with wildlife, is highly simplistic. This thesis proposes developing new ways of understanding the impacts of hunting that recognizes and accounts for its complexity.

2.2.3 Investigating Spatial Patterns to Understand the Impacts of Neotropical Hunting

It appears that neotropical indigenous wildlife use exhibits important geographic variation within a given hunting area. Hence, investigating hunting's emergent spatial patterns can provide useful information regarding the impact of this activity as well as its long-term sustainability. For example, Siona-Secoya hunters in Ecuador use areas closer to home more frequently than those found further away (Vickers 1991: 57-58). Thus, assuming that no other groups use these areas, the impact of hunting will likely be greater in nearby hunting grounds versus more distant ones. Yanomamö hunters in Venezuela rotate hunting zones within the overall hunting area when game is depleted to maximize hunting efficiency (Hames 1980). Thus, by temporarily abandoning hunting areas, game populations are likely able to recuperate over time, analogous to fallowing in agriculture

(ibid: 59; see also Leeuwenberg and Robinson 2000: 393).

Spatial patterns also represent complex interactions between many different variables related to the subsistence economy. While little research has explicitly examined how these interactions influence hunting patterns, one elaborate study among the Miskito of Nicaragua showed that hunting in forested areas generally increased in the dry season when weather conditions were unfavourable for sea turtle hunting, the main activity in the study community (Nietschmann 1973: 166). Evidently, the demands of other activities, along with the distribution of game within the hunting area relative to the community, likely determines how far hunters will go to find wildlife. Accordingly, Ventocilla (1992: 116) found that the Kuna of Panama hunt the bulk of their game animals within four kilometres of the community, with effort and yields dropping off substantially at greater distances.

The manner in which wildlife resources are used over space often exemplifies the complexity of influencing variables. For example, Vickers (1991: 58-59) shows that the size and shape of hunting areas was often highly specific to local settlement patterns, which in turn influence the impact of the activity on wildlife. Furthermore, Hames (1983) argues that shared hunting areas between two communities are not simply doubly impacted by hunting but instead negotiated, regulated and used based on the interplay of complex political, economic and ecological variables.

Game abundance also has important spatial patterns. Numerous studies have shown that the distribution of wildlife resources is patchy within the hunting area, with harvesting concentrated in patches where game is more abundant (Beckerman 1983; Hames 1980; MacArthur and Pianka 1966; Nietschmann 1972; Stearman 1995). Game

abundance within the overall hunting area will also be influenced by the presence of adjacent unhunted areas that serve as sources of wildlife that migrate into hunted "sinks" (Hill and Padwe 2000: 93; Pulliam 1988). It would also follow that less hunted areas can be potential sources for more heavily hunted areas, thus allowing hunting to continue at relatively high rates near communities (Hill and Padwe 2000: 92-94).

While the importance of considering the geographic parameters of hunting in assessing its ecological impact is evident, relatively little research has systematically examined hunting's spatial patterns. As a result, questions remain regarding how patterns vary from one game species to another, the role of ethno-zoological knowledge in understanding these patterns and the resulting impacts on individual game populations. Furthermore, while researchers have extensively analyzed factors that cause changes in indigenous hunting patterns, such as technological enhancements, social change and the integration of the market economy (Gross et al. 1979; Stearman 1995, 2000; Yost and Kelley 1983), little attention has been given to how these changes are manifested across space. Finally, while some researchers have divided hunting areas into zones based on frequency of use or on habitat diversity (Hames 1980; Hill et al. 1997; Nietschmnann 1972; Vickers 1991), emphasis is seldom placed on the use of zones to examine the spatial dynamics of hunting. Addressing these issues related to hunting's geographic variation should provide important insights into the overall impacts of this activity on local wildlife populations.

2.2.4 The Role of Indigenous Peoples in Wildlife Conservation and Management

Another question remains regarding the impacts of hunting on wildlife populations. What role do indigenous groups themselves have in the long-term conservation and management of wildlife resources: are they passive observers of a changing environmental dynamics or do they have the capacity to modify their hunting patterns in the face of growing game depletion? Cases exist, at local and regional scales, where groups have organized and successfully managed wildlife (Bodmer and Puertas 2000; Leeuwenberg and Robinson 2000; Nietschmann 1995a). However, in all cases, the development of strong local conservation institutions coincided with the struggle for legal recognition by central governments of each groups' land rights. For indigenous peoples, effective management of game resources that form an important part of their identity can only be achieved through political empowerment. As Janis Alcorn states (1993: 426): "In the real world, conservation of forests and justice for biodiversity cannot be achieved until conservationists incorporate other peoples into their own moral universe and share indigenous peoples' goals of justice and human rights."

Indigenous people can indeed play an important role in managing the impacts of wildlife use within their territories, although this depends on recognition of the need to manage these resources and, most importantly, the political capacity to do so (Berkes et al. 1989). Hunting is often the most extensive form of land-use among indigenous groups and, as a result, will define the boundaries at any given time of a community's subsistence zone. Hence, its management has broad implications for the entire subsistence economy, as well as for communal land claims. A participatory research

methodology is used in this thesis in part to engage local people in the political implications of wildlife conservation, with the ultimate goal of contributing to their empowerment. People are given the opportunity to be part of the research process, which is hoped to foster a heightened awareness of their role as key actors in the management of their resources (Freire 1971: 141; Herlihy and Knapp 2003: 304). However, the participatory approach is limited in that it does not legitimize ownership, a larger political process to be addressed so that people can feel they are protecting what is theirs and, consequently, so that they become protagonists in shaping their relationship with their surrounding environment (Berkes et al. 1989; Bodmer and Puertas 2000: 399-404; Fals-Borda 1987).

2.3 Background: A Review of Neotropical Indigenous Hunting

The neotropics are inhabited by a wide variety of indigenous peoples that continue to practice hunting in a variety of ways, reflecting differing relationships between cultures and wildlife. Nevertheless, there appear to be a number of similarities with respect to hunting among groups. For example, in many areas, subsistence hunting today is a secondary activity, practiced only occasionally. However, wildlife remains an important part of peoples' worldview as well as an important source of protein (Redford and Robinson 1987; Smith 2005; Townsend 2000; Ventocilla 1992). This section reviews the extant literature documenting neotropical hunting to understand how neotropical cultures relate to the wildlife resources they use. The purpose is to provide a broader context for understanding the nature of Miskito wildlife use in eastern Honduras

as well as interpreting its spatial patterns.

2.3.1 Neotropical Subsistence Hunting: A Primer

Subsistence hunting is different from hunting in western society because its primary motivation is to supply people with food, and is not a recreational activity (Alcorn 1995: 803). Hunting among indigenous groups is integrated within the larger subsistence economy and therefore complementary to other activities that make up this system. For example, while the Bari of Venezuela spend a substantial amount of time fishing, hunting also provides an important quantity of food because people hunt on their way to fishing grounds (Beckerman 1983: 296). Thus, the frequency of hunting will be determined by its importance relative to other activities as well as the possibility to hunt while participating in the local subsistence economy (Jorgenson 2000: 253). Among many groups, particularly those inhabiting regions where contact with outsiders is widespread, hunting is often secondary to wage labour and agricultural activities and is therefore subordinate to their demands (Jorgenson 2000: 262-263; Smith 2005; Stearman 1995: 219; Ventocilla and Paredes 1995: 49-51).

Hunting is generally male-oriented, although women and children have been known to participate in relatively smaller numbers (Gordon 1982: 113; Hill and Hawkes 1983: 147; Leeuwenberg and Robinson 2000: 393; Smith 2005; Stearman 1995: 211-212; Townsend 2000: 269; Werner 1983: 228; Yost and Kelley 1983: 194). Hunting can occur within close range of hunters' communities (Alvard et al. 1997: 979; Smith 2005; Smole 1976: 175; Ventocilla 1992: 116; Vickers 1991: 58), or at large distances, visited

on expeditions lasting several days, although these are usually far less common (Smole 1976: 176; Vickers 1991: 58; Werner 1983). Neotropical hunters have been known to apply a wide variety of tools to catch game, such as bows (Hill and Padwe 2000: 87), traps, snares (Gordon 1983: 116; Smith 2005), and blowguns (Yost and Kelley 1983). However, in recent times, many groups have readily adopted western tools such as shotguns and dogs, often supplanting more traditional weapons (Alvard 1995b: 58; Mena V. et al. 2000: 58; Smole 1976: 179-180; Stearman 2000: 274). Importantly, indigenous hunters are highly skilled at catching game, efficiently applying a variety of techniques, to track down elusive and cryptic animals in a highly unpropitious environment (Baksh 1995: 191-192; Hill and Hawkes 1983: 146-147; Yost and Kelley 1983: 194).

Hunting is usually directed towards large neotropical mammal species, such as the paca (*Agouti paca*), the agouti (*Dasyprocta* spp.), the white-lipped peccary (*Tayassu pecari*), and the collared peccary (*Tayassu tajacu*) (Redford and Robinson 1987: 657), although specific taboos can sometimes restrict or forbid the consumption of certain game (Leeuwenberg and Robinson 2000: 383; Mittermeier 1991: 100; Nietschmann 1973: 111; Smole 1976: 181; Ventocilla 1992: 33). However, indigenous hunters hunt a very wide breadth of game, including small animals, such as songbirds, that are often caught near communities (Gordon 1983: 113; Jorgenson and Redford 1993: 372-373; Smith 2005). Animals are caught in a variety of areas, including highly modified habitats such as agricultural fields (Linares 1976; Smith 2005). Yet, the habitat in which game is caught is highly dependent on individual species' preferences, such that paca and agouti are more likely to be caught in garden areas (Linares 1976: 347), while spider monkeys (*Ateles* spp.) and white-lipped peccaries are more likely to be acquired from undisturbed

forests (Eisenberg 1983; Reid 1997: 282). Also, because modified areas tend to be found close to home while distant areas are usually unmodified, those game less adapted to disturbed habitat, such as monkeys, also tend to be found further away from communities (Nietschmann 1973: 81, 98-99, 144; Ventocilla and Paredes 1995: 46).

2.3.2 The Importance of Neotropical Indigenous Hunting

Hunting forms an important part of the cultural identity of many neotropical indigenous groups. Proficient hunters are often highly respected by fellow community members (Ventocilla 1995: 39; Smith 2005), and wild meat is often perceived as more prestigious than domestic meat (Nietschmann 1973: 106; Stearman 2000: 236). Indigenous people are often reluctant at first to devote as much energy to animal husbandry as they do to catching game (Flowers 1983: 361-362). Hunting is also important among indigenous groups because it forms a cornerstone of traditional food-sharing systems. Game meat is often the primary item of reciprocal exchange for goods and services between community members (Helms 1971: 104-105; Ventocilla 1992: 93). As such, these systems help maintain egalitarianism within communities, an important part of the indigenous identity (Hill and Padwe 2000: 96; Nietschmann 1973: 185; Reichel-Dolmatoff 1996: 30).

Wildlife is often the focal point of traditional cosmology for many groups (Smole 1976: 180-181; Ventocilla 1995: 34, 42; Reichel-Dolmatoff 1996: 166-181; Smith 2005: in press). Hunting is often seen as part of a larger interaction with the metaphysical world, strongly mediated by spiritual powers and ritual obligation (Reichel-Dolmatoff

1996: 32; also see Flowers 1983: 368). Accordingly, it is not uncommon for specific game to be hunted solely for ceremonial purposes (Redford and Robinson 1991: 18-19).

With the increasing roles of animal husbandry and wage labour among indigenous groups, reliance on wild animals as a source of protein has greatly decreased (Jorgenson 2000: 262-263). Despite this, in specific cases, hunting has taken on a new importance in line with a more modern indigenous reality. Among the Aché of Paraguay, hunting has become a psychological outlet for those "facing the difficulties of adjusting to a new world", analogous to weekend vacations in western societies (Hill and Padwe 2000: 96). Among the Xavante of central Brazil, community leaders have identified hunting as a means of maintaining traditional forms of knowledge and therefore a "community responsibility" (Leeuwenberg and Robinson 2000: 393). While the place of hunting within indigenous societies will continue to change, its traditional importance with many neotropical groups makes it more likely that it will take on new roles within the changing identity of these groups than be abandoned completely.

2.3.3 The (Changing) Nature of Hunting in the Neotropics

Like all things cultural, hunting changes over time as people come into contact with different worldviews, economic models and more efficient hunting technologies. However, contact often occurs very abruptly, often as a result of incursion onto indigenous lands by Mestizo settlers[1], sometimes leading to dramatic changes (Ayres et al. 1991; Mena V. et al. 2000; Stearman 1995).

[1] The term Mestizo refers to inhabitants of Latin America of mixed European and aboriginal descent. In Central America, Mestizo peasants are often called "Ladinos".

Subsistence hunting has traditionally been regulated by taboo systems strongly associated with spiritual beliefs. A prominent example of such taboos is found among the Tukano of the Columbian Amazon. According to the Tukano, game abundance is controlled by *Vaí mahsë*, the Master of Animals, "a stern gamekeeper trying to protect his wards from overhunting and other forms of depletion" (Reichel-Dolmatoff 1996: 85). Afraid of misfortune, people often abide by the warnings of *Vaí mahsë* (ibid: 86). By regulating the consumption of specific game, taboos reduce or eliminate hunting pressure on those species. Taboo areas where hunting is not permitted have also been documented (Reichel-Dolmatoff 1996: 84). These act as refugia of game reproduction, thus potential source areas for wildlife to move into sink areas where hunting occurs. Although taboos have been successful in regulating hunting among many indigenous groups, conversion to Christianity and the increasing influence of the market economy have led to the widespread modification of these traditional belief systems (Chapin 1995: 118; Gross et al. 1979; Ventocilla 1992: 33).

One of the most notable changes in neotropical indigenous hunting practices has been the widespread adoption of firearms as the primary hunting tool (Stearman 2000: 243). This weapon has been shown to increase overall hunting efficiency, particularly for catching arboreal game (Yost and Kelley 1983: 212). Among the Huaorani of the Ecuadorian Amazon, firearms all but replaced blowguns and spears fifteen years after their introduction (Mena V. et al. 2000: 60). Although in certain cases more traditional weapons may be retained because of their efficiency in catching certain game (such as the spear for hunting white-lipped peccary), modern tools are readily integrated into indigenous subsistence systems when available (Alvard 1995b: 58). Along with firearms,

the use of hunting dogs to catch burrowing animals (Mena V. et al. 2000: 58; Stearman 2000: 274), and flashlights for nocturnal game have also been documented (Stearman 2000: 243; Ventocilla 1992: 103). However, the use of modern technologies does not directly translate into unsustainable hunting practices. In some cases, the adoption of firearms only brought about a decrease in the hunting effort, while negligible changes were observed in the overall harvest rate (Alvard 1995b: 64; Hames 1979: 251).

The nature of indigenous hunting will likely continue to change. Among certain groups, recent changes have been drastic, eliminating previously embedded hunting limits and creating a strong potential for overharvesting of game and local depletion. However, expecting indigenous peoples to continue to hunt according to "traditional" practices is both unrealistic and paternalistic (Redford and Stearman 1993: 252). Importantly, change can increase sustainability as much as it can decrease it. The Xavante of central Brazil provide a notable example: a growing concern for the state of wildlife populations in their territory and an increasing desire for cultural renewal resulted in the development of wildlife management that integrated western science with more "traditional" approaches (Leeuwenberg and Robinson 2000). Marked increases in certain game populations were observed within a year of implementation (ibid: 393).

2.3.4 The Neotropical Indigenous Landscape

Neotropical indigenous landscapes are highly heterogeneous (Hames and Vickers 1983: 6; Moran 1995), often the result of land use practices that modify the structure and composition of the forest (Gordon 1982: 96-97). The primary form of indigenous land

use is the clearing of small plots of forest for shifting cultivation, or swidden agriculture. Swidden plots are cultivated for short periods followed by longer fallow periods, allowing fragile tropical soils to renew themselves (Ruddle and Manshard 1981: 71-81). The result is a mosaic of areas in various successional stages, creating a diversity of habitats for game species adapted to secondary growth vegetation, as well as an abundance of nutritious crops to feed on. The gaps formed by cropping to some extent mimic natural intermediate disturbances, promoting greater biological production and higher levels of biodiversity relative to mature forests (Connell 1978). Not surprisingly, indigenous groups throughout the tropics have been practicing "garden hunting" for generations (Beckerman 1983: 276; Berlin and Berlin 1983: 316; Jorgenson 2000: 254; Lee 2000: 467; Linares 1976; Nietschmann 1973: 139; Reichel-Dolmatoff 1996: 70; Smith 2005; Ventocilla 1992). Catching wildlife in agricultural areas serves the dual purpose of procuring protein and protecting crops from persistent pests that can potentially destroy entire harvests (Carneiro 1983: 83-85).

Garden hunting exemplifies how indigenous communities utilize the variety of biotopes that make up their surroundings to procure game (Nietschmann 1973: 129-130). Human-induced variation as well as natural variation will result in heterogeneous distributions of wildlife across space (Emmons 1984; see also Bennett and Robinson 2000: 503-504). Indeed, spatial variation in game availability has an important influence on hunting patterns, simply because hunters understand this variation and modify their hunting effort to successfully catch game (Nietschmann 1972).

No clear-cut characterization represents all forms of neotropical indigenous hunting. It is a broad activity that is interconnected with local subsistence economies as

well as with local environmental conditions, both of which are changing over time. The use and study of spatial patterns provide a convenient means of understanding and interpreting these changes because factors that influence hunting patterns generally influence the use of wildlife over space. Spatial variation over time can also give important information about how hunting may be impacting local game populations.

2.4 The Miskito of Central America

The Miskito of Central America were chosen to be the focus of this study largely because hunting continues to be important in many communities. The Miskito are currently the most populous group inhabiting the Atlantic coast of eastern Honduras (with an estimated population of 35,000) and Nicaragua (est. pop. 120,000), often referred to as La Moskitia (Herlihy 1997: 223-224). Despite divergent histories between Honduran and Nicaraguan populations over the past 100 years, Miskito on both sides of the border continue to share many cultural similarities (Pérez-Chiriboga 2002: 37-39). This section provides an overview of Miskito cultural practices most relevant to subsistence hunting. For a history of this group, including their role in the Nicaraguan civil war of the 1980s, see Conzemius (1932), Dodds (1989, 1994, 2001), Dozier (1985), Helms (1971), and Nietschmann (1973: 23-44; 1989).

2.4.1 Miskito Wildlife Use

Conzemius (1932: 77) described the Miskito as "an excellent hunter; the

keenness of his senses is marvellous and nothing escapes his eye." Historically, people relied heavily on hunting for their diet and comparatively less time and energy was devoted to agricultural production (ibid; Helms 1971: 146). This is no longer the case in most parts of La Moskitia (Helms 1971: 117; Dodds 1994: 156). However, hunters continue to be held in high esteem by community-members, those to whom people turn in times of food scarcity (Helms 1971: 117). While hunting is primarily a male occupation, women play an important role in the preparation and distribution of meat to relatives based on complex food-sharing systems (ibid: 463-464; Nietschmann 1973: 58).

As early as seventy years ago, firearms were documented as the primary Miskito hunting tool, while bows, snares and traps were used only occasionally (Conzemius 1932: 77). Non-marine game caught by Miskito hunters have included paca, nine-banded armadillo (*Dasypus novemcinctus*), green iguana (*Iguana iguana*), white-tailed deer (*Odocoileus virginana*), Baird's tapir (*Tapirus bairdii*), hicatee fresh water turtle (*Pseudomys* sp.), along with white-lipped and collared peccary (Conzemius 1932: 79-80; Helms 1971: 117; Nietschmann 1973: 165). Noted food taboos include the common opossum (*Didelphis marsupialis*), two species of sloth (*Bradypus variegates* and *Choloepus hoffmanni*), and the mantled howler monkey (*Allouata palliata*). Helms (1971: 117) noted that the white-faced capuchin monkey (*Cebus capucinus*) and the Central American spider monkey (*Ateles geoffroyi*) were not consumed in all Miskito communities, although according to Conzemius (1932: 79), both monkeys were highly esteemed for their meat.

The Miskito practice swidden agriculture, and "garden hunting" has been observed for paca and white-tailed deer (Nietschmann 1973: 130, 139; Rivas 1993: 421).

Agricultural areas are usually located close to the community (ibid: 144), while forest areas beyond are used for hunting as well as for collecting other forest products, such as lumber and other products to build homes (Helms 1971: 150-151; Nietschmann 1973: 150-152). Miskito men have been observed to use hunting grounds in nearby forests, as well as in distant areas visited on multiple-day expeditions (Conzemius 1932: 77).

2.4.2 Miskito Communities: Two Geographies, Two Realities

Miskito communities are traditionally permanent settlements that dot the vast Moskitia region, usually located on the coast, along coastal lagoons and important waterways, such as the Coco and Prinsapolka Rivers in Nicaragua and the Mocorón and Patuca in Honduras (Conzemius 1932: 13; MOPAWI and MASTA 1993; Nietschmann 1969). The geographic range of the Miskito has greatly expanded over the last four centuries, settling areas previously occupied by different neighbouring Sumu and Pech populations, sometimes by force (Nietschmann 1973: 30-34).

It is important to differentiate between coastal and riverine Miskito communities. Along with terrestrial and freshwater resources exploited by both communities, coastal Miskito also have access to marine resources, resulting in more prolific production systems as well as better nutrition (Nietschmann 1973: 219). Furthermore, coastal communities often have greater access to wage labour and are increasingly less reliant on subsistence lifestyles (Dodds 2001: 89). In comparison, riverine Miskito rely more on agriculture and high quality land for cultivation is more abundant (Helms 1971: 22, 30). While game preferences vary little between coastal and inland Miskito, differences in

habitat and land-use practices likely significantly affect the distribution and abundance of wildlife populations in each area.

2.4.3 Cash, Subsistence and Protected Areas: The Changing Face of Miskito Resource Use

As early as the nineteenth century, Miskito men have been employed outside their communities by foreign investors in a variety of natural resource extraction endeavours (Nietschmann 1973: 40). However, the boom-and-bust nature of these industries was such that the flow of money into Miskito communities has never been steady. Traditional subsistence systems were therefore maintained for survival in times of monetary scarcity, as these were the only stable means of supplying residents' daily needs (Nietschmann 1973: 24). Hence, money is used when available to purchase goods such as clothing and sugar, while subsistence is maintained for the production of core food staples (ibid).

Because men are often absent from their communities for long periods, the burden of maintaining agricultural production is left to the women (Helms 1971: 181). Consequently, women have played a vital role in maintaining cultural practices, such as food-sharing obligations, as well as the Miskito language, over history (ibid). Strictly male activities, such as hunting, are abandoned while men were absent but are quickly resumed upon their return (Helms 1971: 25).

Miskito resource use has greatly changed in response to the integration of the market economy into subsistence production systems. Nietschmann (1973) shows that subsistence systems fall out of balance when subsistence resources, in this case marine turtles, are harvested for commercial purposes. Thus, when turtles, important protein

staples, are exploited at levels well beyond the needs of subsistence, their use quickly spirals towards depletion:

> To become dependent on a declining resource is to enter an ecological blind alley where the exploitation market system is accelerating in intensity because of positive feedback generated from the disruption of the subsistence sector and its rules for social expectations and economic behaviour (202).

Another study conducted in the Honduran village of Belén, focuses on changes in the subsistence economy brought about by Miskito involvement in commercial lobster diving (Dodds 1994: 159). Contrary to Nietschmann's findings, Dodds (1994: 244) observes that increased lobster diving lowers the overall investment into other subsistence activities and therefore the impact on other resources. Thus, because lobsters are not part of local subsistence economies, there is no double pressure from both subsistence and commercial harvesting, as was the case with turtles (ibid: 285).

Miskito culture has become dependent on many goods that can only be purchased with money, and men in particular will readily abandon subsistence interests for the opportunity to earn wages. In the past, the involvement of men in wage labour did not seem to strongly impact subsistence systems because they appeared to be disconnected (Helms 1971: 25). Both studies have shown, however, that the market economy is becoming increasingly part of the Miskito daily life, and no longer an external influence, with an attendant decrease in the relative importance of subsistence production (Dodds 1994: 1).

It is as yet not well understood how balancing subsistence with wage labour affects the relationship between indigenous people and their environment. Hunting plays an interesting role in this dynamic because it is both influenced by the cultural

adjustments necessary to engage in the market economy (e.g. no hunting occurs when men are absent from communities), as well as by land-use changes that may occur as a result of modifications in subsistence production (e.g. lowered reliance on subsistence crops for food), which in turn may affect wildlife. Thus, the relationship between wildlife use and local involvement in the market economy is an important part of understanding the impact of Miskito subsistence hunting on game populations.

In the past thirty years, much of La Moskitia has been the subject of planned protected areas in an attempt to preserve Central America's last remaining rain forests (Heckadon-Moreno 1997). One prominent example is the Río Plátano Biosphere Reserve in Honduras, 5,250 km^2 of land basically surrounding the watershed of the river of the same name. This park has sought to combine protection with the economic needs and land use practices of the local indigenous populations, the majority of which are Miskito, conforming to the United Nations Man and the Biosphere (MAB) program (Herlihy 2001: 106). Thanks to a large participatory project conducted in 1997, much of the reserve's land is zoned in a manner that appears to be sensitive to local needs (Herlihy 1999, 2001). Nevertheless, the reserve's existence will have a strong influence on local resource use in the future as local populations (Miskito, Pech, Garífuna, Tawahka Sumu and Ladino) grow and demand for La Moskitia's natural resources increases. Currently, land is owned by the Honduran state forestry agency, AFE-COHDEFOR, which in itself is highly contested by local indigenous activists (Dodds 2001: 94; Herlihy 1998; 2001: 117-118). How the relationship between Río Plátano's different stakeholders will play out is largely dependent upon the legitimization of indigenous claims to the reserve's lands. Because hunting occurs over large areas, its overall dynamics will likely be

affected regardless of the outcome of any incumbent political struggle.

Chapter 3
Study Area and Research Methods

This thesis is an investigation into Miskito wildlife use based on both independent and participatory methods of research. Independent research consisted of participant observation during hunting expeditions and interviews with local hunters regarding the use of seven key game species. Participatory data collection methods were used to undertake a population census, a registry of hunted game, and community mapping of hunting lands. This chapter presents the preparatory phases of research in the study area: the creation of various collaborative relationships with national environmental agencies and local community leaders, and the consequent formation of a "participatory research team" consisting of eight local investigators and myself. Next, I discuss the data collection methods carried out by this research team. Finally, the spatial data compilation and analysis is outlined, including the compilation of quantitative hunting data and the delimitation of Miskito hunting zones. However, in order to locate the research within its specific geographic context, a description of the study area must first be provided.

3.1 Description of Study Area

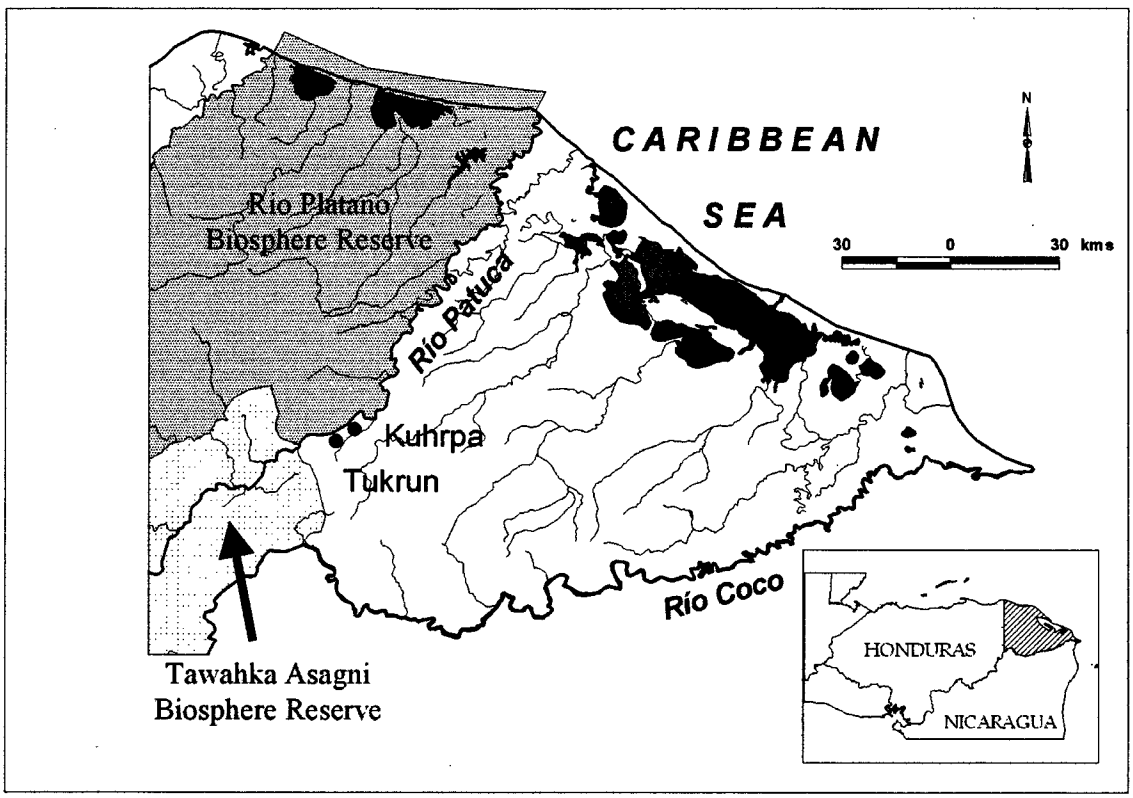
3.1.1 The Honduran Moskitia

The Honduran Moskitia is a triangular area situated in the far eastern portion of Honduras (Figure 1). It is a sparsely settled region that is bordered by the rest of Honduras to the west, Nicaragua to the southwest and the Caribbean Sea to the northwest.

The region is composed mainly of pine savanna and extensive wetland areas along the coast, and large expanses of broadleaf tropical forest further inland (Parsons 1955; Wallace 1997: 81-82). Mean annual rainfall exceeds 240 cm in most parts of the region, with most rain falling between June and December. The region is classified as Tropical Monsoon Wet Climate (Koeppen's Am), with hurricanes and tropical storms most frequent from August to October (West and Augelli 1989: 47-51).

The Miskito Amerindians currently form the majority of the population of La Moskitia, although several small Pech, Tawahka and Garífuna indigenous communities are found on its margins, as well as a growing Ladino population in larger communities, such as Puerto Lempira, Brus Laguna and Wampusirpi (MOPAWI and MASTA 1993). Since most residents live along the coast and major rivers, there remain large tracts of uninhabited forest throughout La Moskitia. In an effort to preserve these forests, the Honduran government has designated large portions of the region as protected areas. These include the Río Plátano Biosphere Reserve and the Tawahka Asagni Biosphere Reserve (Figure 1). However, despite these protective measures, the eastern fringes of La Moskitia (including the headwaters of the Río Patuca) continue to be settled by landless Ladino colonists from other parts of Honduras, who are converting large areas of forest to farms and pasture (Dodds 2001; Heckadon-Moreno 1997: 204-205).

Figure 1: Location of Study Communities in La Moskitia, Eastern Honduras.



3.1.2 Kuhrpa and Tukrun, Gracias a Dios

Kuhrpa and Tukrun are small neighbouring Miskito communities located 2.5 km apart along the Río Patuca (Figure 1). The communities are found near the southern limit of Miskito settlements, near the Tawahka Amerindians, whose settlements begin 15 km further upriver in Krausirpi. According to local accounts, the communities were originally settled by Tawahkas, who were displaced in the 1930s by Nicaraguan Miskitos escaping civil conflict[2]. Conzemius, an ethnographer who traveled through La Moskitia in the early twentieth century (1932: 13-14), did not note any settlements in this region, although the forests of the upper Patuca region have likely been used for centuries by Tawahka, Miskito and Pech hunters (Conzemius 1932: 13-17, 79-81; Floyd 1967: 1-5; Kolankiewicz 1989: 34-35; Nietschmann 1973: 30-34).

Today, settlements along the upper Patuca are generally found five to ten kilometres apart, beginning with Wampusirpi (approximately 20 km downriver from Kuhrpa and Tukrun) and continuing 50 km upriver (MOPAWI and MASTA 1993). According to local accounts, Kuhrpa was found further downriver but was resettled at its current location following the opening of a primary school in Tukrun. Today, the main families that make up each community do not seem to share any common ancestry and it appears that relatively little intermarriage occurs despite their close proximity. Miskito is the primary language spoken in both communities, although most people possess a basic knowledge of Spanish, particularly among the men.

---

[2] Locally referred to as the first Sandino conflict, it seems that numerous Miskito communities were caught in the middle of fighting between Nicaraguan patriots and U.S. marines stationed on the Caribbean coast. Helms (1971: 112-113) describes how inland Nicaraguan communities were negatively affected by the conflict. For a more detailed description of the politics of the conflict, see Dozier (1985).

One to two kilometres south of Kuhrpa and Tukrun, the Warunta Mountains rise from vast lowland plains, part of larger karst-based ranges that run east-west across Honduras and Nicaragua (West and Augelli 1989: 33). This is in sharp contrast to the northern side of the Río Patuca from the communities, where plains and smaller hills dominate. Approximately five to 10 square kilometres of land found between the Waruntas and the community of Kuhrpa is pine savanna. Farmland is found along a 10-km belt of land that runs on both sides of the Patuca. Residents practice swidden agriculture, cultivating small plots for three to five years, then leaving them in fallow for 10 to 15 years. The result is that approximately three quarters of the land near the river are at various stages of regrowth and only about one quarter is under cultivation at any one time. Agricultural staples include rice (*Oryza sativa*), beans (*Phaseolus vulgarius*), maize (*Zea mays*), dasheen (*Colocasia esculenta*), manioc (*Manihot esculenta*) and bananas (*Musa* spp.). The Miskito also tend a variety of plants in dooryard gardens, including pineapples, sugarcane, pejibaye palms, and fruit trees, such as oranges, grapefruits, mangos, tamarinds, avocados and papayas.

Areas outside the savanna not under cultivation can be categorized as old-growth rain forest habitat. While trees are regularly removed for canoes and lumber, elders informed me that the area has always been forested. Small clearings are found throughout the forest landscape, cleared by hunters to serve as campsites, known in the Miskito language as "kiamps," but on a very limited scale.

Kuhrpa and Tukrun were selected as research sites for this project because much of the surrounding area appeared forested (MOPAWI and MASTA 1993), and hunting appeared to be relatively common (S. Paisano, personal comment). Furthermore, the

communities are within a two-hour boat ride from Wampusirpi, the municipal centre, where there is an airstrip and a large health clinic. Finally, Kuhrpa and Tukrun are adjacent to the Río Plátano biosphere reserve, where various research projects have already been carried out and information regarding the area is more readily available (Dodds 1994; Herlihy 1998, 1999, 2001).

3.1.1 *Los Kuhrpeños y los Tukruneros*: A Brief Description of the Residents of the Two Study Communities

Residents of Kuhrpa and Tukrun, locally referred to as *Tukruneros* and *Kuhrpeños*, are mostly subsistence agriculturalists. However, men have in the past and continue to readily engage in a wide variety of wage labour opportunities, such as lobster diving on the coast, gold panning in the Patuca headwaters, commercial logging throughout the region, and rubber and chicle tapping in forests near the communities. Currently, the most lucrative form of employment is small-scale forestry, focused on tropical hardwood trees such as mahogany (*Swietenia macrophylla*), tropical cedar (*Cedrela odorata*), and Santa María (*Calophyllum brasiliense*), sold mainly within La Moskitia as either dugout canoes or lumber. A small but growing number of locals have purchased chainsaws in the past three years to participate in this industry. Most recently, local NGOs and governmental agencies have attempted to restore cacao plantations that were decimated following the floods of Hurricane Mitch in 1998.

At the time of fieldwork in 2003, the combined population of Kuhrpa and Tukrun was estimated at 947 (538 in Kuhrpa and 409 in Tukrun), with half of the residents below 15 years of age. Primary education is provided in both communities, but children must

travel to Wampusirpi for secondary education. A small health clinic and doctor located in Tukrun serve both communities. The principle form of transportation in the region is by canoe along rivers, with walking paths only usable during the dry season.

3.2 Introduction and Establishment: Collaboration with Local Communities and Regional Organizations

Prior to leaving Canada, research methods were reviewed and approved by the Carleton University Research Ethics Committee, whose guidelines conform to the Canadian Tri-Council Policy Statement of conduct for research involving humans (NSERC 2004). The first week upon arrival in Honduras in June, 2003, was spent meeting with relevant government institutions and non-governmental organizations (NGOs), creating collaborative relationships to initiate the research, and familiarizing myself with local institutional frameworks. The Honduran NGO MOPAWI was identified as the primary organization with which I would work, primarily because they are the most active group in the study area[3]. Their representatives provided logistical support and facilitated my introduction to the two study communities.

The initial four weeks in the Miskito communities of Kuhrpa and Tukrun were spent acquainting myself with community members and local customs, as well as selecting and training the research team. Taking time to develop personal and professional relationships helped identify key informants for the research and permitted a

[3]MOPAWI is an acronym for Moskitia Pawisa Apiska, or "the development of La Moskitia" in Miskito. MOPAWI is a privately-funded, not-for profit organization, founded in 1985, dedicated to the promotion of integrated human development and the protection of nature. MOPAWI employs participatory development techniques with the ultimate goal of local empowerment and autonomy (MOPAWI 2003).

greater understanding of the local socio-political context. This permitted me to identify particularly conflictive relationships among community members in Kuhrpa (geographic divisions within the community and family rivalries), which could have hindered participation by some residents in the project (including one key hunter).

Within the first two weeks in the study communities, my research project was presented to the *Patronato Local* (Spanish for local authority), considered the highest political body in the community, made up of community members who are elected on a biennial basis. Members readily supported the project and, contrary to other participatory research accounts, no one appeared intent on using it for personal political gain (Mosse 1994: 505). The project was presented to community members, by both myself and the *Patronato Local*, during the weekly general meeting, explaining (mainly in Miskito) its purpose and objectives. Community members were then asked to approve and support the research. Residents were generally receptive, and many were interested in discussing the project further afterwards.

3.2.1 Selection and Training of Local Investigators

With the help of the *Patronato Local*, two local investigators were nominated and selected in each community that satisfied specific criteria, based on Herlihy (1999: 234). Investigators were required to be: (1) responsible, (2) available, (3) knowledgeable of the surrounding forest, (4) knowledgeable of the community, (5) literate and (6) fluent in Miskito. Candidates possessing certain leadership qualities were also preferred. Candidates were to be paid a stipend of roughly CAD $11 per day (fifty percent more

than the standard wage for the area)[4].

Selection of local investigators in Kuhrpa became complicated, mainly because many of the nominees were also members of the *Patronato*. Upon discussion with MOPAWI members, it was agreed that while selecting members of the *Patronato* presented a conflict of interest, those members were indeed the most qualified for the position. In order to ease this potentially contentious issue, as well as to address other concerns about community divisions, three more local investigators were selected who live in different parts of the community, and who also represent different religious denominations. Nomination and selection of the two local investigators in Tukrun was straightforward. However, after three weeks, I appointed a third local investigator to ease the heavy workload and to represent a more distant part of the community. The research team was formally presented and approved by the community.

Local investigators participated in a one-day training session to review the project's objectives and methods. The importance of rigorous and consistent data collection was stressed throughout the training. Local investigators were assured that, together, we formed a research team and were equal. In addition, they were encouraged to suggest alterations to the research protocol. Fundamental issues of participation among community members were discussed (Chambers 1998; Guijt and Shah 1998; Mosse 1994). In Kuhrpa, one family to which belong three important hunters had very poor relations with some members of the research team and would therefore likely be reluctant to participate in the research. To resolve the problem, it was decided that the family would be regularly visited at their homes by the only investigator who was on

[4]Although I had expressed interest in selecting at least one female investigator, it was expressed that this would not be appropriate considering that hunting is a male activity. Furthermore, their greater day-to-day responsibilities make it difficult to employ women for the entire day.

more amicable terms. Finally, local investigators were encouraged to discuss the research with participants. It was stressed that people had the right to decline participation in the research at any time, conforming to proper conduct required for ethics clearance. Furthermore, based on the recommendations of the ethics committee, while anonymity could not be guaranteed because investigators are from the study communities, the research team agreed to maintain discretion regarding the identity of informants as well as any information collected during the project.

3.2.2 Secondary Research Activities

A series of interactive educational workshops were held with adult residents on basic topics such as natural resource conservation and map reading. The workshops were important in gaining the support of the *Patronato Local*. Education is also a fundamental principle of participatory research because it creates consciousness in both the researcher and the participants, the basis for achieving local empowerment (Fals-Borda 1987: 332; Freire 1971). In this way, local people are more prepared to interpret and understand the results of this research project and, ultimately, to take action as they see fit. The workshops contributed to the research by providing insight into local understandings of environmental problems as well as communities' interest in protecting their natural resources.

Visits were made to other parts of the Honduran Moskitia in coastal areas as well as along the Patuca, by pickup truck, dugout canoe and by plane. This contributed to a greater understanding of the broader geographical context of the study area. A two-day

boat trip was made up the Patuca from the study communities to Nueva Palestina, at the edge of an active colonization front, where the highway begins. Various communities within the Río Plátano Biosphere Reserve were also visited, as well as Puerto Lempira, the capital of the Department of Gracias a Dios.

3.2.3 Dissemination of Preliminary and Final Results

In agreement with MOPAWI and the *Patronato Local*, the research team presented some preliminary results of the research prior to my leaving the study communities. The meeting was announced through the *Patronato Local* and notices were posted around the study area inviting everyone to attend. The findings included a preliminary analysis of the ecological impact of hunting on two specific game species and some ethnographic observations about hunting in general. Issues such as wildlife conservation were discussed and a list of recommendations was presented to community members. People were invited to voice any final concerns they had about the research. Preliminary results were also presented to various members of the Honduran conservation community two weeks later in Tegucigalpa, organized and sponsored by MOPAWI. Finally, in May, 2004, a report of the final research results was presented in person to community leaders as well as the computer generated final maps. Copies of the report were submitted to MOPAWI and various local institutions. Overall, the final products were well-received and provided closure to the research collaboration.

3.3 Field Research Methods

Field research involved a number of related data collection activities, conducted by the research team, undertaken from early August to late October of 2003, in Kuhrpa and Tukrun, to investigate Miskito subsistence hunting. The first data collected in both communities were part of a general population census, followed by community and field mapping, conducted mainly in September, and interviews with local residents, conducted in October. Two methods, participant observation and a voluntary hunting registry, were undertaken throughout my stay in the study communities.

3.3.1 Census of Local Communities

Censuses were conducted in both study communities by the research team to gather information from each household including: (1) the name of the head of the household (which, in most cases, corresponds to the owner of the house), (2) the number of inhabitants, (3) the number of adults and (4) the number of hunters and their hunting frequency. Regular hunters were defined as people who hunt at least once per month, occasional hunters as less than once per month, rare or non-hunters as less than once per year as well as "retired" hunters as older hunters (usually sixty years old) who no longer hunt or do so very infrequently (less than once per year).

The census was conducted firstly to gain an idea of the number of hunters in the community, which was then used to design an appropriate interview strategy. Secondly, the census provided a means of assessing the success of the mapping workshop by noting

the proportion of the population that attended. Finally, the census allowed me to meet individual families, which was especially valuable for people that do not regularly attend community meetings. Local investigators provided translations when necessary.

Because of time restrictions, only 42 of 103 families were visited in Kuhrpa, identified by local investigators as those households where hunters live. Frequent hunters were visited first, followed by occasional hunters, and so on, such that the most active hunters' families were all visited. To complete the data, a census conducted six months earlier by the *Patronato Local* was obtained with their permission. One local investigator then updated this information for those families not visited by the research team (size and number of children), and provided an estimate of their hunting activity. The census of Tukrun meanwhile was conducted entirely by the research team.

3.3.2 Participant Observation

> *Marcos, ahora estás aprendiendo que es de ser Miskito.* (Marc, now you are learning what it is to be Miskito). A Tukrun woman commenting on my carrying a bag of rice during my participation in the harvest.

Throughout my stay in the community, I was involved in participant observation, engaging in the day-to-day activities of the researched. According to participant observation, a good way of understanding the complexities of social life is by experiencing it oneself (Hoggart, Lees and Davies 2002: 252). Researchers not only observe but also work alongside informants as they conduct "normal" activities, ultimately easing the flow of information (Dowler 2001: 158). However, participant

observation has been severely criticized for constructing ethnographies often based more on the prejudices of the observer than the reality of the observed (Hoggart, Lees and Davies 2002: 259). While blatant prejudice today is probably less prevalent, it is nevertheless important to recognize that the observer's "cultural baggage" will inevitably skew interpretations (ibid: 263). As in participatory research, the key to valid and effective participant observation is constant self-reflection on the part of the researcher, particularly of the dynamic relationship between participant observer and observed (ibid: 25-26).

I participated as often as possible in hunting trips to gain an understanding of how local Miskito engage in hunting, as well as to document the different places people go to hunt. I also participated in fishing and agricultural outings, which permitted situating hunting within the context of the local economy, as well as observing any opportunistic hunting that tends to occur during these expeditions (Beckerman 1983; Ventocilla 1992).

Observations were made while participating on hunting expeditions regarding: the identity and number of hunters participating; the time of departure and return; weather conditions; types of tools, equipment and paraphernalia brought; rituals conducted prior to and during expeditions; walking pace; types of paths used; indications of the presence of game such as animal calls, fruiting trees, spots where game has been caught in the past; successful game catches, as well as any other relevant information. While an attempt was made not to disturb or distract people on outings, informal interviews were conducted frequently, usually during breaks. Unsolicited comments made by hunters during the outings were also noted. All observations were recorded using a tape recorder.

Route information was also noted during expeditions, including the direction and

bearing; the name of rivers crossed (and direction of flow) and changes in topography. Bearings were taken using a compass and a watch to record the time for each measurement. Whenever possible, GPS points were taken to help reconstruct expedition routes onto 1:50,000 topographic sheets of the area, which were later entered into a Geographic Information System (GIS). Reconstructed routes were used to help locate important hunting grounds and to map the overall hunting area. In total, I participated in ten hunting outings over three months in the communities, including a four-day expedition.

Data collected on fishing and agricultural expeditions were similar to those collected on hunting outings. However, participation was often more active, leaving little time to note observations *in situ*. Hence, for these expeditions, information was often compiled upon return. GPS points were taken and routes were reconstructed in all cases. I participated in three fishing expeditions and four agriculture expeditions during the study period.

During my four-month stay in Kuhrpa and Tukrun, I also participated in various activities in the communities, such as maintaining communal paths, building a bridge and extracting lumber. Informal interviews were often conducted during these activities. Participating in local activities with women was particularly advantageous, as they were more comfortable and therefore more open to conversation while occupied[5].

Field mapping outings were also conducted by the research team during the study period, to complement participant observation data by: (1) collecting additional GPS coordinates along routes previously used in expeditions, and (2) collecting GPS

[5] Guijt and Shah (1998: 14) refer to these as gender-appropriate spaces and fora.

waypoints in areas important for hunting but not visited during expeditions. Toponyms of important hunting areas corresponding to collected waypoints were noted and their relative location was verified by at least two local investigators. Many areas within the subsistence zone for the study communities were visited to build a strong geographic frame of reference.

3.3.3 Participatory Mapping

Participatory mapping has emerged in the 1990s as an important part of participatory research, most notably among indigenous peoples in Latin America (see Herlihy and Knapp 2003; Knapp and Herlihy 2002). Despite playing an historically significant role in the cartography of the "New World," the tremendous spatial knowledge possessed by indigenous groups has commonly been used against them, first by Spanish *Conquistadores*, then by central governments eager to integrate their lands into the larger national territory (Knapp and Herlihy 2002: 257-258; Smith 2003: 332). Still today, "conventional" maps, representing a nationalist discourse, commonly exclude the identities and worldviews of its indigenous inhabitants (Herlihy and Knapp 2003: 306).

Participatory mapping seeks to give a voice to indigenous people in articulating their lands and resources. Maps are constructed from peoples' extensive cognitive understanding of their surroundings and, as a result, "counter" perceptions of indigenous territory as large forest tracts of "empty space" (Herlihy and Knapp 2003: 306; Peluso 1995: 385-388). Counter-mapping embraces the fundamental principles of participatory

research by building, within local groups, consciousness of their intrinsic rights to their traditional lands (Herlihy and Knapp 2003: 306), the first step towards empowerment (Perez 1997: 2). This comes at a time when encroachment of indigenous lands by outsiders is becoming increasingly prevalent throughout Latin America (Herlihy 1997; Nietschmann 1995b).

In practice, maps created as a result of participatory mapping also tend to be more accurate than conventional ones because of local involvement, particularly for toponym information (e.g., Herlihy 2003: 326). Also, the simple, diagrammatic nature of maps demands little more than a basic education to understand, read and interpret (hence its widespread use in participatory development) (Chambers 1994: 1256-1257). Consequently, created maps can be used by communities themselves for a variety of endeavours, such as natural resource management. Finally, when created in a standardized cartographic form, counter-maps are effective at communicating indigenous space across cultural and linguistic barriers (Smith 2003: 334).

Community mapping workshops were held in Kuhrpa and Tukrun to locate and identify the different toponyms that are found within the local hunting area, as well as to begin a delimitation of the communal hunting zone. This information would then be used as a basis to locate spatial data collected in the hunting registry and the interviews.

Local investigators were trained to co-facilitate the workshops on two separate occasions. The first meeting was held to discuss the goals and objectives of the workshop so the research team could then explain its significance to others, while the second was to develop their abilities as facilitators. On the latter occasion, I facilitated a simulation workshop where local investigators were the participants. A number of issues

were also discussed in the second meeting, such as the importance of vigilance of more "politically-motivated" participants who may attempt to use the workshop for their own benefit and of participants who may coerce or exclude views of other participants (Mosse 1994: 508-510).

Residents were encouraged to participate in the workshop by both the research team and the *Patronato Local*, through personal visits, general announcements, and signs posted throughout the communities. In an attempt to boost attendance, free coffee and bread were served during the workshops. Workshops began with an educational workshop on how to read maps, followed by a mapping session. Approximately 30 people (20 men, 10 women) attended both parts of the workshop in Kuhrpa while 20 people (15 men, five women) attended in Tukrun. Prior to creating the maps, concerns among participants regarding their ownership were addressed. Some residents believed that by mapping hunting lands, they would obtain legal title. As a result, as well as to avoid any more false expectations, I assured that local people understood clearly what they would gain from participation in the workshop, which was a map that documents their hunting lands and not an official land claim.

Participants were divided into two subgroups, responsible for mapping community lands on each side of the Río Patuca on large blank sheets of white paper, working from the basic question of where people go to hunt. Each sub-group had at least one woman. Participants first listed, and then located the different rivers, mountains, hunting grounds and *kiamps* that make up the hunting area. Participants were also asked to verify the other group's map, and many roamed between groups during the workshop, discussing the location of areas.

Maps that were not completed during the first workshop, due to bad weather and poor lighting in late afternoon, were completed later in the week. One map, created in Tukrun, considered inaccurate by participants, was also redrawn during a second workshop. In both communities, fewer residents participated during subsequent sessions. Hunters not in attendance during the second meeting were later visited to review the maps, resulting in some minor changes.

To help delimit the overall hunting area, participants were questioned in detail regarding places found on the edges of the completed maps. Participants were asked how far local hunters go beyond the end of mapped paths, or other important landmarks, such as the mouths of rivers, hills and *kiamps*. Participants were also asked questions about the frequency of use for these areas. If areas were not used to hunt, they were excluded from the hunting area.

Although there were fewer women present than men, those who did attend the mapping workshops played an important role. However, as one woman explained to me, women do not go into the forest as much as men so they do not know as much about hunting areas. Nevertheless, the presence of women participants was important to lend credibility to the activities of the men and to make sure that they witnessed and approved the maps' creation (in one case, a Kuhrpa woman designed all the symbols and assigned the colours to the maps). It seemed that young peoples' knowledge of the forest was also less developed than older residents and very few young Miskitos actually participated in the workshop (one in Kuhrpa; three in Tukrun).

Active hunters and other residents who did not attend any of the workshops were consulted at their home to verify the accuracy of the created maps, resulting in more

minor changes. The revised paper maps were then presented to both communities during their general meetings. Residents attending the meeting, which included most important hunters, then validated the map.

Data from the validated maps for Kuhrpa and Tukrun were combined and transferred, by the research team, onto photocopies of 1:50,000 topographic maps. Different toponyms collected during the workshop were located on standardized maps, allowing the research team to delimit, in a more precise manner, a provisional boundary of the hunting area. Toponyms of areas previously visited during participant observation and surveying outings were first located on the topographic sheets using reconstructed routes and GPS waypoints for reference. Local investigators were then consulted to locate nearby areas. Once the research team was confident of the location for toponyms, they were placed on the topographic sheets. For distant areas not previously visited, a variety of aspects were noted, such as the time required to walk along a path from one stream to another, the number of meanders in a river between two points and any major changes in topography. This information was then compared and contrasted with that found on the topographic maps to estimate their location, which were then tentatively placed on the maps. Estimated locations on the topographic base map were verified whenever possible during subsequent outings[6].

Toponym locations were compared with a 1:50,000 map created during a participatory research zoning project in the region (Herlihy 1998). Discrepancies between the two maps were addressed, with local investigators having the final say on

[6] Estimates generally decrease in accuracy with distance from the community because distant areas were less frequently visited during the field research period and few hunters know the area well. Furthermore, some distant hunting areas, most notably directly northwest and south of the communities, are poorly mapped on the 1:50,000 topographic sheets. Nevertheless, upon one outing to distant hunting grounds, estimates were often within 500 m of their actual location.

where toponyms should be located on the community maps. The final map was continually revised by the research team until the end of the field research, although any changes were relatively minor.

3.3.4 Hunting Registry

Game captured in Kuhrpa and Tukrun during the study period was recorded in a registry by the research team. The hunting registry was kept in Kuhrpa from August 12 to October 25, 2003 (74 days) and in Tukrun between August 17 and October 25 (69 days), to assess the type and quantity of game captured and to complement qualitative, ethnographic data collected from interviews and participant observation. Local investigators were assigned groups of about 10 to 15 households that they were responsible for visiting every two to three days to document any game caught. For all captured animals, local investigators noted the following information: the date caught, species, sex, age, the weapon used and the general location of the catch. The registry remained anonymous to ease apprehensions among hunters towards having their names written down by local investigators. While anonymity prevents any comparisons between individual hunters, data can be assumed to be more valid since there is less reason for respondents to under-report hunting activity.

I believe that, while some animals were not registered, the data collected by investigators are accurate. I met regularly with local investigators to review the data collected and to discuss any problems. I made it clear that investigators collect data directly from hunters or their spouses and not to note catches from word of mouth. Local investigators seemed to take pride in their work and, for the most part, showed concern

that data was collected rigorously. Hunts of smaller game, such as songbirds, often went unnoticed by the research team, although these animals likely contribute little to the overall yield. However, I am confident that approximately nine out of ten large game hunts, including animals such as peccaries, monkeys, deer and paca, were documented.

3.3.5 Interviews

During the final month in the study communities, the research team conducted interviews with 35 hunters (14 in Kuhrpa and 21 in Tukrun), regarding the use of seven key game species in order to investigate ethnozoological knowledge as well as variations in the temporal and spatial patterns of hunting. Respondents were asked to recount, as well as they could remember, details of past hunting activities, thereby accounting for seasonal changes in hunting that are otherwise not observable over a short field research period. By focusing on a select group of species, interviews also served to gather more detailed information on local knowledge of game species' ecology, and the role this may play in capturing specific animals. Interviews were also conducted with nine retired hunters to understand how wildlife use and its spatial patterns have changed in Kuhrpa and Tukrun since the 1930s.

The seven focal species for the interviews were the white-faced capuchin (*Cebus capucinus*), the Central American spider monkey (*Ateles geoffroyi*), the Baird's tapir (*Tapirus bairdii*), the collared peccary (*Tayassu tajacu*), the white-lipped peccary (*Tayassu pecari*), the white-tailed deer (*Odocoileus virginianus*), and the red brocket deer (*Mazama americana*). These were selected because: 1) they are important large game

species; 2) they are hunted only occasionally (i.e., not every week) and 3) they are culturally significant. Furthermore, successful catches of these animals are usually announced within the community and the meat is usually shared or sold between households. For all of these reasons, hunters tend to remember more clearly when these game were caught, and other specific information regarding individual hunts. Focusing on larger mammals also gives a good indication of the impact of local hunting practices on local game populations because these species tend to be the most vulnerable to depletion (Bennett and Robinson 2000: 5).

The first half of the interviews consisted of a standard questionnaire, used to gather quantitative information about specific hunts, followed by open-ended questions about the use of the focus species, animal behaviour, seasonality, and other topics related to hunting. This format allowed the research team to gather specific information about the seven focus species, while keeping part of the interview flexible to encourage more open discussions with respondents. Local investigators translated questions and responses whenever necessary.

Hunting frequency data collected during the census served as a basis for the sampling regime. Because not all hunters catch larger game, the research team first identified those regular hunters (i.e., those who hunt at least once per month) that most likely hunted the seven focus species. Five more interviews were conducted in both communities with regular and irregular hunters not identified as big game hunters to verify if they indeed did not hunt the seven species in the past year, which proved to be the case. In total, 30 of 58 regular hunters identified from the census were interviewed, 60% of which were from Tukrun, where most people still hunt, although less frequently

than in Kuhrpa. Households were visited in the afternoon when respondents were most likely to be home, and hunters' spouses were encouraged to attend because their role in the preparation of hunted game may result in them remembering details of certain successful catches. Interviews were recorded using a tape recorder.

Interviews began by asking respondents their name, age, place of birth, age when they first hunted and how they learned as well as the weapons they normally use. They were then shown illustrations of each key game species from a field guide (Reid 1997). Interviewees were asked to identify the species by their Miskito name and the last time they hunted the animal. The date was then narrowed down from season to month and, sometimes, to the day, or until the respondent could no longer remember. Interviewees were asked for information on the number hunted, sex, age and weapon used when they were hunted, if they could remember. Finally, interviewees were asked for the location of the successful hunt in the hunting zone as specifically as possible. Approximate locations cited were found using the map made by community members. Once the information for a successful catch was compiled, the interview would move on to the previous successful catch of the same species, and so on until the hunter no longer remembered. Hunters were then asked to discuss each species by sharing observations they may have on the natural history of the animal, the habitats where they are most likely found, the time of year most likely hunted, challenges with hunting the animal and tools commonly used for hunting it, as well as the quality of the meat. This format was repeated for each of the seven focus game species.

Once all seven species were covered, interviews became open discussions where respondents were asked general questions regarding wildlife use (e.g., whether hunting is

more or less difficult than in the past and why; what measures can be taken to protect wildlife; do people hunt more or less than in the past; do people hunt more in neighbouring communities; is wildlife more or less abundant elsewhere in the region) as well as questions about the relationship between hunting and other subsistence activities (e.g., how often do people hunt during harvest periods, when do people hunt in distant areas and why; what are the costs of hunting and how are they covered). Local investigators were encouraged to introduce additional topics to the discussion.

A major limitation of the interviews is related to uncertainties about the memory retention of hunters. Some hunters remembered details of captured game more than others. Conversely, some often readily forgot details, often confusing months in the year. To account for these problems, questions were sometimes restated in different ways in hopes of getting more accurate information (e.g., whether the game was caught before or after I arrived in the community, before or after last Christmas). When hunters caught too many individuals of a species within a year to remember the details of each specific hunt, such as for both species of peccary and for spider monkey (some hunters catch upwards of 25 in a year), they were asked to estimate how many individuals they catch in a month. Nevertheless, catches for these species were likely under-reported. To address problems of accuracy, respondents were requested prior to beginning interviews to be honest and not over-report any hunts. Furthermore, local investigators were vigilant of any boasting and, in one case, a hunter's claim of catching a large number of white-lipped peccary was discarded.

Non-disclosure was not usually a problem for several reasons. Firstly, because interviews were conducted towards the end of the field research, many respondents knew

me personally, a consequence of my participation in many day-to-day activities. Secondly, past studies have noted that in areas where hunting restrictions have yet to be imposed, such as La Moskitia, people tend to openly discuss hunting with researchers (Peres 2000: 37). Finally, respondents were assured that all data they provided would remain anonymous to outsiders and interviews could be stopped at any time if they so desired.

3.4 Data Compilation and Analysis

Data compilation began upon return to Canada in November, 2003. Quantitative data were compiled using Microsoft Excel 2000. To calculate hunting yields, weights for game species were compiled using published average adult body mass estimates, with juveniles assumed to weigh one half of adult weights (Dunning 1992; Reid 1997; Robinson and Redford 1986; Stiles and Skutch 1989). All spatial data were compiled and mapped using ArcView 3.2, a Geographic Information Systems (GIS) software package.

3.4.1 Mapping the Hunting Area

The boundaries of the overall shared hunting zone of Kuhrpa and Tukrun were delimited based on the results of the community mapping workshops, field verifications during participant observation, and interviews with hunters about the extent of the areas they use. Once completed, the limits were digitized for use in a GIS by first scanning and geo-referencing 1:50:000 topographic maps of the study area, which were then used as a

backdrop for heads-up digitizing of streams and selected topographic contour lines, traced over the map images. River toponyms documented by the research team were entered into an attribute table. GPS waypoints collected from participant observation and field surveying outings were loaded into the GIS for reference purposes to locate specific elements within the hunting area.

Because hunting areas found near the communities were visited extensively during the study period, resulting in an abundance of GPS-referenced locations, the limits for the central part of the hunting zone are quite accurate. However, the accuracy of hunting zone limits tends to decrease with distance from the community, because less overall spatial data was available for peripheral areas, making them more difficult to map. Consequently, the size of boundary hunting grounds in distant areas may have been over-estimated. A paper map documenting the limits of the hunting area used by Kuhrpa and Tukrun, along with important toponyms, was returned to the communities in May 2004.

Reconstructed routes of hunting outings were digitized as a separate layer in the GIS to better understand where hunters go during expeditions and to verify the boundaries of the hunting zone. The distance travelled for each outing was calculated in the GIS and compiled using Microsoft Excel.

3.4.2 Interview Data and Game Kill Site Locations

Interview data on the harvest of the seven game species were compiled in a spreadsheet. Only successful catches between November, 2002 and October, 2003 were

used in data analysis to address problems of memory retention beyond this period. Given that hunters often recall successful hunts up to ten years after they occurred, reported hunts within the past year are assumed to be relatively accurate. During the one-year period, any error caused by hunters' memories was assumed to be equal between respondents. Beyond a year, memories become very inconsistent (e.g., some remember details clearly for many years while others only remember pieces, such as the location or the date). Reported hunts occurring prior to November 2002 were retained as background information. Interview data for the seven focus species were verified using registry data collected between August and October 2003. Based on comparisons, it is evident that hunters' memory with respect to the timing of hunting is generally inaccurate, but usually falls within a month of actual hunts. Location data, on the other hand, appeared generally accurate.

Kill site locations were classified based on their estimated precision – a code of "1" denoting very precise (within 1 km of a GPS located site) and a "4" denoting less precision (estimated based on mapping exercises with local investigators). Only spider monkey kill sites were mapped and digitized for use in a GIS. The overall hunting area for this species was estimated based on the precision of each individual kill-site locations.

3.4.3 The Four Sub-zones of Miskito Hunting

Based on ethnographic and spatial data, I distinguished within the hunting zone four distinct sub-zones, characterized by their frequency of use, the type of game caught, the type of hunting strategy employed, and other factors. These sub-zones were mapped,

drawing from spatial patterns documented during community mapping sessions, interviews with hunters, participant observation and field mapping outings.

The boundaries of the first sub-zone, in which both study communities are located, generally follow the border between swidden agricultural lands and undisturbed forested areas. In contrast, outer boundaries of the second sub-zone were delimited based on the distance from the communities and frequency of use by hunters. The same criteria were used to delimit the third sub-zone, characterized by overnight hunting trips. The fourth zone consists entirely of rarely used, distant northern hunting grounds, whose boundaries are indeterminate.

Accuracy of the zonal boundaries is highest in areas I visited most often during the field research period, which tend to be closer to the communities. I estimate that approximately three quarters of sub-zone 1 were visited, approximately one quarter of sub-zone 2 were visited, less than ten per cent of sub-zone 3 were visited and no parts of sub-zone 4 were visited. Hence, confidence of the accuracy of the sub-zones is generally highest for sub-zones 1 and 2, with sub-zone 3 a conservative estimate. Sub-zone 4 was not delimited for lack of information and because the highly diffuse nature of the area results in highly indeterminant boundaries. Boundaries for the other sub-zones were indicated by dashed lines to denote that they are approximate.

Chapter 4:
Results

Over four months spent in the Honduran Moskitia, different methods were employed to answer the basic questions: Who hunts? What is hunted? When do people hunt? How do people hunt? Why do people hunt? And, most importantly, where do people hunt? The result, summarized in this chapter, is a detailed ethnographic account of Miskito wildlife use, complemented by quantitative hunting yield data and interview information focused on the hunting of seven large game species. All of this information is used to understand and interpret the spatial patterns of Miskito hunting, that emerge as due to complex interactions between variables such as the distance from home, topography, the distribution of habitats in which different game species are found, the demands of agriculture and wage labour, and many other factors. It appears that hunters in Kuhrpa and Tukrun use their hunting area according to four different hunting sub-zones, based on local hunting behaviour, but also strongly influenced by ecological conditions as well, with each sub-zone used to catch a specific suite of game, at specific times, using specific strategies.

4.1 An Ethnography of Miskito Hunting

Miskito wildlife use is a complex activity, influenced by the preferences and abilities of the person hunting, the type of game being hunted as well as its ecological preferences, the strategies and tools employed to catch game and the motivation for hunting the animal. A detailed description is therefore required to understand how

this activity is practiced as well as to understand its main limitations, thus providing a broad context with which to interpret hunting yields and the spatial patterns of wildlife use.

4.1.1 The Uses of Wildlife Among the Miskito

The first and foremost use of wildlife among the Miskito of Kuhrpa and Tukrun is for food. The taste of wild meat is generally favoured over domestic meat and is readily eaten when available. The distribution of game is characterized by a strong ethic of sharing and cooperation. When hunting is conducted in a group, the catch is always equally shared among every member (even the researcher!). Once the catch is returned home, women are responsible for distributing it to family, friends, neighbours and relatives. A part of the catch is often given to single-mothers and elderly community members who otherwise would not have access to game.

Hunting, however, is not without its monetary costs. Today's Miskito reportedly pay up to CAD $200 for a used 0.22-calibre rifle and CAD $65 for a hunting dog, sold as a puppy which must be trained. In addition, hunters must have a supply of ten to twenty bullets, costing CAD $0.23 apiece. As a result, many hunters sell a part of their catch to other community members. When one or more large animals are caught, once meat is first divided up to give away, the remains, usually comprising less than one half of the total, are sold at CAD $0.77 to $0.92 per pound, depending on the type of meat (e.g., white-lipped peccary meat is generally more expensive than collared peccary meat). However, this price is relatively low (domestic meat is more expensive, despite its taste

being generally less favoured among residents), and many hunters sell only a small part of their catch strictly to cover costs. Thus, while the exchange of game has changed with the integration of money into the local economy, hunting remains primarily subsistence-based and plays an important role of maintaining social relations.

While secondary, there exist other uses for wildlife among the Miskito. For example, specific parts of game are used for medicinal purposes. Animals such as the green iguana (*Iguana iguana*), the collared peccary (*Tayassu tajacu*), the Central American spider monkey (*Ateles geoffroyi*), the Baird's tapir (*Tapirus bairdii*) and the white-tailed deer (*Odocoileus virginianus*) are sometimes used to treat illnesses such as rheumatic arthritis and fevers[7]. However, while many residents continue to believe in the healing abilities of animal products, they are rarely hunted for medicine. Animal parts are also kept among certain residents as ornaments, believed to have special powers, in accordance with traditional spiritual beliefs. For example, hunters often keep preserved animal products in their home to protect them from danger or to attract game, as well as to keep unwanted animals away (usually snakes).

One of the more widespread uses of wildlife is the live capture of mainly juvenile animals as household pets. Many Miskito households keep a wide variety of different animals, such as spider monkeys, white-faced capuchins (*Cebus capucinus*) and toucans (*Rhamphastos* spp.), as well as, on occasion, white-lipped peccary (*Tayassu pecari*), collared peccary and red brocket deer (*Mazama americana*). However, birds from the parrot family (Psittacidae) are by far the most common pets, with some households keeping two to three different species.

---

[7] For a complete list of the Miskito and common Honduran names for game species, crops and trees, see Appendix I.

Finally, wildlife has at times been captured for sale. According to community elders, in the past residents trapped jaguars (*Panthera onca*) and ocelots (*Leopardus pardalis*), to sell their furs. There also existed commercial harvesting of hicatee turtle eggs (*Pseudomys* spp.), as well as iguana eggs, although there is no indication that many people participated in this industry. Today, live parrots are sold to Ladino traders who visit the communities approximately once per year, purchasing hundreds of birds, representing various species. According to local accounts, traders pay up to CAD $13 per Macaw (*Ara* spp.) to re-sell in Tegucigalpa or San Pedro Sula.

4.1.2 What is Hunted and What is Not

Miskito hunters catch a wide variety of fauna for food: the size of game caught ranges from small ground-doves (*Claravis* spp.), weighing 100-200 g, to the large Baird's Tapir, weighing up to 300 kg. Miskito seem to particularly enjoy consuming wild fowl (this group comprises the great curassow, *Crax rubra*, the crested guan, *Penelope purpurascens*, and chachalacas, *Ortalis* spp.), green iguana, white-lipped peccary, collared peccary, spider monkey, paca (*Agouti paca*), and white-tailed deer. Other important game species include the nine-banded armadillo (*Dasypus novemcinctus*) and the red brocket deer; as well as small-bodied game, such as doves (*Leptotila* spp.) and oropendolas (*Psarocolius* spp.), which tend to be captured near the community.

The Miskito usually prefer game based on the taste of the meat, with the white-lipped peccary and spider monkey commonly listed as having superior flavour. Large and difficult to hunt game are also highly esteemed by hunters. Accordingly, smaller

animals such as frogs and mice are not hunted, probably at least in part because they offer little return in terms of quality and quantity relative to the effort required to catch and butcher them. While there exist few taboos restricting the consumption of specific animals in Kuhrpa and Tukrun, many wildlife species are considered inedible. These include: snakes, raptors, as well as mammals such as the mantled howler monkey (*Alouatta palliata*), the giant anteater (*Myrmecophaga tridactyla*), the common oppossum (*Didelphis marsupialis*) and the northern naked-tailed armadillo (*Cabassous centralis*). It appears that tapir was formerly a taboo food, and is often avoided by older community members. Most recently, game monkeys are increasingly being avoided, particularly among younger generations and more educated community members, who cite the animals' resemblance to humans as the reason for this change.

Food taboos are often observed among residents attempting to avoid misfortune caused by other peoples' curses. Restrictions are usually prescribed by someone well versed in "sorcery"[8]. For example, one resident has not hunted nor eaten any monkey since his wife died three years before, based on advice that he must avoid the animal so that he or any family-member remain protected from the return of her illness.

4.1.3 Who Hunts Among the Miskito

Hunting in Kuhrpa and Tukrun is done by men. While women regularly fish, they do not participate in hunting outings. According to informants, elsewhere in La Moskitia

[8] *Sukyas*, traditional Miskito shamans, are well described by Helms (1971: 182-189) and more recently by Perez-Chiriboga (2002: 219-222). Although there are no longer any *sukyas* in Kuhrpa and Tukrun, certain residents are more knowledgeable in sorcery than others. Residents are often uncomfortable discussing this issue so information regarding the matter was difficult to obtain.

women do on occasion accompany expeditions that last several days, mainly to prepare food for the hunters.

Most adult men in Kuhrpa and Tukrun are exposed to hunting at a young age. Young boys develop skills as early as five years old, in the past using small bows and arrows to hunt butterflies, and today using slingshots to hunt small birds. Most are taken for the first time to hunting grounds, often by older relatives, between fifteen and eighteen years of age. However, today, many adolescent Miskito have little interest in learning to hunt, stating that they prefer making money or playing soccer. Many hunters stop going on outings in their late forties, often citing poor vision as their reason.

Not all Miskito men catch wildlife with the same frequency and, while the majority keeps dogs and rifles to catch game opportunistically when working in agricultural fields, far fewer regularly venture into the deep forest to hunt. A greater number of *Tukruneros* report being regular hunters (once per month) than do *Kuhrpeños*, despite this community's smaller population (Table 1). Oppositely, in Kuhrpa, many men choose not to hunt. When asked why they do not hunt, respondents commonly answered that they find hunting too physically demanding, with game often difficult to find. As a result, they are not willing to invest a full day of trekking, sometimes harsh, terrain amid frequent rain and abundant mosquitoes, for such a low rate of return. Also, some indicated that they did not like killing animals. In Tukrun, however, most men physically capable of hunting report hunting at least once per year.

Table 1. Hunting Activity Among Residents of Kuhrpa and Tukrun, Gracias a Dios, with Hunting Yields over 74 Days between August and October, 2003.

	Total Population	Number of Regular Hunters†	Number of Animals Captured	Total Harvest (kg)
Kuhrpa	538	24	170	1,165
Tukrun	409	34	140	445
Total	947	58	310	1,610

† Regular hunters are defined as people that claim to hunt at least once per month.

4.1.4 Strategies for Catching Game

Game is caught in Kuhrpa and Tukrun according to three main strategies: hunting expeditions, "sit-and-wait" hunting and opportunistic hunting. While distinct, different strategies can be combined within a day. For example, a person working at his agricultural fields may catch game opportunistically in the morning, and then depart on an expedition in the forest in the afternoon.

The most common hunting strategy is the hunting expedition, when hunters leave their homes with the expressed purpose of catching game. Local people identify this scenario as "true hunting." As one hunter in Kuhrpa states: "*Cuando quiero comer carne, voy al monte para buscarla* (when I want to eat meat, I go into the forest to look for some.)." The activity is usually solitary, although groups of two to five people often form for longer trips. The customary day of the week for hunting expeditions among the Miskito is Saturday. Hunters leave their homes as early as 5 am to reach hunting grounds as early as possible. Transportation is usually by foot, although visits to grounds that are found across the Patuca require a dugout canoe. Very distant areas are at times reached by canoe, but most streams and rivers within the hunting zone are very narrow and difficult to navigate. Because game can potentially be caught anywhere en route to the hunting grounds, hunters pay attention for game as soon as they exit the community. However, at the early stages of the expedition, smaller game is often discarded to save bullets for larger animals.

On one outing, hunters paused before entering the forest to pray for protection against enemies, such as snakes, during their journey. Frequent stops are also often made

to collect a variety of forest products, such as bark to make as support straps to hold equipment, pine cuttings for kindling or medicinal plants to help prevent infections, such as severe athlete's foot and leischmaniasis, sometimes contracted in the forest.

Upon reaching hunting grounds, hunters become very attentive for any sounds they may recognize. Hunters employ a wide variety of techniques to locate game, such as imitating calls (especially for monkeys); observing physical traces of an animal's presence, such as half-eaten fruits, fresh tracks and scats, as well as characteristic odours; visiting areas commonly frequented by game, such as mud wallows, large fruiting trees and watering holes. Hunters are particularly skilled trackers, able to identify from tracks the direction the game has gone and the time elapsed since it passed. If the hunter judges the tracks to be fresh enough, he will whistle to other hunters and the party will either follow the tracks or attempt to surround the animal. Depending on the species hunted and the terrain, this can last from a few hours up to several days. In places, hunters mark their paths by cutting bark off trees with a machete to ensure that they will not get lost.

Hunting expeditions can last between a few hours and several days. Short journeys are often made to the pine savanna, usually with dogs, to catch armadillos, white-tailed deer and large rodents that are found in this type of habitat. Expeditions lasting most of the day are made to more distant hunting grounds, where habitat is mainly mature forest. During these expeditions, game such as collared and white-lipped peccary, wild fowl and monkeys are caught. Hunters sometimes bring along a harpoon and an underwater mask to fish for one or two hours in nearby streams.

Multiple day expeditions are made to hunting grounds not easily accessed in one day. The same species that are found in nearby forested hunting grounds are hunted on

extended journeys, although they appear to be more abundant in distant areas. Also, fish, such as snook (*Centropomus* sp.) and the bass-like guapote (*Cichlasoma* sp.), appear to be larger and more abundant in distant streams. On long journeys, hunters usually stay at existing campsites, known as *kiamps*, where shelters are erected if not already present. Based in the *kiamp*, hunters seek game in the morning while the afternoon is devoted to fishing and preparing the catch. Game caught on long expeditions is preserved by smoking it in a small shelter over a low fire, as described by Conzemius (1932: 89). Hunters sometimes plant fruit trees that require less care in *kiamps*, such as bananas and pejibaye palms, so they may have a supply of food during their stay. Also, hunters mention that these trees attract game.

Hunters go to great lengths to avoid returning from an expedition empty-handed. If an outing is unsuccessful, hunters often scan areas near the community for small game, such as birds, or small aquatic species like snails, to bring home for food. On multiple-day expeditions, hunters often wait until their rucksack is full of meat before returning home.

Besides being a means of procuring meat, hunting expeditions are important for numerous other reasons. Miskito hunters enjoy going on expeditions. Social bonds appear to be very strong between hunters on trips, and much time is spent laughing, singing and chatting. It seems that hunting is also a good way of claiming and patrolling community lands that are otherwise rarely visited. In recent times, outsiders have frequently invaded the forests near Kuhrpa and Tukrun in search of large mahogany (*Swietenia macrophylla*), tropical cedar (*Cedrela odorata*) and Santa María trees (*Calophyllum brasiliense*), species highly prized for building dugout canoes, especially

among residents of areas along the coast, where these trees have become very scarce and where the demand for strong ocean-going vessels is high. Hunting also provides an opportunity to collect medicinal plants and tree seedlings that are transplanted in hunters' dooryard gardens. Finally, while on expeditions in the forest, hunters often care for young trees that will be used to build canoes in the (sometimes distant) future by clearing surrounding vegetation.

During the eight hunting expeditions in which I participated, the average distance covered was 17 km. The longest distance traveled was 29 km during a four-day expedition while the shortest distance was a nine km trip made to the pine savanna. The longest single-day journey was 24 km. A total of 55 kg was caught during these outings from one collared peccary, one white-nosed coati (*Nasua narica*), two slaty-breasted tinamous (*Crypturellus boucardi*), three crested guans, and six great curassows. Game was only caught during two expeditions, with the bulk of biomass caught during the four-day expedition. While traces of game were found on all expeditions, in most cases individuals were difficult to locate. Thus, only the extended expedition was considered successful by participating hunters. However, it is difficult to assess whether the success rate for these expeditions is typical since hunters tend to concentrate on positive elements of their trip (i.e., that they return home safely), and avoid comparing outings.

"Sit-and-wait" hunting describes situations whereby a hunter waits in one area, usually where a game animal has been feeding, and waits for it to return. This occurs mainly in the forest under large fruiting trees or in agricultural areas. Hunters first visit these areas during the day to ascertain whether an animal is feeding regularly, indicated by the tracks it leaves behind. If this is the case, the hunter goes to the area, usually at

night but sometimes shortly before dawn, to wait for the animal to return to feed. Elevated platforms are sometimes built to wait on, though often hunters simply stand in one spot. Flashlights, propped atop the rifle, are used to freeze game by flashing directly into their eyes. According to local informants, night hunting only occurs when there is a clear sky without any moon. "Sit-and-wait" hunting in agricultural areas is often done equally to protect crops and to catch game. Informants cite many occasions when entire harvests have been lost to game animals.

The animal most commonly caught using sit-and-wait hunting is the nocturnal paca (*Agouti paca*). However, diurnal species, such as tapir, collared peccary and white-tailed deer, are often caught feeding at night as well, although this tends to occur at specific times during the year when their preferred food is abundant. I participated in one sit-and-wait outing, conducted at night in a maize field one kilometre outside Tukrun where a paca had been eating maturing maize. The unsuccessful outing lasted two hours.

Opportunistic hunting is the third "strategy" employed to hunt game, occurring when an animal is caught while the hunter is doing something other than pursuing game, such as agricultural work or making a dugout canoe in the forest. When game appears, work is stopped to pursue the animal. The potential for such chance encounters exists throughout the hunting zone, and hunters rarely leave home without a rifle or hunting dog. No game was caught while participating on one fishing and two agricultural expeditions. However, on separate mapping outings, local investigators hunted one yellow-naped amazon (*Amazona* spp.) and one crested guan, totaling 2.5 kg. Both animals were caught in forested areas, very near the limit with agricultural areas.

It appears that many people who do not necessarily enjoy going on hunting

expeditions readily engage in opportunistic and "sit-and-wait" hunting. As one resident of Tukrun states: "*Aquí uno carga su rifle, y a la hora cuando el animal sale, lo tira, pero no anda muriendose buscandolo por que hay bastante* (Here, a person loads his rifle and when the time for the animal to reveal itself comes, he shoots it, but he does not walk tirelessly looking, because there are many animals)."

4.1.5 Hunting Technologies Used

The hunting tool of preference among the Miskito is the 0.22-calibre rifle. Approximately half of all households are equipped with at least one rifle, even if none of the inhabitants are regular hunters. According to elders, residents have hunted using firearms for as long as they could remember. In the past, however, muzzle-loading shotguns were used and bullets were made with gunpowder, lead pellets (both store-bought) and re-used bullet shells (referred to as *kapi kapi*). Today, some hunters possess 16-gauge shotguns, although their use is not widespread because bullets are six times more expensive than 0.22 shots (approximately CAD $1.10 each).

A primary limitation to the use of firearms is the availability of bullets. Firstly, hunters regularly run out of money to purchase bullets. This problem is sometimes averted by acquiring them from friends in exchange for a part of the catch. Secondly, bullets are often scarce throughout the community. Stores frequently sell out their stock. This however is of short duration since supplies are continuously brought in from Wampusirpi, a two-hour boat ride downriver.

Hunting dogs have long been used by Miskito hunters, particularly to catch pacas,

but also to catch other burrowing game such as agoutis (*Dasyprocta punctata*) and armadillos (Conzemius 1932: 78). Dogs are effective hunting tools because they can easily enter burrows to trap or flush out game, they can outrun most game and they help find arboreal animals that fall amid vegetation on the forest floor. Hunters often develop strong relationships with their dogs and are in constant communication through calls and whistles when hunting. According to hunters, when a dog embarks on a chase, hunters must follow closely behind, so that the dog does not lose interest. Chases often end with an animal jumping into a stream to flee its pursuer, at which point a hunter catches it using a rifle or a machete. Some hunters use dogs to catch large game by letting them loose along the river's edge and following it in a dugout canoe. Deer and tapir are often encountered using this method.

The use of hunting dogs is not extremely widespread. Dogs are costly and require a substantial time investment to train. Many hunters told me that when their dog dies, they are often reluctant to purchase another. Furthermore, dogs are limited in their use because hunters will not take them to forested hunting grounds out of fear that a jaguar will eat them.

Hunters in Kuhrpa and Tukrun no longer use many traditional Miskito hunting tools. Firstly, there was no evidence of the use of blowguns and poison arrows (see Conzemius 1932: 73). Also, it appears that spears were used to hunt white-lipped peccary up until ten years ago, although some hunters still keep one in their homes. While Miskito hunters do not use snares, traps or slings to catch game, according to elders, in the past, baited traps, often with tapir meat, were used to catch jaguars. It appears that these were abandoned with the demise of the fur trade in the region. Finally,

while the bow and arrow has not been used for hunting for generations, only one resident used this tool to fish on occasion at the time of study, and most fishing today is done using lines and hooks or submerged, with a harpoon and mask.

4.2 Miskito Hunting Yields

Local investigators documented game caught by local hunters for a period of 74 days in Kuhrpa and 69 days in Tukrun, between August and October, 2003, providing a snapshot of wildlife use in the two communities. Data were collected on the species hunted, the date caught, the number of individuals, the sex and age of the animals (adult or juvenile), the weapon used and the location caught.

Over the study period, 58 regular hunters caught 310 animals with a total yield of 1,610 kg (Table 2). If extrapolated over the entire year, each regular hunter harvests, on average, 140 kg of game (live weight; butchered weight would be less). This results in a combined average contribution of 160 kg of meat per week to local diets, resulting in a per capita consumption of 23 grams of wild game per day for all of Kuhrpa and Tukrun. Thus, while a relatively small proportion of the overall population hunts on a regular basis, the amount of game caught by active hunters is significant.

Table 2. Game Caught in Kuhrpa and Tukrun, Gracias a Dios, between August 12 and October 25, 2003 (58 censused "regular" hunters in the two communities†).

Common Name	Species	Individuals Captured	Total Yield (kg)
Collared peccary	*Tayassu tajacu*	32	545
Nine-banded armadillo	*Dasypus novemcinctus*	58	170
Great curassow	*Crax rubra*	35	145
White-lipped peccary	*Tayassu pecari*	5	145
White-tailed deer	*Odocoileus virginianus*	3	120
Crested guan	*Penelope purpurascens*	49	100
Red brocket deer	*Mazama americana*	4	90
White-nosed coati	*Nasua narica*	17	80
Paca	*Agouti paca*	11	80
Agouti	*Dasyprocta puntata*	18	55
C.A. spider monkey	*Ateles geoffroyi*	4	30
White-faced capuchin	*Cebus capucinus*	9	20
Toucans	*Ramphastos* spp.	26	15
Parrots	*Amazona* spp.	14	7
Slaty-breasted tinamou	*Crypturellus boucardi*	14	6
Chachalacas	*Ortalis* spp.	10	5
Green iguana	*Iguana iguana*	1	5
Mammals		161	1,330
Birds		148	280
Total		**310**	**1,610**

N.B. Biomass measurements taken from Robinson and Redford (1986) for mammals and Dunning (1992) for birds, with the exception of *Amazona* spp. (Stiles and Skutch 1989) and *N. narica* (Reid 1997)

†Registry was anonymous to respect privacy of informants. Regular hunters identify themselves as hunting at least once per month.

** 12 individuals were not included in the calculations because data was incomplete (7 *D.novemcinctus*, 2 *D. puntata*, 3 *C. capucinus*)

Mammals contributed 83% of the total hunted biomass in this study, two thirds of which came from four species: the collared peccary (545 kg), the nine-banded armadillo (170 kg), the white-lipped peccary (145 kg) and the white-tailed deer (120 kg). One bird species, the great curassow, also contributed an important amount of biomass (145 kg). 55% of all hunted biomass came from four large ungulate mammal species, the white-lipped and collared peccaries, as well as the white-tailed and red brocket deer. With the exception of armadillos and coatis, all other hunted species are mainly herbivorous (Reid 1997; Ridgely and Gwynne 1989).

The collared peccary accounts for 35% of the entire harvest, three times more than the second largest contributor, the armadillo, at 10% (Table 2). This large mammal was hunted in all habitats except the pine savanna, including agricultural areas. It was also hunted consistently throughout the study period. 58 armadillos were harvested during the study period, making it the most hunted species, with more than three quarters of all hunts occurring in modified habitats. Five species were caught exclusively in mature forest habitats: the Central American spider monkey, the white-faced capuchin monkey, the red brocket deer, the white-lipped peccary and the great curassow. In contrast, 80% of all pacas and parrots were caught in modified swidden-fallow habitats.

Nearly three quarters of the overall biomass was caught in Kuhrpa, despite a smaller proportion of the community that hunts compared with Tukrun (Table 1). The main difference lies in the collared peccary harvest: 30 were harvested in Kuhrpa compared with only two in Tukrun. Hence, while hunters from Kuhrpa only harvested 38 more animals than Tukrun hunters, the latter relied more heavily on smaller game, such as armadillos, pacas and agoutis, as well as toucans and parrots.

Seventy-eight per cent of game was caught using a rifle and 20% was caught using only dogs, with hunts using dogs concentrated in agricultural areas and the pine savanna. Among sexually dimorphic species, which includes mammals and some bird species, males accounted for a greater proportion of individuals caught than females (60%). Finally, 95% of the total biomass was taken from adult animals.

While small game such as parrots and toucans were registered, local investigators did not register other small game, such as doves or oropendolas. While it is not completely clear why these species were not registered, it is likely explained in part because they tend to go unnoticed when hunted and therefore require special attention from the research team to document, who may have thought them unimportant to document. It is also possible that many hunters simply did not hunt these animals very frequently. While recognizing that hunting can have an impact on these species' population dynamics, their contribution to the overall hunting biomass over the study period is assumed to be modest.

Due to seasonal variation in hunting effort and the availability of different species over the course of the year, the results are not representative of activity throughout the year. However, further analysis of seasonal variations can provide insight into how these results may change within a year.

4.2.1 Temporal Variations in Miskito Hunting Yields

Variations in hunting yields over the year are caused by changes in hunting effort, influenced by cultural practices and preferences as well as the demands of agriculture and

wage labour. Variations are also caused by changes in game availability, influenced by ecological seasonality. These influencing factors operate at different time-scales, often interacting together. However, hunting yield data are limited to three months between August and October, 2003. Interview data are therefore used to discuss the causes of variation for time ranges longer than the study period.

The observance of holidays and the weekly schedule among the Miskito is an important cause of variation in hunting effort. Within a given week, hunting activity tends to be concentrated towards Friday and Saturday because people generally enjoy eating meat on Sunday, a day of rest. As one Tukrun resident states: "*Los domingos, quiero comer sopa (de carne)* (On Sundays, I want to eat meat soup.)." Over three months in Kuhrpa and Tukrun, 54% of all game biomass was caught on Friday or Saturday. Comparatively fewer animals are caught at the beginning of the week, when time is mostly devoted to agricultural work. Holiday periods within the year are often taken to rest and spend time with family, leading to dips in hunting activity. Three holidays are squeezed into one and a half weeks following September 15th, the Honduran Independence Day, during which time, hunting activity declined four-fold (Figure 2). Similar declines in hunting appear to be observed during *Las navidades* (Christmas and New Year's) as well as during *Semana santa* (Holy Week).

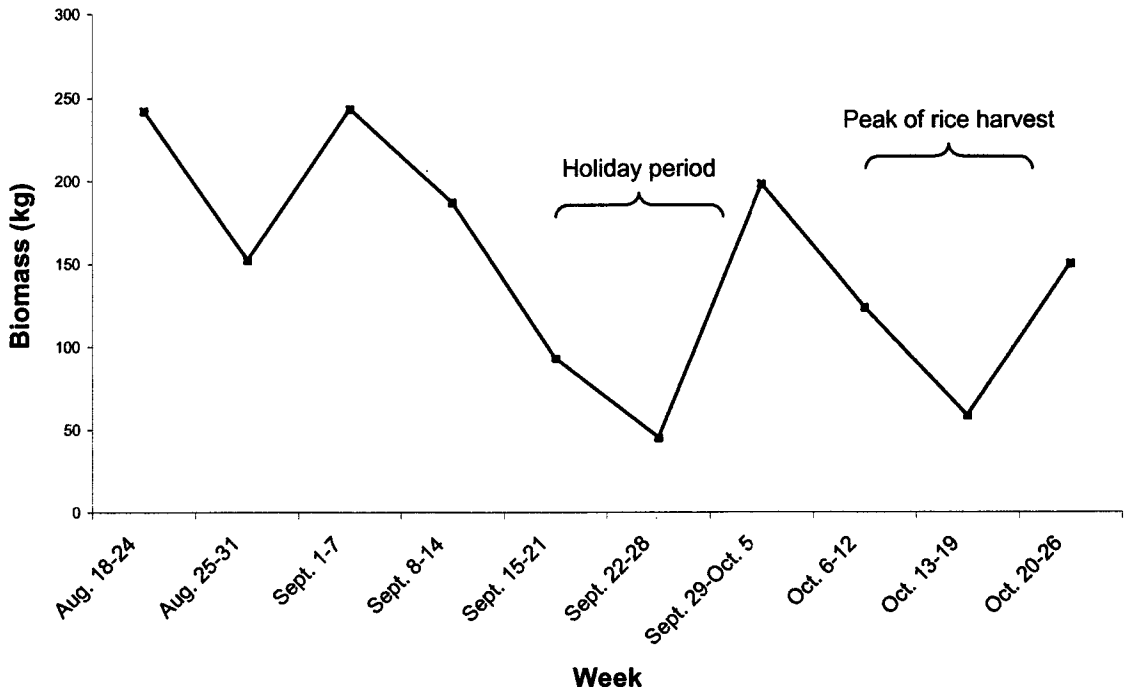


Figure 2. Hunting Yields over Ten Weeks in Kuhrpa and Tukrun, 2003.

The demands of agriculture and the need to engage in wage labour also limit hunting effort, causing temporal variations in hunting yields. During the study period, hunting activity was at its highest during the week of August 18th and the week of September 1st, during the maize harvest. In contrast, at the peak of the rice harvest, from October 6th to the 19th, hunting yields decreased five-fold (Figure 2). Harvesting rice is time-consuming and physically demanding: plants must be cut at the ground level and grains must be removed manually by pounding shoots against a flat surface, all amid a strong sun before the advent of the afternoon rains. Maize harvesting, on the other hand, requires far less effort and can be performed in any weather. Moreover, maize is eaten by a number of game species that can be caught opportunistically, while large animals rarely feed on mature rice crops. Conversely, hunting effort appears to increase at times between harvests, when hunters go on extended hunting and fishing trips. These trips appear to be most common in December and March, prior to both major Christian holidays, when people particularly enjoy eating meat and fish.

Hunting activity (and agricultural activity) generally decreases when there is a chance to make money outside of the community. However, availability of wage earning opportunities is episodic and can therefore arise at any time of year. Miskito men from Kuhrpa and Tukrun have worked in many different resource extraction industries in the region, from gold panning to lobster diving. At the time of this study, however, only one *Kuhrpeño* was diving and panning had not occurred since 1998, when major flooding of the Río Patuca caused by Hurricane Mitch appears to have covered the remaining gold with layers of sediment. Many men currently work in Wampusirpi in construction and lumber extraction. As a result, they were absent for most of the study period.

Environmental fluctuations within a year often influence hunting yields. Miskito subsistence culture is well attuned to seasonal variations in game availability (Nietschmann 1973: 115). Miskito months often refer to times when specific game are particularly abundant, such as *Kakamuk kati* (month of the iguanas, corresponding to April) and *Kuswa kati* (month of the river turtle; February), at which times hunters seek out these species. The hunting of spider monkeys and pacas appears to increase at certain times of year (between June and August for monkeys and in November for pacas) although this is not necessarily because animals are more abundant, but instead hunters indicate that the animals' meat is tastier during these times. This appears to be related to seasonal peaks in production of the animals' preferred foods, particularly fruiting trees. Finally, multiple-day hunting trips appear to be more widespread in the dry season (January-May), when less rain makes paths easier to walk along.

A wide range of cultural and ecological factors, acting at different temporal scales, cause important variations in hunting yields within a year. Miskito hunting effort is often timed according to these variations. However, while fluctuations influence overall hunting patterns, their effects on the harvest of individual species need to be examined in order to understand their impacts.

4.3 The Use of Seven Large Game Species: Ethnozoological Knowledge and the Spatial and Temporal Patterns of Miskito Hunting

Hunters target certain game at different times of the year, the timing of which does not occur by chance. Local ecological knowledge, accumulated over generations, plays a role in focusing hunting effort on specific animals, in specific locations, at

specific times of year. As a result, the effects of hunting on individual wildlife populations can only be understood through the examination of their harvest over an entire year. Interviews were conducted with 44 local Miskito hunters on the harvest of seven key game species — the Central American spider monkey, the white-faced capuchin, the Baird's tapir, the collared peccary, the white-lipped peccary, the white-tailed deer and the red brocket deer — to give a picture of hunting activity that is broader than the study period, as well as to document ethnozoological knowledge and its role in the dynamics of wildlife use.

In total, 18 *Kuhrpeño* and 26 *Tukrunero* hunters were interviewed. 52% (30/58) of regular hunters were interviewed, of which eight were identified by the research team as frequent hunters (those who usually hunt more than once per week). Nine interviews were conducted with retired or semi-retired hunters, three with irregular hunters and two with non-hunters who possessed exceptional knowledge about wildlife use for background purposes.

The following subsections provide a review of the ecology of each game species covered in the interviews, followed by related ethnographic information, local ethnozoological knowledge and observations made while participating in hunting outings. The final subsection presents quantitative interview data regarding the use of the seven species in the past year.

4.3.1 Monkeys

The two monkey species hunted by the Miskito are the white-faced capuchin

(*Cebus capucinus*) and the Central American spider monkey (*Ateles geoffroyi*). The former is small (1.8-4.3 kg) while the latter is quite a bit larger (5-9 kg) (Reid 1997). Like most monkeys, both species are gregarious, and spider monkeys spend part of their day in very large groups of up to 40 individuals (Chapman 1988). Both animals rely heavily on fruits for food but capuchins also feed on small insects (ibid). The geographic distribution of spider monkeys is restricted to old-growth forest while capuchins have been known to inhabit regrowth forests although at lower densities (Sorensen and Fedigan 2000). Spider monkeys are known to have very large home ranges (2.5-4 km^2) (Eisenberg 1983), moving very quickly from one place to another along what are believed to be set routes (Sorensen and Fedigan 2000). Both animals tend to be wary in areas where hunted (Reid 1997), and spider monkeys are particularly sensitive to overhunting, sometimes requiring up to 25 years to recover in an area (Sorensen and Fedigan 2000).

Among Miskito hunters, *wakling* (capuchin) is not a preferred species. Many people do not consume the animal at all and some hunters are reluctant to put effort into hunting an animal that is "always skinny". For example, while participating in one outing, the hunting party came across a troop of capuchins, but did not hunt any individuals, stating that they wished to save their bullets for more worthwhile game. *Urus* (spider monkey), on the other hand, is among the most popular game species hunted among the Miskito. However, as noted by Helms (1971: 117), because of its resemblance to humans, the animal is not consumed everywhere in La Moskitia. Indeed, Miskitos from elsewhere tend to have a negative view of people who hunt this species. Nevertheless, in Kuhrpa and Tukrun, many residents prize spider monkey meat and

elders told me about how this game sustained them when they worked as rubber-tappers, living in the forest for long periods at a time. Juveniles of both monkey species are also often caught live to sell, to give away or to keep as pets in the community.

According to Miskito hunters, both species of monkey are found only in mature forest. Capuchin monkeys are hunted at a similar frequency throughout the year, although they are often associated with trees that produce fleshy fruit at specific times of year, namely the mamey tree (*Lucuma mammosa*), the silk-cotton tree (*Ceiba pentandra*), as well as the "tasmuk" and "masica" trees (unidentified; see Appendix I). All of these trees tend to fruit from July to September. Spider monkeys, on the other hand, are caught almost exclusively during this time of year because, according to local hunters, feeding on the fruits makes them very fat and their meat very tasty. At these times, hunters seek out this monkey, often by looking for its arboreal "path", indicated by fallen half-eaten fruits. Anticipating the eventual return, hunters will often wait in silence beneath the path, sometimes making a loud whistle to emulate the monkey's call. Another strategy to locate spider monkeys is simply seeking out fruit trees where troops are known to feed, also assessed by fallen fruits. However, the animals are very elusive and, on one outing in which I participated, the entire troop easily escaped from hunters.

4.3.2 Tapir

The Baird's tapir (*Tapirus bairdii*) is the largest terrestrial mammal in Central America, weighing up to 300 kg (Reid 1997). It is a solitary, stocky, hoofed herbivore with a long, extensible upper lip reminiscent of an elephant's trunk (Janzen 1983b).

Tapirs generally prefer vegetation characteristic of regrowth forests, and have been known to feed on certain agricultural crops, such as corn and sugarcane (Fragoso 1991: 161). Individuals usually travel along set routes, easily distinguished from the surroundings by the trampled vegetation and compacted soil (Reid 1997). Tapirs are strongly associated with open water and rarely stray far from rivers or mud wallows, particularly in the dry season (ibid). The tapir is a very popular game animal throughout its range, this despite its protected status (Reid 1997; Tobler 2002; Ventocilla 1995: 39), and is often very wary of hunters (Janzen 1983b). Partly due to hunting pressure and partly due to lower reproductive rates, tapirs are usually found at very low densities (Robinson and Redford 1986).

According to elders in Kuhrpa and Tukrun, in the past, *tilba* was not eaten. Still today, the animal's meat is not as desired as other game and many elders do not consume it. However, the large quantity of meat that can be acquired from one individual makes it quite appreciated when hunted. Tapirs are almost exclusively caught in the dry season in two locations: bean fields and mud wallows. Local residents identify this animal as an important agricultural pest, feeding heavily on young flowering bean plants, "like cows", according to one resident. In 1997, a hunter killed seven individuals in one month feeding on bean crops, all within approximately 500 m of each other. When hunting in the dry season, hunters often check the few remaining mud wallows for tapirs. One hunter from Tukrun reported catching a tapir every year for the last five years in the same wallow.

4.3.3 Peccaries

The collared peccary (*Tayassu tajacu*) and the white-lipped peccary (*Tayassu pecari*) are piglike mammals that possess a large scent gland on their rump that secretes an oily musk (Reid 1997). Both species are gregarious, with the more common collared peccary usually found in small groups of up to fifteen individuals (Robinson and Eisenberg 1985). White-lipped peccaries, for their part, form very large herds of up to 200 individuals, that travel over very long distances (Peres 1996). Both animals feed mainly on fruits that fall to the forest floor (Barreto et al., 1997; Bodmer 1991; Robinson and Eisenberg 1985), although collared peccaries are also known to feed on a variety of plants and animals (Judas and Henry 1999), as well as on agricultural crops (Carneiro 1983; Smith 2005). While collared peccaries are found in a wide variety of habitats throughout the Americas, ranging from scrub desert to tropical rainforest (Sowls 1983), white-lipped peccaries are generally restricted to forested areas of the neotropics (Reid 1997).

Peccaries are among the most popular neotropical game species (Peres 1996). However, hunting impacts the two species in different ways. The collared peccary has a high reproductive rate that is often synchronized to forest fruit production (Henry 1997), and adapts well during times of food scarcity (Judas and Henry 1999). As a result, this highly resilient species persists in many areas where hunting occurs, although usually in smaller numbers compared with unhunted areas (Peres 1996). In contrast, lower reproductive rates and herding behaviour result in white-lipped peccary being much more vulnerable to overhunting (i.e., hunters can capture several individuals in one encounter)

(Gottdenker and Bodmer 1998), and local depletion has been frequently noted (Reid 1997; Peres 1996).

Among the Miskito, both *buksa* (collared peccary) and *wari* (white-lipped peccary) are readily consumed. However, while residents of Kuhrpa and Tukrun state that *buksa* has always been a regular part of their diet, it is *wari* meat that is the most prized of the two. This may be related to the odour emitted from their scent gland, which can contaminate meat if the gland is not immediately cut off upon hunting the animal. According to local hunters, while white-lipped peccaries also emit a characteristic odour, its smell is generally not as strong.

Collared peccaries can be found in every type of habitat found within the hunting area, although hunters often associate it with manioc (*Manihot esculenta*) fields because of the damage this species can inflict on this crop, although they are also important pests for dasheen and immature rice stalks. White-lipped peccaries, on the other hand, are restricted to continuous tracts of mature forest. Both animals are hunted throughout the year, but, according to interviewees, hunting of collared peccaries peaks in August and September when numerous trees are fruiting, such as the "masica" and hog plum tree, as well as in November and December, when manioc crops mature. According to local hunters, white-lipped peccary hunts increase in the dry season, when hunting parties of 10-15 people commonly go on multiple day hunting trips to the distant northern hunting grounds. Hunters reported a wide range of white-lipped peccary herd sizes that generally fell between 50 and 150 individuals.

It is the characteristic must smell of both peccary species that often alerts hunters of these animals' presence. On outings in which I participated, hunters identified

collared peccaries as being nearby from their odour on three separate occasions, as well as a herd of white-lipped peccary once. Hunters also often find peccary tracks below "masica" and hog plum trees when these are fruiting. However, hunting these animals can be quite challenging. Collared peccaries, on one hand, are very fast and often require several bullets before they fall to the ground. White-lipped peccary herds, on the other hand, can be tracked for days without success and can be very aggressive when attacked (one hunter from Kuhrpa was reported to have nearly been killed by a peccary ten years ago). This may partly explain why the animal is so highly revered by Miskito hunters.

4.3.4 Deer

The white-tailed deer (*Odocoileus virginianus*) and the smaller red brocket deer (*Mazama americana*) are large ruminants, characterized by antlers found only on males (Reid 1997). Both animals are known to feed mainly on fruits, although white-tails commonly feed on twigs, leaves, flowers and buds (Janzen 1983a), foods that brockets only eat when fruits are scarce (Bodmer 1991; Gayot et al. 2004). White-tails generally prefer clearings and grasslands and are found throughout the Americas (Janzen 1983a). Red brockets, on the other hand, are usually restricted to forested areas and are found only in tropical regions (Reid 1997). While less is known about the red brocket deer, it appears that populations are not strongly affected by hunting in many parts of its range (Hurtado-Gonzales and Bodmer 2004), nor do they respond negatively to low-scale disturbances (ibid). White-tailed deer continues to be heavily hunted in many areas, despite its protected status (Reid 1997).

Among the Miskito, *sula pauni* (white-tailed deer) has always been a highly esteemed source of meat (Nietschmann 1973: 107). The residents of Kuhrpa and Tukrun are no exception. In contrast, *snapuka* (red brocket deer) is known by hunters as a very difficult animal to catch, and, as a consequence, few have tasted its meat.

Miskito hunters immediately associate white-tailed deer with the pine savannas, and elders reminisce about a time when this habitat abounded with deer. Hunters often hunt deer in the savanna using a flashlight, which freezes the animal when flashed in the eye. At the end of the dry season, villagers burn the savanna as well as their agricultural fields. Hunters often enter these areas in the days following the burning specifically looking to catch a deer browsing on emerging vegetation. Informants note that the animal is also hunted opportunistically while feeding on flowering bean plants in February-March, which usually stops once beans mature.

According to local hunters, red brocket deer is caught throughout the year in mature forest or in tall fallows, but rarely in cultivated areas. However, Miskito hunters harvest relatively less of this animal compared with other game, and they are not considered as a very important source of meat.

4.3.5 The Harvest of Seven Key Game Species Over One Year

Quantitative data regarding the harvest of the seven key game species between November, 2002, and October, 2003, was obtained from 30 regular hunters in Kuhrpa and Tukrun, corresponding to approximately half of all residents that report hunting on average at least once per month. Ten of these respondents are identified as frequent

hunters, who hunt on average at least once per week. I estimate that this sample represents roughly three quarters of the overall harvest of these animals in the two communities. Furthermore, for large, less frequently hunted game, such as tapirs, the sample may represent the entire harvest between November, 2002, and October, 2003, because it appears that frequent hunters tend to catch most individuals within a year. Nevertheless, all figures should be taken with caution because they are based entirely upon hunters' memories.

The three most important sources of game biomass among the seven interview species in Kuhrpa and Tukrun from November, 2002, to October, 2003, were the Baird's tapir (3,900 kg), the white-lipped peccary (1,680 kg) and the collared peccary (1,410 kg) (Table 3). Overall, according to interviews, the seven game species contributed 8,950 kg to local diets in one year, corresponding to 9 kg of meat per resident. The two most hunted animals were the spider monkey (71 individuals caught) and the white-lipped peccary (59 individuals caught).

Table 3. Harvest of Seven Large Game Species by 30 of 58 Regular Hunters in Kuhrpa and Tukrun from November, 2002, until October, 2003.

Species	Number of Captures Reported	Approx. Total Harvest (kg)	Habitats where captured (approx.)			Comments made by Hunters
			Swidden-fallow (%)	Savanna (%)	Mature Forest (%)	
Tapirus bairdii	13	3,900	60	0	40	Caught mainly in dry season (May-June), in bean fields.
Tayassu pecari	~60	1,680	~<5	0	~>95	Hunting seasons variable.
Tayassu tajacu	~80	1,410	~35	0	~65	Caught year-round.
Odocoileus virginianus	30	1,180	50	25	25	Often caught after burning at end of dry season.
Ateles geoffroyi	72	530	0	0	100	Caught Jun.-Sept. when hog plum, mamey trees fruiting.
Mazama americana	7	180	15	0	85	Hunting seasons variable.
Cebus capucinus	17	60	0	0	100	Caught year-round.
Total	**275**	**8,950**				

Harvests for three of the seven species — the Baird's tapir, the white-tailed deer and the spider monkey — occurred at specific times of year. All but two tapirs (80%) and roughly half of all deer (60%) were captured during the dry season (January to early June), when both eat bean plants. Five tapirs were also hunted during the dry season in mud wallows in the forest. Twenty-five per cent of reported deer captures occurred at the end of the dry season, following residents' burning of savanna and agricultural fields. The capture of spider monkeys occurred mainly from June to September. According to local hunters, monkey meat is particularly prized during these months when animals feed on an abundance of fleshy fruits in the forest, causing them to fatten. Although hunters indicated that collared and white-lipped peccaries are hunted at higher frequencies at certain times of year (June- September and November for collared peccary and January-May for white-lipped peccary), data did not indicate any significant seasonal hunting trends for either species.

Harvest data for collared and white-lipped peccaries should be considered approximate. In the case of collared peccary, hunters catch this animal frequently and may not have remembered all of the details of specific hunts. As a result, in certain cases, hunters were asked to estimate the number they hunt in a given month, with some stating that they harvest approximately fifteen. In the case of white-lipped peccary, hunters may have tended to overestimate the overall catch because many individuals are usually hunted at the same time, and some hunters may be taking credit for other peoples' catches. Harvest data were discarded when hunters claimed to have hunted more than two individuals per person. This is because the large size of the animal as well as the large distance needed to travel back to the community from where it is caught makes it

difficult to carry more than one individual, and more than two is virtually impossible. Nevertheless, some over-reporting was likely not detected.

The harvest of white-lipped peccaries, spider monkeys and white-faced capuchin monkeys is restricted to mature forest habitat. With the exception of white-lipped peccary herds that very occasionally stray into tall fallows, hunters state that these animals are very specific to mature forest areas. Six red brocket deer were captured in deep forest, with the seventh occurring in a fallow area. White-tailed deer was the only species among the seven that was hunted in the pine savanna, with seven individuals captured in this habitat. Finally, the collared peccary was found in both forest and swidden-fallow areas, although hunting tends to be slightly biased towards forested areas.

Data were collected about the gender and age of prey. The harvest of collared peccary was greatly slanted towards males, making up about 85% of the total harvest. However, hunters did not recall the animal's sex for many reported hunts, and, consequently, this figure only represents half of all estimated collared peccary hunts between November, 2002, and October, 2003. While hunters claim that female spider monkeys are usually fatter and therefore more desirable, males and females of this species were caught in equal proportion. Harvests for the other five species do not indicate any bias towards one sex. Furthermore, all but two reported hunts for the seven species were restricted to adults.

4.4 The Spatial Patterns of Miskito Subsistence Hunting

The Miskito in Kuhrpa and Tukrun use upwards of 500 km^2 of land surrounding

their communities to hunt, but also to fish, to extract lumber, to collect medicinal plants and to practice swidden agriculture. As a result, the hunting zone is a mosaic of different habitats, modified and unmodified, used to tap the different biological resources that make up the subsistence economy. These different habitats have tremendous influence on game abundance and distribution within the hunting zone. However, habitats themselves are not distributed evenly in this area, but instead are concentrated in different areas, based on a variety of ecological factors, but also influenced by human modifications of the landscape, particularly agriculture, which tends to be found closer to home. The geographic distribution of game within a hunting area therefore varies. In addition, hunting activity varies over time, often influenced by ecological seasonality and the demands of subsistence livelihoods, and place, influenced by the distance of hunting grounds from the communities, topography, the location of *kiamps*, the location of rivers and streams and the location of agricultural lands. Hunters do not randomly move through the hunting zone in search of game but, instead, concentrate their efforts in specific places, using a variety of strategies developed over generations to catch desired wildlife. Thus, Miskito hunting is intimately linked to specific geographic locations, resulting in complex spatial patterns. Examining spatial patterns therefore provides a window into the complex interplay of culture, geography and ecology in tropical indigenous hunting, thereby helping further understand this complex activity.

To better understand the spatial patterns of Miskito hunting, the hunting zone for Kuhrpa and Tukrun was divided into four different sub-zones. These zones are defined by clear differences in hunting effort, strategies used, and the type of game caught. However, they can only be understood within the context of the entire hunting zone used

by Kuhrpa and Tukrun. Examination of the use of seven large game species within the context of the different hunting sub-zones provides a greater appreciation for the complex geographic dynamics of subsistence wildlife use.

4.4.1 The Shared Hunting Zone of Kuhrpa and Tukrun

The shared hunting zone in the Miskito communities of Kuhrpa and Tukrun is a highly irregular shaped area, found on either side of the Río Patuca. The size of the hunting zone is 335 km^2, not including distant northern hunting grounds, which are estimated to measure anywhere between 150 km^2 and 250 km^2. Most peripheral parts of the zone are within a 20 km walking distance from the community, with the exception of distant northern hunting grounds, which, at parts, is a 25 km walk from either community. The area is generally oriented northwest to southeast, with the Río Patuca cutting through near midway as it flows towards the Caribbean Sea. The zone contains swidden agricultural lands, including fallows in various stages of regrowth, and a large pine savanna, all located closer to the community, as well as vast forested areas.

Various factors explain the hunting zone's irregular shape. Firstly, lands south of the Río Patuca are more rugged and streams are smaller, thus travel by canoe is not possible and travel by foot is more difficult. As a result, when distant northern hunting grounds are included, the relatively flat lands north of the Patuca cover double the area of southern lands. In addition, the different hunting grounds that make up the hunting zone are not uniform in size and shape, but rather vary according to how hunters use them, which can be influenced by the predominant topography of the area as well as game

distribution and abundance. For example, if the hunting grounds consist of a valley, hunters will likely use the entire valley, regardless of its shape. The shape of the hunting zone can also be influenced by the paths that hunters use to travel because residents often do not deviate too far from them while walking. As a result, hunting grounds in parts become narrow corridors connecting two wider areas where hunters roam more freely. This occurs along the *Kuswakrik Tingni*, a major stream north of the Río Patuca, where a path that follows alongside connects to discreet hunting grounds in headwater areas (Figure 3).

Much of Kuhrpa and Tukrun's hunting grounds overlap, with middle areas often used by hunters from both communities. While the use of the hunting zone by other communities along the Patuca was not systematically documented, I estimate that hunters from neighbouring communities use peripheral areas to some degree. These include the headwaters of *Kuswakrik Tingni*, used by Pimienta residents, a community neighbouring Tukrun, as well as the stream's lower reaches by hunters from Wampusirpi, located downriver (Figure 3). According to local hunters, residents of Wawina, found near the confluence of the Río Uhra with the Patuca, approximately 45 km downriver from Kuhrpa and Tukrun, use the distant northern hunting grounds, although not all residents agree to the extent that *Wawineros* use it.

The four sub-zones of Miskito hunting fit into two broad categories: the first three sub-zones, located closest to the communities, make up the main hunting area (335 km^2), while the fourth, consisting of the distant northern hunting grounds, is in a separate category (area estimated between 150 km^2 and 250 km^2). The main area can be further divided into the core area, comprising sub-zones 1 and 2 (240 km^2), and the extended

area, consisting of sub-zone 3 (95 km^2) (Table 4).

Boundaries for the four sub-zones are diffuse and can change from one year to another. Furthermore, their boundaries are estimated and should not be considered precise. Finally, these sub-zones do not necessarily represent the way in which the Miskito in Kuhrpa and Tukrun perceive the hunting zone.

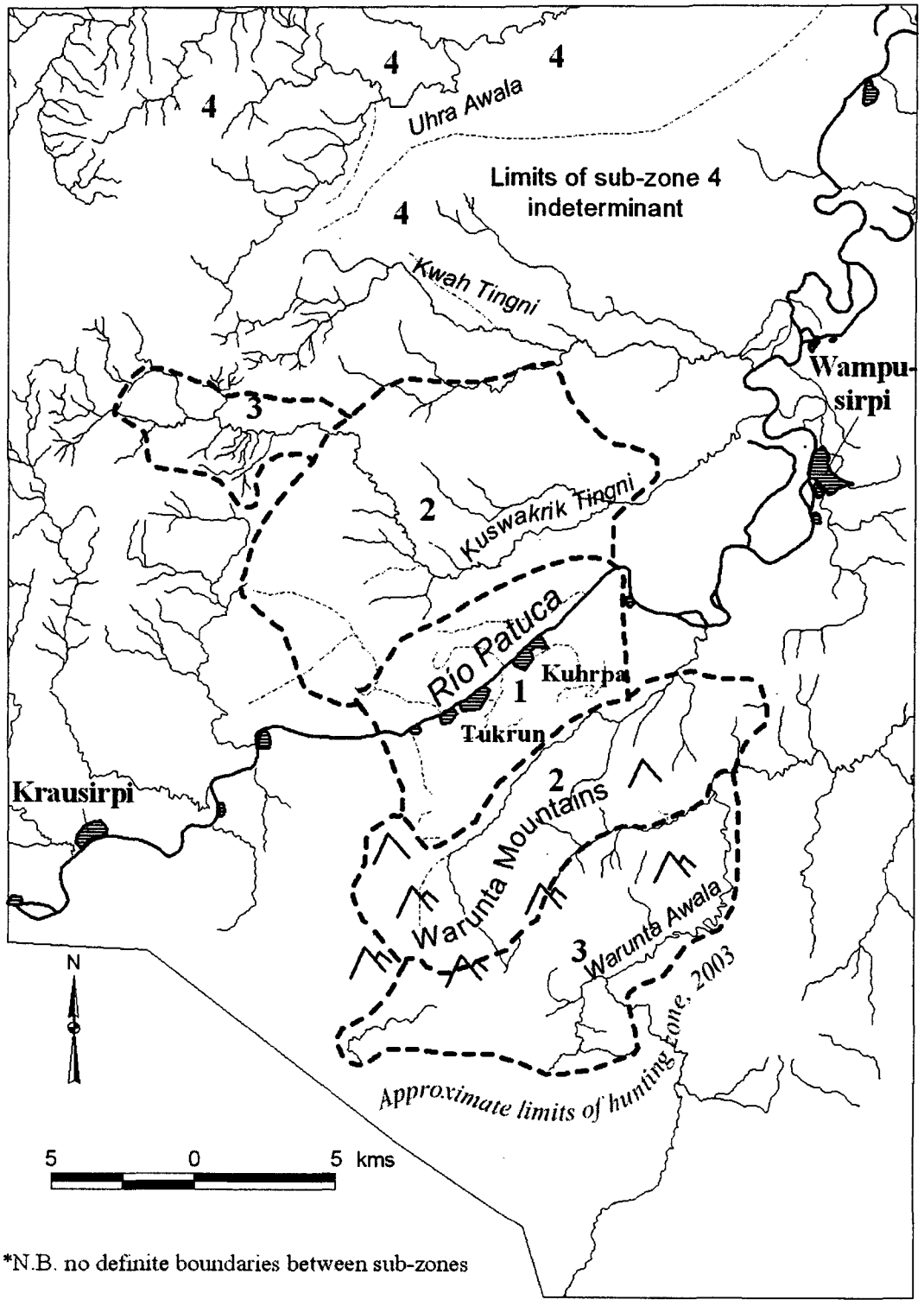


Figure 3. Map of the four Miskito hunting sub-zones for Kuhrpa and Tukrun, 2003 (see text for description).

Table 4. Hunting sub-zones exploited by Miskito hunters of Tukrun and Kuhrpa.

Sub-zone	**Approx. Area** (km^2)	**Approximate % of Total Hunting Yield** (Aug.-Oct. 2003)	**Types of Hunting Strategies Used** (in order of importance)	**Characteristics**
1	60	35	1. Opportunistic hunting 2. Sit-and-wait hunting 3. Hunting trips (half-day, full day)	• Surrounding community • Made up mostly of swidden-fallow mosaic
2	180	50	1. Hunting trips (full day) 2. Opportunistic hunting 3. Sit-and-wait hunting	• Minimum of 1-2 hours walk from community. • Mostly continuous mature forest; very small agricultural clearings • Visited primarily for hunting purposes
3	95	5	1. Hunting trips (multiple-day)	• Visited monthly during multiple-day outings • Abundant in game
4	150-250	10	1. Hunting trips (multiple-day)	• Rarely visited (once per year); multiple-day outings • Forest plains of the Río Plátano Biosphere Reserve

4.4.2 The Core Area: Sub-zones 1 & 2

Sub-zones 1 and 2 make up the core hunting area. These are the most commonly used areas to catch game and account for roughly 85% of the harvest between August and October, 2003. The areas within these two sub-zones are mostly found within a 10 km radius of the study communities. They are frequently visited not only for hunting but also for a variety of other subsistence activities. As such, they form the core area not only for hunting, but also for the local economy as a whole.

Sub-zone 1 is characterized by heavily altered habitats. The two study communities are found within this sub-zone as well as most of the swidden agricultural lands used by their residents. Thus, almost all of the land is made up of parcels either under cultivation or in various stages of regrowth. Hence, this area is highly important for garden hunting. While some older forest fragments can also be found, they are generally small and are used mainly for lumber. This sub-zone also includes the pine savanna found south of Kuhrpa. Areas further away from the communities or on the other side of the Río Patuca are accessed by dugout canoe. The many paths to forested hunting grounds also begin in this sub-zone, usually departing from the river's edge and continuing away perpendicularly from the water.

Although not specifically documented during interviews with local hunters, it is apparent that much of the game in sub-zone 1 is caught opportunistically, usually when hunters are working in their agricultural fields. Dogs facilitate this process as they are sniffing out wild animals while their owner works. Game is also caught during sit-and-wait hunting, usually at night in agricultural areas when wildlife are feeding on crops.

Finally, game can also be caught on short hunting expeditions. For outings within the first sub-zone, hunters often bring their dogs in order to catch burrowing game, such as the armadillo or paca. Hunters also go to the savanna in search of white-tailed deer. Finally, small game is often caught in sub-zone 1, usually at the end of the day when empty-handed hunters wish to have some meat for dinner.

Sub-zone 2 is composed of two areas mainly of undisturbed forest found on either side of the Río Patuca beyond sub-zone 1 — a flat northern side (approximately 110 km^2) and a smaller, mountainous southern side (approximately 70 km^2). Some agricultural clearings are found in this sub-zone, particularly near major streams closer to sub-zone 1, but these are few and far between. Sub-zone 2 is mainly visited on hunting expeditions that rarely extend beyond a day. The zone is also a source of lumber, and game is often caught opportunistically when residents are felling a tree. Hunters also practice sit-and-wait hunting near wild fruit trees if they believe these are being visited by nocturnal game. However, people usually do not wish to stray too far from home at night, so this activity becomes less and less widespread with distance from the communities. Most species caught by Miskito hunters can be found in sub-zone 2, although deep forest species that are not found closer to home are often specifically sought out in this area, such as spider monkeys and wild fowl.

Between August and October, 2003, game caught in sub-zone 1 represented 34% of the total harvest. The animal that contributed the most to the total yield in sub-zone 1 was the collared peccary (40%), followed by the nine-banded armadillo (20%), the white-tailed deer (15%), the paca (15%), and the white-nosed coati (10%). Nearly half of all game caught over three months in sub-zone 1 involved hunting dogs. This figure drops

to 9% in sub-zone 2, likely because hunters tend to not bring their dogs deep into the forest of this area out of fear of it being eaten by jaguars.

Game caught in sub-zone 2 represents over half of all biomass caught in the hunting zone between August and October, 2003. The most important species, by weight, caught in the sub-zone were the collared peccary (35%), the great curassow (15%), the crested guan (10%), the red brocket deer (10%), and the nine-banded armadillo (5%).

4.4.3 The Extended Area: Sub-zone 3

Sub-zone 3 is part of the main hunting area because hunters visit these hunting grounds on a regular basis (usually once per month). Over three months, this area accounted for only 5% of the total hunted biomass in Kuhrpa and Tukrun. The sub-zone is almost exclusively used for hunting, although it is occasionally used to cut down trees for dugout canoes. Because of the area's distance to the communities, its use is almost entirely restricted to multiple day expeditions. The zones are therefore dotted with small clearings, *kiamps*, used by hunters as campsites.

Kiamps are often found on the shores of large streams. Hunting pressure in the extended area tends to be localized around these *kiamps*, mainly because hunters often by-pass large tracts en route to their final destination, and usually do not stray far from them upon arrival, unless they decide to follow a white-lipped peccary herd. As a result, there are likely very large tracts of forests away from the main paths and *kiamps* in this area that are hunted less than once per year, if ever. For this to change, new paths would

need to be cut and new campsites established, which appears only to occur when game is depleted near present sites.

Upon one outing to sub-zone 3, I saw and heard a wide variety of different wildlife. Hunters note that wildlife is less wary of people in the extended area and game is generally more abundant compared with areas closer to the community. These appear to be the main reasons for hunting in these distant areas. Hunters usually return home within four or five days but will often stay as long as is needed to fill up their rucksacks with meat (including fish) or to track a herd of white-lipped peccary. To prevent spoilage, hunters smoke meat caught on extended outings.

Only five game species were caught in sub-zone 3 between August and October, 2003. These were, in order of importance by weight, the collared peccary (60%), the great curassow (25%), the spider monkey (10%), the crested guan (5%) and the white-faced capuchin (<5%).

4.4.4 Distant Northern Hunting Grounds: Sub-zone 4

The vast northern hunting grounds that make up sub-zone 4 are generally visited once or twice a year. The boundaries for this zone are likely indeterminate because they are far away from the communities, and because they are used very infrequently. Nevertheless, residents consider this area just as much part of their hunting lands as more frequently visited ones. Indeed, between August and October, 2003, 10% of all hunted biomass was harvested in this sub-zone, entirely from white-lipped peccary.

Sub-zone 4 is only found on the northern side of the Río Patuca because no

equivalent areas seem to exist on the southern side, where more rugged topography likely makes distant areas costly to reach. Furthermore, the distant northern hunting grounds are relatively accessible, reached by foot and by dugout canoe via the Patuca. In contrast, streams on the south side empty into the Caratasca lagoon on the Caribbean coast, resulting in a long trip from Kuhrpa and Tukrun. According to local hunters, the distant northern hunting grounds are among the most beautiful areas they know, and many people look forward to visiting them each year. While visits occur year-round, many hunters said that they visit the areas before Christmas or holy week, or in the dry season when travel by foot is easier.

The centre of sub-zone 4 is the Uhra River (Figure 3). The headwaters of this river are located on the eastern edge of La Moskitia, and the river flows east, emptying into the Patuca near Wawina. Most *kiamps* are found on the Uhra River and it is the area most locals identify with the distant northern hunting grounds. Residents also fish extensively as well as pan for gold on the Uhra, although the latter appears to be less common because there are currently no buyers in the region. From *kiamps* on the Uhra, hunters will also seek out white-lipped peccary herds in nearby areas. Hunters also occasionally hunt in a very large pine savanna located near the confluence of the Uhra River with the Patuca.

4.4.5 The Spatial Patterns of Seven Large Game Species

As Miskito hunters are well aware, each of the seven key game species examined during household interviews has specific habitat preferences. Hunting strategies are

therefore often directed at the specific habitats where hunters expect to find these species (Table 3). However, as is evident from the four hunting sub-zones, the locations of habitats as well as their frequency of use generally varies within the hunting zone. As such, the harvest of game will likely vary accordingly, resulting in different spatial patterns for each of the seven species. Through assigning a location to each successful hunt during interviews, it is possible to examine the spatial distribution of hunting for the seven species within the hunting zone between November, 2002, and October, 2003.

Game species found in human-modified habitats would likely be caught in sub-zone 1, which is characterized by gardens, fallows and a small number of mature forest fragments. This was indeed the case for tapirs and deer, where 60% and 70% respectively were captured in this sub-zone (Figure 4). Collared peccaries were also caught in this sub-zone, although the bulk of the catch for this animal was made outside of sub-zone 1. In addition, tapir, deer and collared peccary tracks are often found throughout this sub-zone, at times on the edges of the communities.

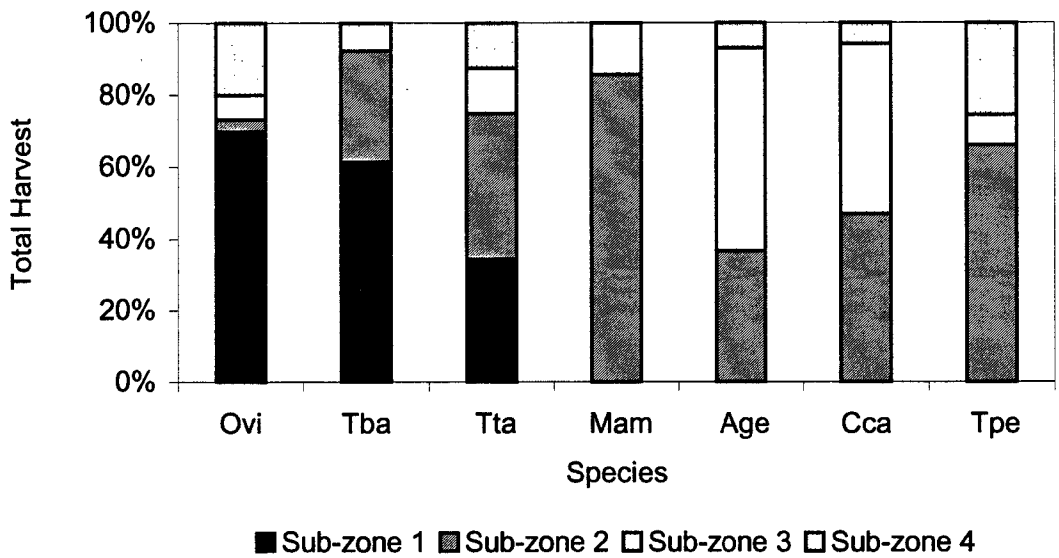


Figure 4. Approximate Harvest by Sub-zone for Seven Important Game Species Between November, 2002, and October, 2003. (Abbreviations correspond with scientific name; Ovi = white-tailed deer, Tba = Baird's tapir, Tta = collared peccary, Mam = red brocket deer, Age = spider monkey, Cca = white-faced capuchin monkey, Tpe = white-lipped peccary)

Eight of 17 game species hunted in Kuhrpa and Tukrun can be identified as garden game because they are mainly caught in human-modified habitat. Interview data, covering November, 2002 to October, 2003, were combined with registry data from August to October, 2003, to investigate the extent of garden hunting among the Miskito (Table 5). The pine savanna is included in this table as an important garden hunting habitat because it appears that the area was created largely by human-induced fires over many centuries (Parsons 1955: 42).

Table 5. Percent harvest of common garden game species in Kuhrpa and Tukrun with main crops eaten. Hunting data were collected directly from hunters using a voluntary hunting registry over three months in 2003, and indirectly from interviews with hunters regarding their use of specific game over one year between 2002-2003.

Species	**% Caught in Sub-zone 1**	**Crops Eaten**
Data from hunting registry		
Agouti paca	80	Corn, manioc, banana
Amazona spp.	80	Corn, rice
Dasypus novemcinctus	75	(Pine savanna, fallows)
Nasua narica	60	Corn, manioc, dasheen
Dasyprocta punctata	45	Manioc, corn
Data from interviews		
Odocoileus virginianus	70	Burned fields, bean flowers (Pine savanna)
Tapirus bairdii	65	Beans, corn, manioc
Tayassu tajacu	35	Manioc, dasheen, pejivalle palm, corn, rice

The hunting area outside sub-zone 1 is dominated by mature forest habitat. Thus, variations in hunting patterns between sub-zones 2, 3 and 4 are more a result of differences in their frequency of use than habitat variation. In general, hunting areas near Kuhrpa and Tukrun are visited at a greater frequency, and therefore tend to supply a larger quantity and greater diversity of game compared with distant areas. Indeed, according to interviews, at least 30% of the total reported harvest for six of the seven focus species was taken from sub-zone 2, with white-tailed deer the exception (Figure 4).

Drops in harvests occur between sub-zone 2 and 3 for the tapir, the collared peccary, the white-lipped peccary, and the red brocket deer. These species are all significantly heavier than the two species of monkeys, which show little variation in harvests between sub-zones 2 and 3. Thus, the higher costs of carrying the animals back home may influence their harvests in distant areas. This is particularly evident with tapirs, which require several hunters to carry it. According to hunters, when this large animal is encountered, they will kill the animal and return later with other community members to bring it home. This would likely not occur at greater distances because of increased travel time to and from the community. Similarly, when white-lipped peccary herds are encountered, hunters return to the community to form a hunting party to hunt many individuals. Evidently, hunting parties are more difficult to form for herds located further away, particularly when people are busy with other work. Hence, when lone hunters encounter these large animals in more distant areas, they will tend to only hunt as many as they can carry, resulting in at most two white-lipped peccaries and one tapir, if any.

The harvest of most of the seven species drops off in sub-zone 4, with the

exception of white-lipped peccary and white-tailed deer. The harvest of white-lipped peccary likely increases from sub-zone 3 to sub-zone 4 because people often travel in groups to the distant northern hunting grounds specifically to hunt this species that appears to be relatively abundant in this area. Thus, whereas encounters in other sub-zones likely occur more by chance, hunters will actively seek herds in sub-zone 4. The harvest of white-tailed deer may increase because of the large pine savanna located on the eastern part of this sub-zone, influencing the overall abundance of deer in the area.

Spider monkey hunting demonstrates important variations within the four sub-zones. This contrasts with the other six species, where the spatial patterns can be adequately explained within the context of the four sub-zones. More than 90% of all spider monkey kill-sites from household interviews were located on the southern side of the Río Patuca (Figure 5). According to elders, this animal was never abundant on the north side of the river. This may possibly be related to topography, since monkeys were only caught in areas adjacent to the Warunta mountain range, an extension of larger mountains further inland. According to local hunters, spider monkeys are also rare on the eastern edge of the south side, towards the end of the Warunta range. Conversely, on the northern side, monkeys were only hunted on the extreme western fringes of the hunting area where inland mountain ranges taper off. However, little evidence exists in the literature of any relationship between monkey abundance and topography.

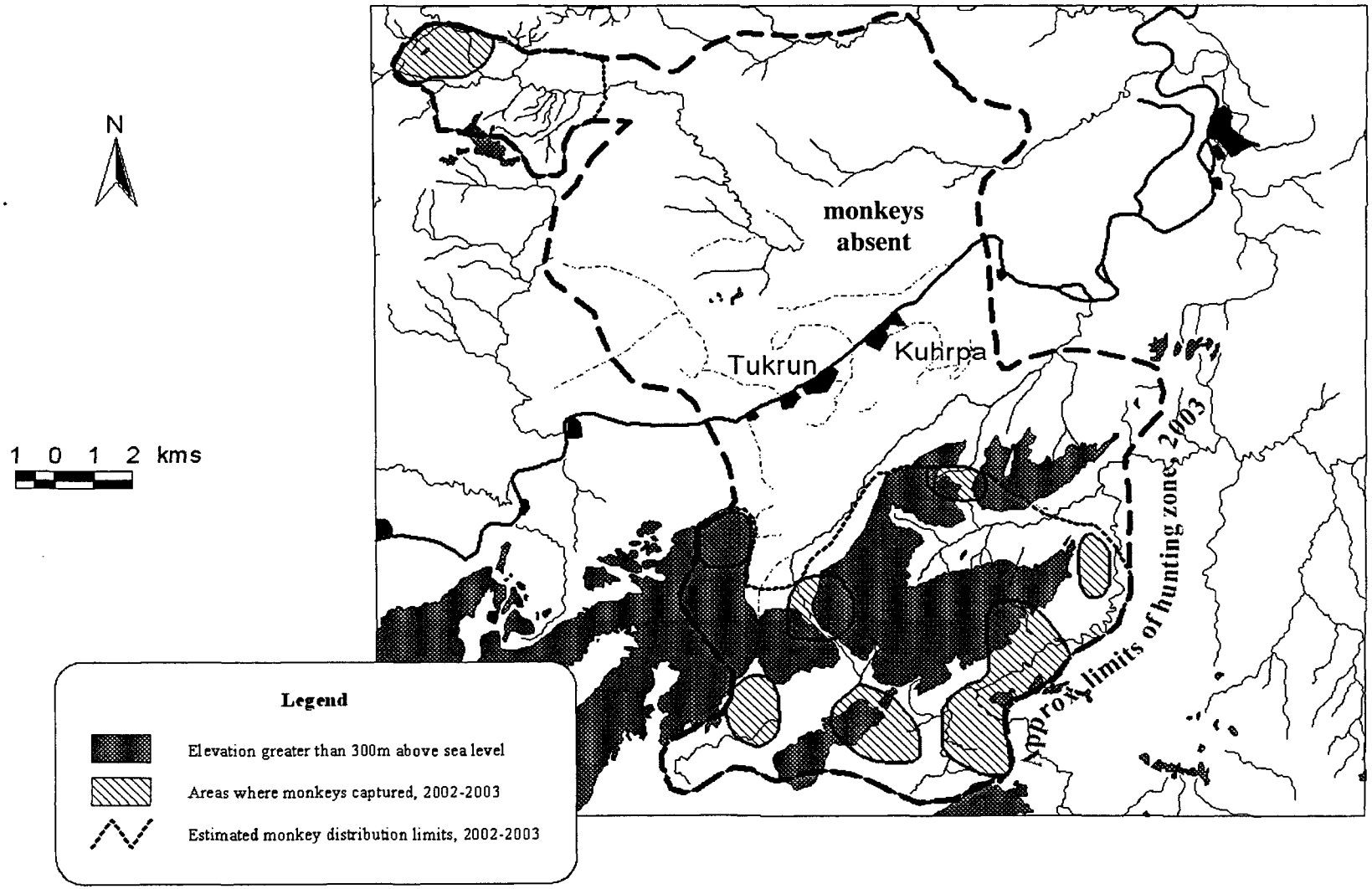


Figure 6. Estimated Distribution of Spider Monkeys, Ateles geoffroyi, Within Hunting Zone, 2002-2003.

Hunting data collected from interviews with Miskito hunters in Kuhrpa and Tukrun show important spatial variations in hunting for each of the seven game species. Game found in anthropogenic habitats typical of sub-zone 1, such as Baird's tapir and white-tailed deer, tend to be caught in greater numbers near the communities compared with more distant areas. In addition, game that supply important quantities of meat, such as tapir and white-lipped peccary, tend to be caught in greater numbers either close to home or at large distances, often because very distant hunting grounds are visited by groups of hunters for the specific purpose of hunting large-bodied game. Conversely, some species, such as collared peccary, appear to be so common that they are hunted in all areas more or less equally. Finally, the harvest of spider monkeys has shown that ecological factors play an important role in determining where an animal is caught within the hunting zone, possibly related to the impacts of past hunting practices on local populations.

Chapter 5:
Discussion

The Miskito hunters in Kuhrpa and Tukrun who participated in this study harvested a total of 1,610 kg of game over a period of ten weeks between August and October, 2003. Hunting was highly concentrated on a relatively small number of species, made up of armadillos, peccaries, large birds and the white-tailed deer, with a particularly strong reliance on the collared peccary (*Tayassu tajacu*, 35% of total harvest). Qualitative and quantitative data show that there exist important spatial variations in wildlife use, influenced by the location of hunting areas relative to where people live and work as well as the habitat preferences of game species. In addition, where people go to find game is influenced by the relative locations of mountains, rivers and streams, as well as the relative costs of travel to different places. Interviews regarding the use of seven key game species also reveal that the harvest of certain species shows strong seasonality, with specific habitats within the hunting zone used more frequently at certain times of year.

For many Miskito living along the Río Patuca, hunting remains an important part of life. Game provides a substantial quantity of meat for many families in Kuhrpa and Tukrun. Miskito men use extensive knowledge — of the ecological processes that influence the spatial and temporal distribution of game, of local geography and of animal behaviour — that has accumulated over generations, to catch game. As a result, along with general searches for game that, for some hunters, is perpetual, hunting effort is often focused on specific animals, in specific places at specific times of year. However, subsistence hunting is not static, but is instead constantly expanding and contracting

concurrently with changes in the many other activities in which people engage, as livelihood strategies are modified to meet changing wants, needs and conditions. The Miskito cultural landscape also plays a key role in this system because it is the source of both wildlife and other natural resources used by the Miskito, and because it changes with the use of these materials over time. Finally, changes are not deterministic, but instead are greatly influenced by how people shape their identity over time and the role they choose hunting to take in this process. The study of the spatial patterns of hunting provides a means of understanding this complexity simply because changes in hunting are reflected in where hunters go to find game and where game is found as well as where they no longer go and where game is no longer found.

Hunters in Kuhrpa and Tukrun catch game within a defined area that is highly dynamic, the result of complex interactions between physical features in the landscape, cultural perceptions and preferences, economic conditions that influence the allocation of time for hunting as well as environmental conditions that mediate game abundance. This hunting zone can be divided into four different sub-zones, based on differences in predominant habitats, the main species caught in each area, the relative distance of the sub-zones from the community and their frequency of use. A relatively constant hunting pressure and a highly heterogeneous mix of habitats characterize the nearby core area surrounding both study communities, made up of sub-zones 1 and 2. Crops, medicinal plants, lumber and many other materials that make up the Miskito way of life are taken from this area. Approximately 85% of all hunted biomass was caught in the core area over the study period. The extended hunting area, made up of sub-zone 3, constitutes areas visited only on multiple-day expeditions. Hunting pressure, while regular, remains

highly localized around *kiamps*, with large expanses of forest that appear largely untouched. While most game species are likely present throughout this area, hunting appears to be directed towards more preferred game species, such as the white-lipped peccary and monkeys. Finally, the distant northern hunting grounds, sub-zone 4, are only visited regularly by a select number of hunters. These hunting grounds are mainly found around the Uhra River; the relatively flat, extensive forests that characterize the sub-zone provide a popular setting for tracking herds of white-lipped peccary, while white-tailed deer can be found in a large pine savanna further north.

Subsistence hunting is one of the many different livelihoods that make up indigenous economies. At the base of this economy is an intimate relationship between people and the surrounding environment. It is a highly complex relationship that varies tremendously over space and time. Indigenous peoples have a highly developed knowledge of this relationship and of the forces that condition game abundance over time. While characterizing groups as being "ecologically noble" is indeed false, these people have a far greater understanding of the benefits and limitations of different natural resource management practices than is often recognized. Participatory research, by involving local people in the gathering of knowledge, provides a means for indigenous groups themselves to become part of the process of defining the relationship between themselves and their environment as well as how this will change over time. Inevitably, issues of ownership of indigenous lands and resources will play a key role in defining how the Miskito of Kuhrpa and Tukrun shape this relationship in the future, and therefore will need to be resolved sooner than later for community-based wildlife conservation to become a reality. The Río Plátano Biosphere Reserve, which includes all local hunting

grounds north of the Río Patuca, will also likely be important to consider in this dynamic.

5.1 Hunting Yields and the Sustainability Model

Wildlife harvests in Kuhrpa and Tukrun over three months resulted in a per capita consumption of roughly 21 grams of game per day, a relatively small quantity compared with the results of other studies conducted among neotropical indigenous groups (Table 6).

Table 6. Comparison of Hunting Yields Among Four Neotropical Indigenous Groups

Source	Group	Duration of Study	Study Population	Per Capita Game Consumption (kg/person/day)	Top Game Species
Mena V. et al. 2000	Huaorani (Ecuador)	11 months	167	0.181	Woolly monkey, collared peccary, red brocket deer
Hames 1979	Yanomamö (Venezuela)	15 months	51	0.094	White-lipped peccary, lowland tapir, giant anteater
Ventocilla 1992	Kuna (Panama)	98 days (over 12 months)	279	0.074	Green iguana, paca, agouti
Smith 2005	Buglé (Panama)	8 months	~432	~ 0.024	Paca, agouti, nine-banded armadillo
Dunn 2004	Miskito (Honduras)	3 months	950	0.021	Collared peccary, nine-banded armadillo, great curassow

Results indicating that people in Kuhrpa and Tukrun consume a smaller quantity of game than other neotropical indigenous groups is likely due to several reasons. Firstly, the short study period discounts any possible temporal variability in hunting yields. During my stay in the community, three important hunters were away for work, one week consisted mostly of major national holidays and the rice harvest peaked (Figure 2). Therefore, hunting yields over the study period are not necessarily representative of an entire year's harvest (Figure 2). Indeed, Nietschmann (1973: 166-168) showed that game consumption often increases in the dry season when there is more free time among residents and weather is more favourable for expeditions. Secondly, tapirs (*Tapirus bairdii*), by far the largest sized game animal in the region, were not caught during the study period. According to interviews, this large animal appears to be caught more frequently during the dry season, which would indeed greatly skew yields (Table 3). Finally, many households in Kuhrpa and Tukrun have access to alternative sources of protein. Thus, while game provides a large proportion of the meat intake for certain community members, particularly among less wealthy families, most do not regularly consume game.

Miskito wildlife use is highly dynamic and likely varies from one year to the next. Hunting yields documented during this study period provide only a snapshot of an activity that likely changes over larger time-scales. Game appears to have only provided a significant quantity of meat for a relatively small number of families. This however is not to say that hunting is no longer important for Miskito identities. On the contrary, hunters continue to be well-respected members of their communities and wild meat is still preferred over domestic meat. As a result, the results cannot be interpreted as a

decline in the importance of hunting among residents of Kuhrpa and Tukrun.

The main species hunted by the Miskito, such as peccary, monkeys, wild fowl, as well as large rodents such as paca, are commonly hunted by other Central American indigenous groups (Gordon 1982: 112; Jorgenson 2000: 255; Ventocilla 1992: 126). Seventeen different species were captured during the study period, including ten mammals, six birds and one reptile. The top five species hunted (collared peccary, armadillo, curassow, white-lipped peccary and white-tailed deer) contributed approximately 70% of the total harvest. Yields were strongly biased towards mammals (83%), similar to results found among the Huaorani of the Ecuadorian Amazon (85%) (Mena V. et al. 2000: 63), and the Chimane of Bolivia (82%) (Chicchón 1995: 230-231).

The harvest of seven key game species between November, 2002, and October, 2003, compiled from interviews, was compared with maximum sustainable yields calculated using the Robinson and Redford hunting sustainability model, its limitations notwithstanding (Table 7) (Robinson and Redford 1991: 424). Due to under-reporting, particularly for commonly hunted game such as collared peccary, non-reporting of wounded animals that likely die after being shot, as well as the fact that many regular hunters were not interviewed, the data should be considered very rough, corresponding to the minimum number of individuals of each species harvested within the year. However, even if the data are off by a wide margin, they still give a good indication of how yields compare with their assumed maximum sustainable yields (MSY). For the purposes of these calculations, hunting sub-zone 4 was not included as part of the overall hunting zone (Table 2 & Figure 4). However, the area does supply important quantities of certain large game, particularly white-lipped peccary. However, the complexity and overall lack

of understanding of the geography of this sub-zone makes defining its area highly problematic.

Table 7. Evaluation of Harvest Rates for Seven Important Game Species in Kuhrpa and Tukrun, 2002-2003.

Species	Number Captured	Minimum Harvest Rate (kg/km^2)*	Maximum Potential Harvest (kg/km^2) †
Cebus capucinus	17	0.3	0.6
Ateles geoffroyi	72	1.7	1.2
Tapirus bairdii	13	11.6	4.5
Tayassu tajacu	~80	~5.9	42.2
Tayassu pecari	~60	~5.5	23.7
Odocoileus virginianus	30	3.9	--
Mazama americana	7	0.8	17.5

*Biomass figures taken from Robinson and Redford 1986
†Calculations for *C. capucinus*, *A. geoffroyi* and *T. bairdii* taken from other, closely related species. The MSY for *O. virginianus* is not available.

Based on the Robinson and Redford (1991) model, tapirs and spider monkeys (*Ateles geoffroyi*) appear to be harvested unsustainably, while four species are hunted below their respective maximum sustainable yields. The most striking result is found with the Baird's tapir (*Tapirus bairdii*), where according to the model, the Miskito harvest rate is two and a half times the species' MSY. While hunting could be having a negative impact on local populations, considering that this animal is usually found at low densities (Reid 1997), one could assume that such a large difference between the harvest and production rates would rapidly drive down populations. However, this does not appear to be the case: the animal continues to cause damage to bean crops, tracks are frequently found throughout the hunting zone, including near the communities, and they are often heard barreling through the forest at night at hunting camps and even on the outskirts of the two communities. Indeed, one hunter from Kuhrpa claims to have hunted seven individuals within a small area of bean crops in February, 2002. It is possible that swidden beanfields may be contributing significantly to this large animal's reproductive potential, supporting greater densities than would be present in undisturbed forest habitat and thereby resulting in an under-estimate of MSY figures for the study area. Alternatively, immigration from adjacent unhunted areas north and south of the study area may be rejuvenating hunted populations within the hunting zone.

Spider monkeys are currently harvested at levels greater than the limits of sustainability, suggesting that hunting may be negatively affecting populations. Considering this animal's low reproductive potential, unsustainable hunting rates can cause considerable long-term damage to local populations (Sorensen and Fedigan 2000). Indeed, it appears that the species is currently mainly found in forested areas on the south

side of the Río Patuca, with distribution on the north side restricted to the western fringe of the zone (Figure 5). It is quite possible that this limited distribution is the result of past over-hunting, although differences in topography between the mountainous south side and the flat north side may have played a role as well. According to local informants, monkeys appear more abundant in the mountains, although no one that I interviewed could give a reason why, and there does not appear to be any relationship between the animal's distribution and topography in the literature. Nevertheless, elderly hunters could not recall the animal ever being abundant on the north side. While it is difficult to determine conclusively whether hunting has indeed depleted spider monkeys in parts of the hunting zone, it is clear that it is currently being harvested at rates sufficiently high to cause alarm. As a result, local populations would likely benefit from some form of protective measures to lower hunting pressure.

Capuchin monkeys, (*Cebus capucinus*) are harvested at roughly half of their maximum sustainable yield, although their actual harvest is likely higher. Nevertheless, because the species is not highly prized, and because hunters observe that it is relatively abundant in forested areas throughout the hunting zone, it is unlikely that hunting rates exceed the species' MSY. The collared (*Tayassu tajacu*) and white-lipped peccary (*Tayassu pecari*) are harvested at levels well below the maximum sustainable hunting rate, suggesting that people are only harvesting a small proportion of the total population. According to local hunters, the collared peccary is found throughout the hunting zone and is frequently cited as damaging manioc crops. Hunters observe that white-lipped peccary is less abundant in areas near the community than it once was, while it remains abundant in distant areas. It is possible that the highly nomadic lifestyle of white-lipped peccary

results in herds going in and out of the hunting zone. This is significant in areas such as the northern and southern limits of the hunting zone that are adjacent to forested areas that appear unhunted (MOPAWI and MASTA 1993). While the movements of white-lipped peccary are not entirely understood, it is possible that individuals are being hunted by neighbouring communities in hunting grounds closer to the Río Patuca. Hence, assessing the sustainability of hunting for this species likely requires a larger geographical scale than was used in this study. Red brocket deer (*Mazama americana*) are hunted at levels well below the MSY estimate. These animals do not appear to be extremely sought out by Miskito hunters, giving reason to believe that the species is not currently threatened by over-harvesting.

Applying the Robinson and Redford sustainability to evaluate hunting in Kuhrpa and Tukrun gives some indication of the impacts of current wildlife use practices on game populations. However, as is evident from tapirs and white-lipped peccary, the results of the model at times contradict qualitative data collected from these two communities, apparently skewed by differences in habitat and their relative location within the hunting zone, as well as by spatial variation in hunting activity. Another important point to consider is that harvest rates lower than production rates could indeed be a result of past over-hunting, resulting in very low game densities today. Finally, the fourth hunting sub-zone exemplifies the complexity of defining an appropriate hunting area for calculating the harvest rate. Indeed, if the sub-zone was included in the calculations, harvest rates would have been lower and figures for the spider monkey catch would have fallen below that species' maximum sustainable yield. Despite the usefulness of the sustainability model, a closer evaluation shows that it tends to simplify

highly complex variables. Hence, in order for the model to be effective in understanding the impacts of hunting on game populations, a more complete picture of local hunting patterns, including qualitative, quantitative and spatial data, is needed to provide a broader context with which to interpret its results.

5.2 Habitat and Hunting

A major difficulty with the sustainability model is that habitats within a hunting area are assumed to be homogeneous. Yet, the indigenous cultural landscape is made up of a wide variety of different habitats, each characterized by different levels of human-induced disturbance. Animals will react differently to these disturbances depending on their ecological needs and preferences. Among the Miskito of the upper Patuca, game can be divided into two broad categories based on habitat preference: (1) garden game that is commonly hunted in agricultural areas, and (2) deep forest game, found only in mature forest habitat.

Garden game includes species that are hunted in habitats modified for swidden agricultural practices (Linares 1976). They can range from animals strictly associated with anthropogenic habitats to generalists that enter agricultural areas to feed on abundant and nutritious foodstuffs, often categorized separately as "intermediate" species. Linares (1976: 348) speculated that the heavy reliance among pre-Columbian peoples on garden game was such that these species played a role analogous to domesticated animals. In fact, catching game in agricultural areas has been well documented elsewhere in Mexico and Central America (Gordon 1983; Jorgenson 1993; Nietshmann 1973; Smith 2005;

Ventocilla 1992). During my stay in Kuhrpa and Tukrun, it became clear that garden hunting is common among the Miskito due to the continuing predominance of swidden agriculture. Indeed, many people that would not necessarily define themselves as "hunters" catch game in this anthropogenic habitat, often with the aid of hunting dogs, while they are engaged in agricultural tasks. However, because garden hunting was not part of any original research objectives, no quantitative data were collected documenting how much game was caught specifically in these habitats. Nevertheless, because swidden plots are found throughout sub-zone 1, game caught in this area is assumed to be closely associated to these anthropogenic habitats.

Linares (1976: 346) identified the paca (*Agouti paca*), the white-tailed deer, the nine-banded armadillo (*Dasypus novemcinctus*), the agouti (*Dasyprocta punctata*) and the collared peccary as the main garden species caught by pre-Columbian hunters in Cerro Brujo, western Panama. These animals appear to be very important garden game in Kuhrpa and Tukrun, along with the white-nosed coati (*Nasua narica*), parrots (*Amazona* spp.), and the Baird's tapir (Table 5). The Miskito cultural landscape in Kuhrpa and Tukrun may be supporting populations greater than would be expected in a forested hunting area of similar size. This may indeed be the case for tapirs, which otherwise appear to be harvested well above sustainable levels (Table 7). In addition, despite a seemingly high hunting pressure, collared peccary populations in the study area are growing according to local hunters. This worries many people because of the potential losses to their manioc crops. Because the hunting of garden animals is in part a necessity, it will likely continue to be a consistent source of meat for the residents of Kuhrpa and Tukrun well into the future, so long as disturbance within these areas remain

at a "tolerable" level for the different species.

The Miskito cultural landscape appears to promote high levels of biodiversity because disturbances are relatively low-scale and the many areas under fallow create a very heterogeneous mosaic of habitats (Connell 1978). In Kuhrpa and Tukrun, there still remains a relatively large area of arable land, such that residents can leave their plots to fallow for relatively long periods. However, rapidly growing populations may increase the demand for land in the future, resulting in either further clearing of primary forest or a decrease in the ratio of fallow plots to areas under cultivation. Both cases could put pressure on game populations, in the former case driving deep forest game further away from the communities, while in the latter case driving away garden game less well adapted to higher levels of disturbance. Understanding the relationship between swidden areas, disturbance levels and game abundance should therefore be a primary focus of research in the future (Anderson 2001; Hames 1983; Jorgenson 1993; Smith 2005).

The large pine savannas found throughout La Moskitia are another important part of the Miskito cultural landscape. Parsons (1955: 42) speculated that persistent burning over very long periods may possibly have played a role in the formation of this ecosystem. When asked about the origins of the pine savanna, community members in Kuhrpa and Tukrun agree that it was created by people, noting that if the area is not burned regularly, it is gradually engulfed by the surrounding rain forest. Many, but not all, species hunted in garden areas, such as pacas, armadillos, parrots and white-tailed deer, are also hunted in savannas. During the study period, 60 kg or four per cent of the total game biomass was caught in the pine savanna south of Kuhrpa.

Mature forest habitat provided roughly 65% of the total yield during the study

period in Kuhrpa and Tukrun. While all species hunted by the Miskito can be caught in the forest (except white-tailed deer, that are highly specific to open woodlands), some are found in this habitat only, namely white-lipped peccary, monkeys, and large fowl such as the great curassow and the crested guan. La Moskitia is unusual in Central America because there remain very large tracts of continuous forest, providing abundant habitat for deep forest game. As a result, species such as white-lipped peccary, today scarcely hunted among the Buglé and Kuna in Panama (Smith 2005; Ventocilla 1995: 35), continue to be found in the Miskito hunting zone. Nevertheless, animals strictly inhabiting La Moskitia's mature forests are likely very sensitive to over-harvesting compared with garden game because of the purely negative impacts of forest clearance on their populations. In addition, many important deep forest game are more adversely affected by hunting because of very slow reproductive rates (Amadon 1983; Ridgely and Gwynne 1989; Robinson and Redford 1991). The white-lipped peccary is also more vulnerable to overhunting due to herding behaviour (Peres 1996), relatively lower production rates (Gottdenker and Bodmer 1998) and very large home ranges that can be fragmented by large-scale deforestation (Peres 2001). Herding behaviour (also present at certain times a year among wild fowl and spider monkeys) allows hunters to easily catch several individuals at a time if desired.

Because deep forest game species are highly sensitive to forest clearing and depend on undisturbed forest habitat to survive, ensuring their long-term survival requires increased monitoring. Indeed, spider monkeys appear already to be adversely affected by hunting in the Miskito zone, and hunters have indicated declines in fowl and white-lipped peccary populations close to home. These animals should therefore be the key focus of

wildlife management efforts in many parts of the neotropics where subsistence hunting continues. Using spatial patterns to track the use of individual deep forest species permits documenting the changing availability of specific species over time within the overall hunting zone (Figures 4 & 5).

5.3 The Miskito Hunting Zone

The Miskito hunting zone is an irregularly shaped area found on either side of the Río Patuca, north and south of Kuhrpa and Tukrun. The main area is 335 km^2, and roughly 485 km^2 if one includes estimates for the distant northern hunting grounds (sub-zone 4), where the precise boundaries are indeterminate. This is far smaller than the zone for two Siona-Secoya settlements in Ecuador (1,150 km^2) (Vickers 1991: 55), but larger than that of five Buglé villages in Panama (Smith 2005). The area comprises agricultural lands, which are found surrounding the communities as well as along the Río Patuca, and mature forest areas that cover roughly 90% of the hunting zone. Game caught in nearby areas tend to be caught opportunistically, employing sit-and-wait hunting strategies and short expeditions, often with dogs, while game found in distant areas are caught on longer expeditions that can last up to several days, with firearms only. Long expeditions are most common during the times of year when the demands of agriculture and wage labour are low, as well as when drier weather makes travel along walking paths easier. Conversely, when agricultural work prevents longer expeditions, hunting effort seems to be concentrated closer to home, often focused on garden game species.

The hunting zone of Kuhrpa and Tukrun is highly dynamic. Its boundaries are in

constant flux, often as a result of expansion of agricultural lands, the opening up of new hunting grounds through the establishment of walking paths or the re-use of older hunting grounds. It likely overlaps the hunting zones of neighbouring communities, which, while the extent is not clear, appears to be localized on the eastern and western fringes of the zone. In contrast, much of the northern and southern border is adjacent to unhunted forest areas, likely sources of game migration into the hunting zone (MOPAWI and MASTA 1993).

The complex, dynamic nature of hunting zones makes any aerial calculations highly difficult. Alvard et al. (1997: 979) use a Machiguenga hunting zone in the Peruvian Amazon representing a circle around the community based on the average distance traveled by hunters as the radius (calculated, in turn, by time traveled and walking pace). The Miskito hunting zone, on the contrary, is characterized by wide varieties of travel distances that go off in many different directions, depending on the type of game sought out and the amount of time available to seek it. Yet, this parameter is crucial in the sustainability model for calculating the harvest rate for game species. Clearly, improper assessments of the size, form and nature of the hunting zone will lead to inaccurate results when assessing the impact of hunting on local game populations.

5.3.1 The Sub-zones of Miskito Hunting

Prior to hunting, hunters will evaluate the costs and benefits of visiting an area, based on the difficulty of getting there (related to distance, topography and weather conditions), the opportunity cost of abandoning other subsistence activities, the ease with

which game can be hunted and the type of game that can potentially be caught. Based on decisions made, the type of game that is caught and the types of trips that are taken, three distinct areas within the hunting area emerge: (1) the core hunting area, located near the communities, which is visited regularly, where both garden and deep forest game are caught and which supplies the large majority of hunting yields; (2) the extended hunting area, visited occasionally on multiple day expeditions, where only deep forest game species are caught, and (3) the distant northern hunting grounds, including mature forest and savannas, visited irregularly on long trips, where hunting is often focused on white-lipped peccary and white-tailed deer.

The core hunting area is made up of sub-zone 1, which consists mainly of agricultural lands, and sub-zone 2, consisting of mature forest. The hunting pressure on game populations appears more or less equal throughout the zone, although hunting is more constant in sub-zone 1, where game can be caught opportunistically, using sit-and-wait hunting as well as on short expeditions. Wildlife use in the core hunting area is heavily influenced by land-use practices. On one hand, gardens attract certain garden game, such as paca, tapir and white-tailed deer. On the other hand, increased land conversion drives away deep forest game, such as monkeys, wild fowl and white-lipped peccary, into more distant areas. Clearly, consideration for the different land-use practices that occur in these areas is an important part of any wildlife management plans in this area.

Both the extended hunting area (sub-zone 3) and the distant northern hunting grounds (sub-zone 4) are covered by continuous forest. While both are visited on multiple-day expeditions, the distant northern hunting grounds are unique because they

are only found north of the communities, probably because the relatively flat landscape makes them more accessible, and are centred on the Uhra River, a very popular destination for many hunters. Nevertheless, most people visit the area only once per year.

Because both the third and fourth sub-zones are only visited on multiple-day trips, hunting pressure is often highly localized around *kiamps* where people stay and major rivers and paths upon which people travel. Hence, very large tracts of forest are often left unhunted. In addition, pressure seems to be highest on larger species and comparatively lower on smaller ones. Finally, the higher costs associated with travelling to distant areas make them most likely to experience decreases in visits whenever the demands of agriculture and wage labour increase. For these reasons, despite that hunting still occurs in the sub-zones, relatively low hunting pressure may signify that the areas are important sources of game migration into the more heavily hunted core area, particularly for smaller species as well as in years when significant drops in multiple-day hunts occur (for example, when many men are away working). They will likely continue to be sources so long as *kiamps* remain relatively dispersed and irregularly used. Currently, incursions by outsiders into peripheral areas in search of valuable hardwood trees is becoming a growing problem because these people often consume large amounts of game while they stay in the area. Hence, patrolling these areas will not only play a key role in maintaining Kuhrpa and Tukrun's claims to these areas, but can also have an important impact on local game populations.

The Miskito hunting zone and sub-zones exhibit the complex interrelations between geography, ecology and culture that will influence where a game animal is

caught within the hunting grounds. They show that subsistence hunting occurs according to distinct patterns that can be deciphered, categorized and understood through a detailed analysis of the hunting area. This information is crucial not only because it shows that the geography of subsistence hunting is highly complex, but also because it accounts for the intimate relationship between people and wildlife, thereby giving a more complete understanding of this activity. Indigenous wildlife use is constantly changing because the activity is deeply entrenched in a larger subsistence economy that is also constantly changing. The study of spatial patterns provide a means to track these changes over time and, consequently, to gain a better idea of the impacts of this activity on local game populations.

5.4 Variations in Miskito Subsistence Hunting

Change is an important part of the cultural ecological understanding of hunting. The many different factors that influence hunting, ranging from the type of game available to the type of technology used and the time of year, that are highly connected through interdependent relationships and feedback loops (Nietschmann 1973: 6). As a result, changes in one factor will likely trigger changes in other factors, often causing the impacts of these changes on game populations to be highly variable. Yet, quantitative models used to understand these impacts are static, giving very little information other than predicting the sustainability of hunting practices at one point in time. While this information can be highly valuable, such models must be used with caution because they shed little to no light into the overall cultural and socio-economic context in which

hunting is occurring and therefore make any long-term predictions problematic. This section provides a glimpse into how some variables of influence — such as the integration of new technologies and the market economy that mediate hunting activity, as well as environmental changes and unique historical events that cause variations in game abundance — can result in important changes in hunting patterns. These in turn cause important changes in the impacts of hunting on game populations. Much of the discussion is based on personal observations as well as information provided to me by many different people in both Kuhrpa and Tukrun. While a diachronic study is needed to more accurately document changes in hunting patterns over time, the information, albeit speculative, gives a good idea of how variable and therefore unpredictable hunting can be.

The integration of new technologies changes hunting because it allows hunters to procure certain game with greater efficiency, such as firearms with arboreal animals (Alvard 1995b; Hames 1979; Yost and Kelley 1983). Among the Miskito, current hunting tools such as rifles and dogs have been used for decades and will likely continue to be used in the future. However, the use of dogs among the Miskito is generally restricted to areas near the community. In addition, the high cost of buying and training a hunting dog makes some hunters reluctant to acquire them. 16-gauge shotguns are probably more efficient than 0.22-caliber rifles at procuring certain game at close range because one bullet contains many shots. However, hunters generally do not use this weapon because of the high costs of bullets. While the adoption of new technologies makes it easier to hunt certain animals, such as dogs with burrowing animals, the overall impact on game depends on the extent of their use among local people. In Kuhrpa and

Tukrun, more efficient technologies are often not used because of their high cost, which in turn limits their ecological impact.

Local economics can play an important role in influencing hunting because it regulates the amount of time people will devote to this activity. Residents of Kuhrpa and Tukrun usually orient their activities towards earning money whenever possible. As a result, hunting is readily abandoned for financial opportunities elsewhere. Men tend to prefer to invest their money in a chainsaw, to sell lumber, instead of a rifle. Today, consumption of game, once common to most households in both communities, is now mainly restricted to the homes of the few active hunters, their close relatives, their friends and those able to purchase the remaining catch. Meanwhile, for more prosperous families, domestic meat has all but replaced game meat as the primary source of protein. As a consequence, many young people do not learn to hunt, likely reducing the number of hunters in the future.

Dodds (1994) showed that increasing participation in market economies leads to the gradual abandonment of subsistence activities unrelated to making money. In Kuhrpa and Tukrun, wildlife is used for little else than subsistence purposes. As a consequence, increasing involvement in the market economy appears to have decreased the number of hunters and therefore the impact of the activity on wildlife populations. However, it is difficult to know the future course of this dynamic, because more money may lead to a growing demand for livestock, leading to further clearing of land for pasture, which could threaten wildlife populations. Furthermore, more money within the community could permit hunters to buy firearms, bullets and dogs, which may then also threaten game populations.

Game abundance fluctuates with larger changes in the surrounding ecosystem. Hunters interpret these changes and modify their hunting patterns accordingly, causing important changes in harvest rates and, therefore, the impacts of this activity on game populations. According to one Miskito elder, a hurricane in the 1940s caused a substantial drop in game for ten years. In 1998, large areas of the upper Patuca were flooded as a result of Hurricane Mitch (in Kuhrpa, only a few houses were spared). Following Hurricane Mitch, most crops were lost and food became very scarce. As a result, game became a primary food source over six months following the floods. Large hunting parties were organized to track peccary herds and other large game, often stranded on elevated forest "islands". Once the floods receded and the mud dried, crops were re-sown and hunting activity decreased. Informants state that game has greatly decreased since Mitch, partly because of the damages, partly because of over-hunting following the flooding, and many appear to have since abandoned hunting because of game scarcity.

Game abundance and hunting appear to have been adversely affected in Kuhrpa and Tukrun in the 1980s by the Contra-Sandanista conflict in Nicaragua. Although no fighting took place in the communities, thousands of Nicaraguan Miskito and Sumu sought refuge in the upper Patuca region (see Nietschmann 1989 and Dodds 1991). According to local accounts, refugees burned large tracts of forest to flush out game and created new paths to reach distant hunting grounds. One story tells of a hunting party using grenades and AK-47 automatic rifles (acquired from Miskito Contra soldiers) to hunt a herd of white-lipped peccary (also described in Pérez-Chiriboga 2002: 76-77). Local hunters tell of an absence of animal tracks throughout the hunting zone for five

years following the end of the conflict in Nicaragua. Some locals claim to have abandoned hunting since the conflict because of game scarcity.

Hunting patterns can be influenced by variables that would otherwise seem unrelated because wildlife use is an important part of the local cultural context. Fluctuations in hunting activity and game abundance cannot be interpreted in a straightforward manner but instead must be understood as part of a much greater process. For example, hunters do not blindly follow game as abundance changes from one area to another but instead make complex choices based on the costs of traveling to new locations where game is found relative to other activities. As such, the impacts of this activity on the surrounding environment cannot be easily predicted over time. Spatial patterns are effective in documenting and understanding change because variability in hunting patterns often occur over space. Where hunters go to find specific game species relative to their community over time can provide a significant amount of information regarding the potential impacts of hunting in an area.

5.5 Towards More Effective Management of Indigenous Wildlife Use

Effective management of indigenous hunting requires sensitivity to the local context because hunting is only one part of a highly complex, multi-faceted and dynamic economic system. Conservationists must therefore give consideration to the socio-economic reality in which this activity occurs. Hunting in Kuhrpa and Tukrun presents a variety of management challenges to conserving local wildlife. Overall, tropical wildlife management would benefit from an increased integration of the study of spatial dynamics

into current methods.

5.5.1 Re-interpreting the Impacts of Hunting in Kuhrpa and Tukrun

According to older hunters in Kuhrpa and Tukrun, many important game populations do not seem as abundant as they once were in the past. This is not surprising considering that only five decades before, these communities consisted of a handful of households. With each new generation, demand for wildlife resources increases. Hence, while the per capita consumption rate is currently low (Table 6), the relatively large population in the two communities results in a high harvest rate over the study period (Table 2). Garden game that is well adapted to Miskito swidden agricultural practices appear to be little affected by hunting in the zone, with tapirs being a possible exception. However, as settlements have grown, certain deep forest game, such as both species of primates, white-lipped peccary and wild fowl, vulnerable to both habitat conversion and hunting, appear to have retreated away from the communities. The question remains whether this will inevitably lead to significant depletion of these animals beyond the immediate surroundings.

While indigenous subsistence hunting can indeed have a negative effect on certain game populations, assuming that it invariably depletes stocks, particularly of more vulnerable deep forest game, is deterministic and wrong. In Kuhrpa and Tukrun, large unhunted areas are found adjacent to the hunting zone, likely important sources of individuals that migrate into hunted population "sinks" to renew game populations. Furthermore, hunting in distant areas, such as sub-zones 3 and 4, as well as of specific

species, such as white-lipped peccary and spider monkey, is often concentrated in specific areas with comparatively larger areas left unhunted (Figures 4 & 5). While it is problematic to automatically assume that game are more abundant in unhunted areas versus hunted ones (Peres 2000), highly localized hunting pressures may to some extent be resulting in unhunted areas becoming sources for hunted area sinks within the hunting zone. The spider monkey catch between November 2002 and October 2003 was particularly concentrated in only a handful of areas within their estimated distribution area (Figure 5). Assuming home ranges to be between 2.5 and 4 km^2, it may be that whole groups of monkeys are not even being hunted (Eisenberg 1983).

The impacts of Miskito hunting on game populations are heavily mediated by agricultural work and the need to earn money. Therefore, when the costs of hunting are high, activity often decreases. For example, while there is little reason to believe that white-lipped peccary herds are not found at medium distances from the communities, very few individuals are captured in these areas mainly because hunters do not seem willing to incur the cost of seeking it out. A major reason for the high costs of catching game is that hunting itself is not a highly lucrative commercial activity. While some money is earned from selling part of the catch to cover expenses, it appears that among most hunters, wildlife use is more a part of a culture of reciprocal exchange. Catches are always shared between hunters, surpluses are often given away and little is wasted. Thus, hunting pressure today, as in the past, is basically driven by a desire to feed one's family. The image of Miskito hunters as wanton destroyers of nature therefore does not apply.

Optimal foraging theory assumes that hunting is generally skewed towards larger game in order to maximize economic benefits (Alvard 1995a: 798). While the costs of

hunting are indeed high, the theory discounts many intangible benefits of hunting. Among the Miskito of Kuhrpa and Tukrun, many people travel large distances and camp out many days because they enjoy it. Hunters are often eager to teach younger relatives the importance of having a strong conservation ethic, and are often heard complaining about wasteful and destructive hunting practices. Hunting applies generations of accumulated ethno-ecological knowledge and facilitates its exchange among people. Furthermore, hunters engage on a wide variety of other activities while hunting, such as collecting medicinal plants and tree seedlings as well as patrolling for "illegal" incursions by outsiders into community territory. Optimal foraging theory also discounts cultural preferences. If an animal is not considered good to eat by hunters, regardless of its size, it will not be hunted. Furthermore, the growing distaste among residents for spider monkeys because of its resemblance to humans is a prominent example of how cultural preferences can indeed change over time.

In Kuhrpa and Tukrun, only green iguanas (*Iguana iguana*) appear to have been heavily depleted in the hunting zone. Current high harvest levels for spider monkeys, combined with evidence of a limited distribution within the hunting zone, are enough to cause concern. Wild fowl, particularly the crested guan, would also benefit from a decrease in hunting. Clearly Miskito hunters are not "ecologically noble," and wildlife depletion can very much become a reality in Kuhrpa and Tukrun without any shift by community members towards a more active management of these resources. Many hunters would indeed agree that wildlife management frameworks are needed to curb the impacts of hunting on local game populations.

5.5.2 Searching for Practical Solutions: Cultural Practices, Participatory Research and the Politics of Wildlife Management

In order for wildlife management to be effective in neotropical indigenous communities, there must be a greater understanding of the local socio-economic situation, of which species are most threatened by over-hunting and of the measures that are acceptable to local villagers. Local people will favour certain management frameworks over others depending on the degree to which these complement cultural practices. For example, although capuchin monkeys and spider monkeys exhibit very similar ecological habits and would therefore benefit from similar conservation approaches, most Miskito hunters prefer spider monkeys. If informed of the dangers of overhunting on populations of the smaller capuchins, I believe that many hunters would abandon hunting them, or at least greatly lower harvests, with relative ease, possibly allowing populations to recover in relatively little time (Freese 1983; Sorensen and Fedigan 2000). However, spider monkey conservation approaches require greater sensitivity, mainly because hunters would likely not halt hunting animals held in such high esteem. Hence, techniques such as bag limits or quotas, that limit the overall harvest, would be more appropriate. In both cases, educational programs regarding the impacts of hunting on monkey populations would be very beneficial.

Finding practical solutions involves working with local people to find appropriate times to pose any type of hunting restriction. For example, hunting has been shown to greatly decrease during the rice harvest (Figure 1). This would be an appropriate time to limit forest hunting as community members are already quite occupied, thereby completely eliminating hunting pressure during these times of year. Conversely, posing

restrictions before Holy Week, the traditional time for long hunting expeditions, would be inappropriate.

Working with community leaders in the development of management frameworks has proven successful elsewhere (Leeuwenberg and Robinson 2000). These people often have tremendous insight into the challenges of their communities and would therefore be highly capable of devising management strategies that combine social development with wildlife management. Participatory research can also play an important role in the development of long-term management frameworks. Local investigators become familiar with the science of wildlife management and the importance of rigorous research. They can then link these principles with the realities of their own community. They can therefore become key actors in the development of culturally sound management practices.

An important goal of community-based wildlife management and participatory research involves local people developing a strong sense of empowerment (Park 1993). Through participation, people come to understand that they are highly capable actors in the development of solutions to the challenges they face on a daily basis. However, empowerment is a highly political process. For local wildlife management to occur, people must develop a consciousness of ownership over their knowledge (Agrawal 1995), and of wildlife resources (Bodmer and Puertas 2000; Leeuwenberg and Robinson 2000). A major part of this process involves indigenous people acquiring legal title to their traditional lands (Alcorn 1993: 426). If indigenous people do not feel that they are the owners of the wildlife resources they use, building strong local conservation institutions becomes more difficult (Berkes et al. 1989).

Currently, MASTA, the Honduran Miskito federation, continues to struggle to acquire legal rights to the vast lands of La Moskitia. This fight appears to be strongly supported by residents of Kuhrpa and Tukrun. Many community members have complained to the municipal government regarding incursions into peripheral lands, as well as the purchase of large parcels of farmland by Ladinos west of Tukrun. However, because no one possesses legal title to these lands, locals have little legal recourse to prevent these occurrences. The struggle for these lands and their resources will likely play a central role in the relationship between community members and their surrounding environment and, consequently, the management and conservation of wildlife. As one resident from a neighbouring Tawahka community stated at a general meeting regarding the Río Plátano Biosphere Reserve:

> *¿Tu crees que nosotros los indios vamos a mirar mientras que los demas están sacando todos nuestros recursos? Si vemos que no se para, vamos a hacer lo mismo antes que se vaya todo nuestro dinero.* (Do you think that we Indians are going to watch as outsiders are taking away our resources? If we see that nothing is done to stop it, we are going to exploit them just as much before it is all gone and we don't get anything).

Like most Miskito settlements, Kuhrpa and Tukrun remain loosely organized beyond the community level. As the fight to legalize land rights continues, political structures and alliances between communities will likely grow. However, wildlife is one of many natural resources currently used by residents, and therefore its conservation may come into conflict with other forms of land-use seen as more important by the majority, or even of the few who hold power. Currently, forestry is the primary economic activity carried out in the upper Patuca. Many hunters often complain that increased chainsaw use is driving wildlife from the community. Land use for agriculture has also come into

conflict with hunting, as some residents have shown interest in opening up new lands for cultivation and pasture, particularly near the northern border of sub-zone 1 and 2, to the dismay of certain hunters. As regional political institutions gain prominence and interests become consolidated, it could very well be that the importance of the lumber industry or agriculture over-ride that of hunting. Hence, the fight for land rights does not necessarily equate to the conservation of hunting lands. Unless hunters are recognized as valid stakeholders in the management of indigenous lands, conservation will not occur.

National and international politics will play a fundamental role in shaping the management of wildlife in Kuhrpa and Tukrun. Currently, lands surrounding these communities are owned by AFE-COHDEFOR, the Honduran state forestry company. Furthermore, lands north of the Río Patuca fall inside the Río Plátano Biosphere Reserve. During the study period, I did not have the impression that the reserve played any role in the day-to-day activities of local people. At the same time, people often complained that COHDEFOR was doing very little to help people, despite the reserve's mandate to improve the local standard of living (Herlihy 1999). While this may or may not be true, what is most important is the overall lack of confidence that local interests were being represented. Clearly, the presence of the biosphere reserve can be advantageous for local residents because it can prevent further incursions by Ladino colonists interested in clearing large parcels of the forest. However, it can also be seen by locals as an attempt by outside political interests to take control of land that is rightfully Miskito. If the Honduran government is not willing to cede ownership of the areas to local people, they will at least need to ensure that the Miskito feel they have a role in deciding how these lands are to be used and managed, if there is to be any hope of local stewardship in the

future.

The presence of the biosphere reserve also adds an international dynamic to this relationship. Alliances among international conservation organizations and indigenous federations have been well documented in other tropical protected areas (Brown and Rosendo 2000; Peet and Watts 1996: 10-11; Sponsel 1995). Growing involvement of external organizations will likely have a strong influence on how wildlife and many other resources are perceived, used and managed simply because the interests of international conservation organizations do not necessarily match those of local communities (Robinson 1993). While the Biosphere Reserve is an attempt to combine the needs of local populations with conservation, there will be times when these two elements come into conflict. For example, while finding common ground to conserve wildlife is ideal, this does not necessarily mean that it will always occur. When such agreements occur, whose interests will be favoured? Fully understanding how this process will influence local relationships to wildlife will require constant re-examination of what is defined as important in the management of natural resources, who decides it is important and who does not (Braun 2002: 7-9).

5.5.3 The Integration of Spatial Patterns into Tropical Wildlife Management

This thesis attempts to show the importance of geography in understanding wildlife use. The distribution and abundance of game are highly variable across space, influenced by the distribution and location of different habitats as well as the abundance of nearby unhunted source areas. Furthermore, depletion caused by hunting does not

occur as a single event but instead is a gradual process that tends to begin near communities, moving outwards and away. Finally, hunting activity is mediated at any time by hunters' knowledge of where game are located and their willingness to travel to these areas to hunt, both of which are highly sensitive to changes in the social and environmental conditions in which they live. Hence, the many factors influencing hunting tend to converge at any given time in specific, discreet locations across the landscape. Monitoring these locations as well as how they change over time provides substantial information into the character of wildlife use. For this reason, I argue that integrating spatial patterns into wildlife management frameworks would provide a small window into the culture of hunting and its relationship with the surrounding environment.

Probably the most effective means of integrating spatial patterns into wildlife management is through participatory mapping. By getting local people to provide a spatial description of their hunting area, a step is already being taken towards identifying the different zones where hunting is important. Understanding the spatial differentiation of the hunting area among local hunters is a fundamental part of how people use their hunting area, where they go to find game and the relative importance of different hunting grounds, not to mention the advantages of involving local people in this process.

Participatory zoning of the hunting area also provides a basis for spatially structured management frameworks. Areas where restrictions are most appropriate can be designed together with community members. For example, rotating hunting pressure in frequently used hunting areas with rarely used areas can also allow game populations to recuperate over time (Hames 1980: 55). Unhunted areas provide a safe haven for individuals to reproduce, allowing resident populations to become sources to renew

populations in hunted sink areas.

Management of spaces is effective because it focuses on whole areas and not specific species, thus providing a more encompassing conservation strategy. The four sub-zones of hunting show that the overall hunting zone is often used by hunters according to the location of hunting grounds, based on the habitats found in these grounds, the game caught and the costs of getting to them. It would therefore make sense to provide different regulations for each individual sub-zone that reflect the manner in which they are used. Setting aside "no-touch" areas would likely be most effective in sub-zone 2 because hunters visit these areas frequently and hunting pressure is relatively high throughout the zone. In contrast, hunting pressure in distant hunting grounds (e.g., sub-zones 3 and 4) is already localized, creating less of a need for refugia. Instead, monitoring of the creation of new paths and *kiamps* as well as incursions would be more effective in these areas. Finally, in sub-zone 1, land-use management to ensure that swidden agricultural practices maintain consistent, but not necessarily growing, garden game populations and to limit the clearing of primary forest that drives away deep forest game would be most effective. Because this area is used for many purposes, multistakeholder approaches that meet the needs of the different uses of the area, both commercial, such as forestry, and subsistence, such as hunting, may be appropriate.

Wildlife use is fundamentally spatial by nature: game is not caught in a vacuum, nor do hunters range randomly through their territory in search of it. Hunting is closely associated with a time and a place. Recognition of this fact from management practitioners will be one step closer towards appreciating the cultural nature of this activity and the importance of the people using these resources in their long-term

protection. Local investigators in this study, hunters themselves, have showed that they can also become effective monitors of game populations and can document changes of hunting over time, thereby playing a key role in wildlife management in the future. However, one fundamental element must always prevail to ensure real protective measures in neotropical indigenous communities: consensus must be reached between wildlife managers and community members, where the latter truly feel that their rights and cultural reality have been well-represented in the process.

5.5 Personal Reflections

During my stay in Kuhrpa and Tukrun, I learned as much about hunting and tropical conservation as I did about myself. However, this is not to say that the experience was easy. Participatory research, while beneficial to local people, can at times be long and trying. Empowerment is not something that occurs overnight but instead can be a very messy process where people (myself included) face their reality head-on. It seems that the Miskito often hear from outsiders that they are inferior and therefore incapable of managing their resources and so on, and, unfortunately, it appears as though some have come to believe it. My short stay in the communities did not easily reverse such a deeply entrenched feeling. When I presented the results of the study to community members and suggested that people get organized to limit the harvest of spider monkeys, many people laughed and stated that it would never happen unless I would enforce the rules myself. Evidently, much work remains to be done towards instilling a belief among local people that they possess the capacity to be managers. At the same time,

some people, including the research team, told me afterwards that they appreciated my research, agreed with my conclusions, and believed local conservation was possible.

This research project was not without its shortcomings. Firstly, the important role throughout the project played by local investigators likely skewed interpretations towards their knowledge and views. Furthermore, much of the data was collected from the most frequent hunters. Although not intended, some infrequent hunters were probably ignored in the process, and it was not determined how hunting shapes their identity. Furthermore, while I can confidently state that women do not attend hunting expeditions, I suspect that they often hunt small animals, such as squirrels, near their homes. The hunting of some small game that did not show up on the registry, such as doves (*Claravis* spp.) and oropendolas (*Psarocolius* spp.), is also problematic. This is particularly strange given that some small animals were registered, such as parrots (*Amazon* spp.) and toucans (*Ramphastos* spp.). While I am not quite sure why this occurred, only realizing it in the final days of my field stay, I suspect that some local investigators simply did not think they were important to document while others did not even pay attention to their harvest. With regards to participation, some people did not participate in the research because they did not trust me as an outsider and therefore did not wish to participate. While I tried to approach people as much as possible, I did not want to impose myself upon those that clearly had no interest in talking to me. This could possibly have been resolved over time, especially as my knowledge of the Miskito language improved, thereby eliminating an important barrier. Finally, I recognize the possibility that the research team might have ignored a hunter that caught important quantities of game during the study period, although I personally do not think this occurred.

I was fortunate to get to know many hunters in both Kuhrpa and Tukrun. From these experiences, I saw first-hand their concern for the long-term conservation of wildlife. However, not all residents of these communities share this concern. In fact, three hunters told me, on separate occasions, that their interests are being represented less and less in the communities, and that people are more concerned with making money than respecting what they see as a Miskito tradition. Similarly, I often felt that few people showed concern for my research, which possibly explains why it seemed that few people politicized the project. Interestingly, I also felt that community members had a quiet respect for hunters. Evidently, life in Kuhrpa and Tukrun, as in many other indigenous communities throughout the neotropics, is changing very quickly. The role of "old traditions", such as hunting, is being re-defined in the process. Hopefully, there will be enough young people in the community that recognize the importance of hunting to continue this tradition in the future.

Chapter 6:
Conclusion

My research attempts to show that the spatial patterns of hunting give extensive information about this resource extraction activity. I have looked at these patterns from the point of view of those that use game as well as from that of the animals that are being hunted. The result is a complex system where various factors interact with each other to produce clear spatial patterns, as exhibited by the four Miskito hunting sub-zones. Spatial patterns, when interpreted within the context of local hunting practices, can give a great deal of information regarding the nature of wildlife use and its potential impacts on local game populations. Furthermore, using participatory research to understand the spatial patterns allows people to become intimately involved in the gathering of this information. Local people gain a greater appreciation for scientific research and an understanding of the importance of wildlife management.

6.1 The Struggle Over the Rain Forest: Protected Areas and Indigenous Identity in La Moskitia

The ancestors of today's Miskito have been hunting in the vast forests of La Moskitia for thousands of years. This subsistence activity is deeply entrenched in Miskito culture. However, this culture is rapidly changing as people strive to maintain their distinct way of life while faced with new and often complex challenges. The Honduran Miskito have struggled many years to forge their own distinct identity amidst a bloody struggle that brought their Nicaraguan brothers onto the international stage

(Perez-Chiriboga 2002). They are an organized, creative and resilient people who are prepared to continue fighting to maintain a way of life that is often intimately connected to their surrounding environment. This struggle will no doubt take on new forms over time. The relationship between the Miskito and the resources they use will change as a consequence. Hunting, as an important part of this dynamic, will continue to be re-defined within the context of local economies throughout the region. Extracting wildlife resources at levels that do not risk the long-term survival of forest biodiversity will be key.

The current challenges faced by the Miskito probably share some similarity to those of many indigenous societies throughout the neotropics. While different cultures will respond to these challenges in different ways, subsistence wildlife use will invariably be affected everywhere it is practiced. Hence, if we are to ensure the proper functioning of the remaining parts of a once vast neotropical rain forest, we must come to understand and appreciate the dynamic nature of hunting. Tropical conservation must seek to work with local communities' wildlife use patterns and not impose restrictions that are seen by groups as repressive to their way of life (Chicchón 1995; Chernela 1995).

Despite being the first of its kind in Central America, up until the mid-1990's, the Río Plátano Biosphere Reserve remained a "Paper Park", where knowledge of the reserve among local residents was extremely limited and conservation efforts were essentially non-existent (ibid). Although efforts in the late 1990's, including an extensive participatory zoning project in 1997 (ibid), appear to have improved local awareness of the reserve, the devastation caused by Hurricane Mitch in 1998 has basically slowed down conservation efforts in many areas (Carlos Molinero, pers. comm.). Although most

residents of Kuhrpa and Tukrun know of the reserve's existence, very few understand its purpose. Furthermore, there is a growing frustration over AFE-COHDEFOR's taxation of commercial lumber extraction in the protected area, especially when many wealthy Miskitos and Ladinos successfully evade these fees. This may be very damaging in the long run if people begin believing that they are being short-changed by the reserve. Now is the time to get local people more involved in the management and conservation of the Río Plátano world heritage site.

Long-term conservation in the Río Plátano Biosphere Reserve must be sensitive and responsive to local resource use patterns (Chicchón 1995: 241). These patterns are closely linked to a rapidly changing Miskito identity. The Miskito, like many indigenous groups throughout the Neotropics, have a unique but extensive understanding of nature conservation (Redford and Stearman 1993: 253-254). While differences between western concepts of biodiversity protection are sometimes at odds with that of their indigenous counterparts, finding a common ground is not simply for convenience (ibid). On the contrary, giving indigenous people a key role in the future of forested regions of the Neotropics is part of a greater process of reversing years of top-down policies based on colonialist discourse (COICA 1989: 78), that have, in the case of Honduras, only intensified centuries of indigenous marginalization (González 1998; Martínez 1998: 62-63).

Advances in the field of poststructural political ecology have shown us that notions such as "environmental conservation" and "sustainable development" are not self-evident terms but instead have deep historical and political meaning (Escobar 1996). Thus, these terms reveal highly contested domains, "where epistemology and politics are

not separate" (Braun 2002: 3). Too often, the popular rally cry "Save the Rainforest" has left out one key actor in the fight to save this rapidly depleting biome: the indigenous groups that call the forest home (COICA 1989). To bridge this gap, conservationist discourse has shifted towards promoting "rational use", recognizing the needs of peoples inhabiting the forest by developing systems that at once conserve while improving peoples' standard of living (Robinson 1993: 20-21). While a step in the right direction, these systems are problematic because external actors, with very little understanding of the cultures that regularly use these resources, usually decide the definition of "rational".

6.2 Participatory Research, Resource Consciousness and the Spatial Patterns of Miskito Hunting

There has been a vigorous debate in recent years over the nature of indigenous conservation, as if this was a static entity in itself. In this thesis, I have tried to show that hunting, an activity at the centre of the indigenous conservation debate, is dynamic and diffuse, whose ebbs and flows are tightly linked to a rapidly changing indigenous cultural landscape and identity. With this in mind, it is unrealistic to believe current models used to manage tropical hunting, based on a small number of parameters, can provide an adequate understanding of this activity. Perhaps even more troubling is that once again, the indigenous groups that continue to depend and use wildlife resources are left out of this conservation strategy. Indigenous peoples have a vested interest in whatever form wildlife is managed in the rain forest. For this reason, I advocate the greater use of participatory research to give a voice to indigenous peoples in the development of knowledge that ultimately informs the policies that will greatly influence their lives.

From my experience in Kuhrpa and Tukrun, participatory research in general and participatory mapping specifically has created a greater resource consciousness among many actors involved, including myself (Freire 1971). I would like to end my thesis by sharing quotes from two local residents.

> *Estaba pensando que es muy importante documentar nuestra vida, no para nosotros, pero para nuestros nietos* (I was thinking that it is very important to document our lives, not for ourselves, but for our grandchildren). A local investigator from Kuhrpa.
>
> *La naturaleza es la riqueza de los pobres.* (Nature is the wealth of the poor people). A resident of Tukrun during an educational workshop on natural resource management and conservation.

It is only by bringing in the people that live in close contact with the tropical rainforest, and by understanding the challenges that face these primary caretakers, that we will ever be successful in conserving this world heritage.

Appendix I:
Miskito and Honduran (Spanish) Names for Important Animal, Tree and Agricultural Species

English Name	Miskito Name	Honduran Name	Scientific Name
(Animal Species)			
Guapote	Sahsing*	Guapote	*Cichlasoma* spp.
Snook	Mupi, Kalwas*	Róbalo	*Centropomus* spp.
Green iguana	Kakamuk	Iguana	*Iguana iguana*
Hicatee Turtle	Kuswa	???	*Pseudomys* spp.
Slaty-breasted tinamou	Suhar	Perdis, Gallina de monte	*Crypturellis boucardi*
Toucan	Wrak	Picón, Tucán	*Rhamphastos* spp.
Dove	Swita	Paloma (?)	*Leptotila* spp.
Ground-dove	Tuut	Palomita (?)	*Claravis* spp.
Oropendola	Tulu	Oropendola	*Psarocolius* spp.
Great curassow	Kusu	Pavón	*Crax rubra*
Crested guan	Kwamu	Pava	*Penelope purpurascens*
Amazon	Rafa	Loro	*Amazona* spp.
Macaw	Apu	Guara	*Ara* spp.
Common opossum	Sikiski	Zorro	*Didelphis marsupialis*
Nine-banded armadillo	Taîra	Cusuco	*Dasypus novemcinctus*
Northern naked-tailed armadillo	???	Cusuco venenoso	*Cabassous centralis*
Giant anteater	Winkutara	Oso caballo	*Myrmecophaga tridactyla*
Jaguar	Limy	Tigre, Jaguar	*Panthera onca*
Ocelot	Buhuru	Ocelote	*Leopardus pardalis*
White-nosed coati	Wistiting	Pizote	*Nasua narica*
Baird's tapir	Tilba	Danto, Tapir	*Tapirus bairdii*
White-lipped peccary	Wari	Jaguilla	*Dicotyles pecari*

Collared peccary	Buksa	Quequeo	*Tayassu tajacu*
Paca	Ibizna	Tepezcuintle	*Agouti paca*
Agouti	Kiaki	Guatusa	*Dasyprocta punctata*
White-faced capuchin	Wakling	Mono carablanca	*Cebus capucinus*
Mantled howler monkey	Kunkun	Mono olingo	*Alouatta palliata*
Central American spider monkey	Urus	Mono araña	*Ateles geoffroyi*
Whitetail deer	Sula pihni	Venado colablanca	*Odocoileus virginiana*
Red brocket deer	Snapuka, Sula pauni	Tilopo, Venado colorado	*Mazama americana*
(Tree Species)			
???	Bratara	Carizo	???
???	Dimansukut	???	???
Hog plum	Pahara*	Jobo	*Spondias lutea*
Mahogany	Yulu	Caoba	*Swietenia macrophylla*
Mamey tree	Kuri	Zapote	*Lucuma mammosa*
???	???	Masica	???
Silk-cotton tree	Sisin	Ceiba	*Ceiba pentandra*
???	Tasmuk	???	???
Tropical cedar	Yalam	Cedro real	*Cedrela* spp.
Santa María	Krasa	Santa María	*Calophyllum brasiliense*
(Agricultural Crops)			
Banana	Siksa	Banano	*Musa* spp.
Dasheen	Dasheen*	Malanga	*Colocacia esculenta*
Maize	Aya	Maís	*Zea mays*
Manioc	Yauhra*	Yucca	*Manihot esculenta*
Rice	Raíz	Arroz	*Oryza sativa*
Sugarcane	Kayu*	Caña	*Saccharum officiarum*

* Source: Nietschmann 1973

References Cited

Agrawal, Arun. 1995. Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change* 26: 413-439.

Agrawal, Arun and Clark C. Gibson. 1999. Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation. *World Development* 27(4): 629-649.

Alcorn, Janis B. 1984. *Huastec Maya Ethnobotany*. Austin: University of Texas Press. 982 pp.

Alcorn, Janis B. 1989. An Economic Analysis of Huastec Mayan Forest Management. In *Fragile Lands in Latin America*, edited by J. O. Browder. Boulder, Col.: Westview Press. Pp. 182-206.

Alcorn, Janis B. 1993. Indigenous Peoples and Conservation. *Conservation Biology* 7(2): 424-426.

Alcorn, Janis B. 1995. Comments. *Current Anthropology* 36(5): 802-804.

Alvard, Michael. 1995a. Intraspecific Prey Choice by Amazonian Hunters. *Current Anthropology* 36(5): 789-818.

Alvard, Michael. 1995b. Shotguns and Sustainable Hunting in the Neotropics. *Oryx* 29(1): 58-66.

Alvard, Michael S., John G. Robinson, Kent H. Redford and Hillard Kaplan. 1997. The Sustainability of Subsistence Hunting in the Neotropics. *Conservation Biology* 11(4): 977-982.

Alves, D.S. 2002. An Analysis of the Geographic Patterns of Deforestation in the Brazilian Amazon in the Period 1991-1996. In *Deforestation and Land Use in the Amazon*, edited by C. S. Wood and R. Porro. Gainesville, Fla.: University of Florida Press. Pp. 95-106.

Amadon, D. 1983. *Crax rubra* (Great Curassow). In *Costa Rican Natural History*, edited by D. H. Janzen. Chicago: University of Chicago Press.

Anderson, Anthony B., ed. 1990. *Alternatives to Deforestation: Steps Toward Sustainable Use of the Amazon Rain Forest*. New York: Columbia University Press.

Anderson, David L. 2001. Landscape Heterogeneity and Diurnal Raptor Diversity in Honduras: The Role of Indigenous Shifting Cultivation. *BIOTROPICA* 33(3): 511-519.

Anderson, Stanley H. 2002. *Managing our Wildlife Resources*. Upper Saddle River, NJ: Prentice-Hall. 554 pp.

Ayres, J. Marcio, Deborah de Magalhaes Lima, Eduardo de Souza Martins, and Jose Luis K. Barreiros. 1991. On the Track of the Road: Changes in Subsistence Hunting in a Brazilian Amazonian Village. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson and K.H. Redford. Chicago: University of Chicago Press. Pp. 82-92.

Baker, Leslie. 1989. Cultural Survival Imports: Marketing the Rain Forest. *Cultural Survival Quarterly* 13(3): 64-67.

Baksh, Michael. 1995. Changes in the Machiguenga Quality of Life. In *Indigenous Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson, Az.: University of Arizona Press. Pp. 187-205.

Barreto, G.R., O.E. Hernandez and J. Ojasti. 1997. Diet of Peccaries (*Tayassu tajacu* and *Tayassu pecari*) in a Dry Forest of Venezuela. *Journal of Zoology* 241(2): 279-284.

Beckerman, Stephen. 1983. *Carpe Diem*: An Optimal Foraging Approach to Bari Fishing and Hunting. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames and W.T. Vickers. New York: Academic Press. Pp. 269-300.

Bennett, Elizabeth L. and John G. Robinson. 2000. Hunting for Sustainability: The Start of a Synthesis. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 499-520.

Berkes, F., D. Feeny, B.J. McCay and J.M. Acheson. 1989. The Benefits of the Commons. *Nature* 340: 91-93.

Berlin, Brent and Elois Ann Berlin. 1983. Adaptation and Ethnozoological Classification: Theoretical Implications of Animal Resources and Diet of the Aguaruna and Huambisa. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames and W.T. Vickers. New York: Academic Press. Pp. 301-327.

Bodmer, Richard E. 1991. Influence of Digestive Morphology on Resource Partitioning in Amazonian Ungulates. *Oecologia* 85(3): 361-365.

Bodmer, Richard and Pablo E. Puertas. 2000. Community-based Comanagement in the Peruvian Amazon. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 395-412.

Brandon, Katrina, Kent H. Redford and Steven E. Sanderson. 1998. Introduction. In *Parks in Peril: People, Politics, and Protected Areas*, edited by K. Brandon, K.H. Redford and S.E. Sanderson. Washington, D.C.: The Nature Conservancy, Island Press. Pp. 1-23.

Braun, Bruce. 2002. *The Intemperate Rainforest: Nature, Culture, and Power on Canada's West Coast*. Minneapolis: University of Minnesota Press. 347 pp.

Browder, John O., ed. 1989. *Fragile Lands of Latin America: Strategies for Sustainable Development*. Boulder Co.: Westview Press.

Brown, Katrina and Sergio Rosendo. 2000. The Institutional Architecture of Extractive Reserves in Rondonia, Brazil. *The Geographical Journal* 166(1): 35-48.

Brunhes, Jean. 1925. Human Geography. In *The History and Prospects of the Social Sciences*, edited by H. E. Barnes. New York: Alfred Knopf. Pp. 55-105.

Bryceson, Deborah, Linzi Manicom and Yusuf Kassam. 1982. The Methodology of the Participatory Research Approach. In *Participatory Research: An Emerging Alternative Methodology in Social Science Research*, edited by Y. Kassam and K. Mustafa. Nairobi: African Adult Education Association. Pp. 67-82.

Carneiro, Robert L. 1983. The Cultivation of Manioc among the Kuikuru of the Upper Xingú. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames and W.T. Vickers. New York: Academic Press. Pp. 65-108.

Chagnon, Napoleon A., and Raymond B. Hames. 1979. Protein Deficiency and Tribal Warfare in Amazonia: New Data. *Science* 203: 910-913.

Chambers, Robert. 1994. Participatory Rural Appraisal (PRA): An Analysis of Experience. *World Development* 22(9): 1253-1268.

Chambers, Robert. 1998. Foreword. In *The Myth of Community: Gender Issues in Participatory Development*, edited by I. Guijt and M.K. Shah. London: Intermediate Technology. Pp. xvii-xx.

Chapin, Mac. 1995. Epilogue. In *Plants and Animals in the Life of the Kuna*, edited by J. Ventocilla, H. Herrera, and V. Núñez. Austin, Tx: University of Texas Press. Pp. 115-120.

Chapman, Colin A. 1988. Patterns of Foraging and Range use by Three Species of Neotropical Primates. *Primates* 29(2): 177-194.

Chernela, Janet M. 1995. Sustainability in Resource Rights and Conservation: The Case of an Awa Biosphere Reserve in Columbia and Ecuador. In *Indigenous Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson, Az.: University of Arizona Press. Pp. 245-262.

Chicchón, Avecita. 1995. Faunal Resource Use by the Chimane of Eastern Bolivia: Policy Notes on a Biosphere Reserve. In *Native Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson, Az.: University of Arizona Press. Pp. 225-244.

Clark, Colin. 1992. Empirical Evidence for the Effect of Tropical Deforestation on Climatic Change. *Environmental Conservation* 19(1): 39-47.

Condit, Richard, et al. 2002. Beta-Diversity in Tropical Forest Trees. *Science* 295: 666-667.

Connell, Joseph H. 1978. Diversity in Tropical Forests and in Coral Reefs. *Science* 199: 1302-1310.

Conzemius, Eduard. 1932. *Ethnographic Survey of the Miskito and Sumu Indians of Honduras and Nicaragua*. Washington, D.C.: Smithsonian Institution Bureau of American Ethnology bulletin. 106 pp.

Coordinating Body for the Indigenous Peoples' Organizations of the Amazon Basin (COICA). 1989. Two Agendas on Amazon Development. *Cultural Survival Quarterly* 13(4): 75-78.

Dickinson, R.E. 1969. *Vidal de la Blache (1845-1918)*: Routledge and Kegan Paul. 305pp.

Dodds, David J. 1989. Miskito and Sumo Refugees: Caught in Conflict in Honduras. *Cultural Survival Quarterly* 13(3): 3-6.

Dodds, David J. 1994. The Ecological and Social Sustainability of Miskito Subsistence in the Rio Platano Biosphere Reserve. Ph.D. Dissertation, Anthropology, UCLA, Los Angeles.

Dodds, David J. 2001. The Miskito of Honduras and Nicaragua. In *Endangered Peoples of Latin America: Struggles to Survive and Thrive*, edited by S.C. Stonich. Westport, Conn.: Greenwood Press. Pp. 87-100.

Dowler, Lorraine. 2001. Fieldwork in the Trenches: Participant Observation in a Conflict Area. In *Qualitative Methodologies for Geographers*, edited by M. Limb and C. Dwyer. London: Arnold. Pp. 153-165.

Dozier, C.L. 1985. *Nicaragua's Mosquito Shore: The Years of British and American Presence*. University, Ala.: University of Alabama Press. 269 pp.

Dunning, John B. 1992. Handbook of Avian Body Masses. Orlando, Fla: CRC Press. 370 pp.

Eisenberg, John F. 1983. *Ateles geoffroyi* (Spider Monkey). In *Costa Rican Natural History*, edited by D. H. Janzen. Chicago: University of Chicago Press. Pp. 451-453.

Elkins, T.H. 1989. Human and Regional Geography in the German-Speaking Lands in the First Forty Years of the Twentieth Century. In *Reflections on Richard Hartshorne's "The Nature of Geography"*, edited by J. N. Entrikin, and S.D. Brunn. Washington, D.C.: Occasional Publications of the Association of American Geographers. Pp. 17-34.

Emel, Jacques and Richard Peet. 1989. Resource Management and Natural Hazards. In *New Models in Geography*, edited by R. Peet, and N. Thrift. London: Unwin Hyman. Pp. 49-76.

Emmons, Louise H. 1984. Geographic Variation in Densities and Diversities of Non-flying Mammals in Amazonia. *Biotropica* 16(3): 210-222.

Escobar, Arturo. 1996. Constructing Nature: Elements for a Poststructural Political Ecology. In *Liberation Ecologies: Environment, Development, Social Movements*, edited by R. Peet, and M. Watts. London: Routledge. Pp. 46-68.

Fals-Borda, Orlando. 1987. The Application of Participatory Action-Research in Latin America. *International Sociology* 2(4): 329-347.

Flowers, Nancy M. 1983. Seasonal Factors in Subsistence, Nutrition, and Child Growth in a Central Brazilian Indian Community. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames and W.T. Vickers. New York: Academic Press. Pp. 357-392.

Floyd, Troy S. 1967. *The Anglo-Spanish Struggle for Mosquitia*. Albequerque, NM: University of New Mexico Press. 235 pp.

Fragoso, Jose Manuel V. 1991. The Effect of Hunting on Tapirs in Belize. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson, and K.H. Redford. Chicago: University of Chicago Press. Pp. 154-162.

Freese, Curtis H. 1983. *Cebus capucinus* (White-faced Capuchin). In *Costa Rican Natural History*, edited by D. H. Janzen. Chicago: University of Chicago Press. Pp. 458-460.

Freese, Curtis H., and Carlos J. Saavedra. 1991. Prospects for Wildlife Management in Latin America and the Caribbean. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson, and K.H. Redford. Chicago: University of Chicago Press. Pp. 430-444.

Freire, Paulo. 1971. *The Pedagogy of the Oppressed*. New York: Seabury Press.

Gayot, M., O. Henry, G. Dubost and D. Sabatier. 2004. Comparative Diet of the Two Forest Cervids of the Genus Mazama in French Guiana. *Journal of Tropical Ecology* 20: 31-43.

González, Silvia. 1998. Políticas estatales hacia los grupos étnicos (1821-1996). In *Rompiendo el espejo: visiones sobre los pueblos indígenas y negros en Honduras*, edited by M. Barahona, and R. Rivas. Tegucigalpa, Hn.: Edición Guaymuras. Pp. 65-80.

Good, Kenneth. 1995. Yanomami of Venezuela: Foragers or Farmers - Which Came First? In *Indigenous Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson: University of Arizona Press. Pp. 113-120.

Gordon, Burton L. 1982. *A Panama Forest and Shore: Natural History and Amerindian Culture in Bocas del Toro*. Pacific Grove, Ca: Boxwood Press.

Gottdenker, Nicole, and Richard E. Bodmer. 1998. Reproduction and Productivity of White-lipped and Collared Peccaries in the Peruvian Amazon. *Journal of Zoology* 245(4): 423-430.

Gross, Daniel R. 1975. Protein Capture and Cultural Development in the Amazon Basin. *American Anthropologist* 77: 526-549.

Gross, Daniel R., George Eiten, Nancy M. Flowers, Francisca M. Leoi, Madeline Lattman Ritter, and Dennis W. Werner. 1979. Ecology and Acculturation Among Native Peoples of Central Brazil. *Science* 206: 1043-1050.

Guijt, Irene and Meera Kaul Shah. 1998. General Introduction: Waking Up to Power, Process and Conflict. In *The Myth of Community: Gender Issues in Participatory Development*, edited by I. Guijt, and M.K. Shah. London: Intermediate Technologies Publications. Pp. 1-23.

Hames, Raymond B. 1979. A Comparison of the Efficiencies of the Shotgun and the Bow in Neotropical Forest Hunting. *Human Ecology* 7(3): 219-252.

Hames, Raymond B. 1980. Game Depletion and Hunting Zone Rotation Among the Ye'kwana and Yanomamo of Amazonas, Venezuela. In *Studies in Hunting and Fishing in the Neotropics*, edited by R. B. Hames. Bennington, Vmt.: Bennington College.

Hames, Raymond B. 1983. The Settlement Pattern of a Yanomamo Population Bloc: A Behavioral Ecological Interpretation. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames, and W.T. Vickers. New York: Academic Press. Pp. 393-428.

Hames, Raymond B. and William T. Vickers, ed. 1983. *Adaptive Responses of Native Amazonians*. New York: Academic Press.

Heckadon-Moreno, Stanley. 1997. Spanish Rule, Independence and the Modern Colonization Frontiers. In *Central America: A Natural and Cultural History*, edited by A. G. Coates. New Haven, Conn.: Yale University Press. Pp. 177-214.

Helms, Mary W. 1971. *Asang: Adaptations to Culture Contact in a Miskito Community*. Gainesville, Fla.: University of Florida Press. 268 pp.

Henry, Olivier. 1997. The Influence of Sex and Reproductive State on Diet Preference in Four Terrestrial Mammals of the French Guianan Rain Forest. *Canadian Journal of Zoology* 75(6): 929-935.

Herlihy, Peter H. 1997. Central American Indian Peoples and Lands Today. In *Central America: A Natural and Cultural History*, edited by A. G. Coates. New Haven, Conn.: Yale UP. Pp. 215-240.

Herlihy, Peter H. (Head cartographer). 1998. La Reserva del Hombre y la Biosfera del Río Plátano - Zona Wampusirpi (Map of Participatory Subzonification Project of the Río Plátano Biosphere Reserve). With five technical assistants and four local surveyors. Tegucigalpa, Hn. (Unpublished).

Herlihy, Peter H. 1999. Participatory Research Zoning of the Río Plátano Biosphere Reserve in the Honduran Mosquitia. In *Natural Resource Management: Between Poverty Alleviation and Nature Conservation, Experiences in Asia, Latin America and Africa*. GFA Studies 4. Gesellschaft für Agrarprojekte, ed. Pp. 225-243. Hamburg, Germany: Wissenschaftsverlag Vauk Kiel KG.

Herlihy, Peter H. 2001. Indigenous and Ladino Peoples of the Río Plátano Biosphere Reserve, Honduras. In *Endangered Peoples of Latin America: Struggles to Survive and Thrive*, edited by S. C. Stonich. Westport, Connecticut: Greenwood Press. Pp. 101-119.

Herlihy, Peter H. 2003. Participatory Research Mapping of Indigenous Lands in Darien, Panama. *Human Organization* 62(4): 315-331.

Herlihy, Peter H. and Gregory Knapp. 2003. Maps of, by, and for the Peoples of Latin America. *Human Organization* 62(4): 303-314.

Hill, Kim, et al. 1997. Impact of Hunting on Large Vertebrates in the Mbaracayu Reserve, Paraguay. *Conservation Biology* 11(6): 1339-1353.

Hill, Kim and Kristen Hawkes. 1983. Neotropical Hunting among the Ache of Eastern Paraguay. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames, and W.T. Vickers. New York: Academic Press. Pp. 139-188.

Hill, Kim and Jonathan Padwe. 2000. Sustainability of Ache Hunting in the Mbaracayu Reserve, Paraguay. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 79-104.

Hoggart, Keith, Loretta Lees and Anna Davies. 2002. *Researching Human Geography*. London: Arnold. 359 pp.

Houseal, Brian, Craig MacFarland, Guillermo Archibold and Aurelio Chiari. 1985. Indigenous Cultures and Protected Areas in Central America. *Cultural Survival Quarterly* 9(1): 10-20.

Houseal, Brian, Monica Ostria, and Jerome Touval. 1998. Parks in Peril: A Conservation Partnership for the Americas. In *Parks in Peril: People, Politics and Protected Areas*, edited by K. Brandon, K.H. Redford and S.E. Sanderson. Washington, D.C.: The Nature Conservancy, Island Press. Pp. 27-36.

Hurtado-Gonzales, Jose L., and Richard E. Bodmer. 2004. Assessing the Sustainability of Brocket Deer Hunting in the Tamshiyacu-Tahuayo Communal Reserve, Northeastern Peru. *Biological Conservation* 116(1): 1-7.

Jackson, Ted. 1993. A Way of Working: Participatory Research and the Aboriginal Movement in Canada. In *Voices of Change: Participatory Research in the United States and Canada*, edited by P. Park, M. Brydon-Miller, B. Hall and T. Jackson. Toronto: The Ontario Institute for Studies in Education. Pp. 47-64.

Janzen, Daniel H. 1983a. *Odocoileus virginianus* (White-tailed Deer). In *Costa Rican Natural History*, edited by D. H. Janzen. Chicago: University of Chicago Press. Pp. 481-483.

Janzen, Daniel H. 1983b. *Tapirus bairdii* (Baird's Tapir). In *Costa Rican Natural History*, edited by D. H. Janzen. Chicago: University of Chicago Press. Pp. 496-497.

Jorgenson, Jeffrey P. 1993. Gardens, Wildlife Densities, and Subsistence Hunting by Maya Indians in Quintana Roo, Mexico. Ph.D. Dissertation, Forest Resources and Conservation, University of Florida, Gainesville, Fla.

Jorgenson, Jeffrey P. 2000. Wildlife Conservation and Game Harvest by Maya Hunters in Quintana Roo, Mexico. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 251-266.

Jorgenson, Jeffrey P. and Kent H. Redford. 1993. Humans and Big Cats as Predators in the Neotropics. *Symposiums of the Zoological Society of London* 65: 367-390.

Judas, Jacky and Olivier Henry. 1999. Seasonal Variation of Home Range of Collared Peccary in Tropical Rainforests of French Guiana. *Journal of Wildlife Management* 63(2): 546-552.

Knapp, Gregory and Peter H. Herlihy. 2002. Mapping the Landscape of Identity. In *Latin America in the 21st Century: Challenges and Solutions*, edited by G. Knapp. Austin: University of Texas Press. Pp. 251-268.

Kolankiewicz, Leon. 1989. The Pesch of Honduras Face Uncertain Prospects. *Cultural Survival Quarterly* 13(3): 34-36.

Laurance, William F., and Bruce Williamson. 2001. Positive Feedbacks among Forest Fragmentation, Drought, and Climate Change in the Amazon. *Conservation Biology* 15(6): 1529-1535.

Lee, Rob J. 2000. Impact of Subsistence Hunting in North Sulawesi, Indonesia, and Conservation Options. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 455-472.

Leeuwenberg, Frans L. and John G. Robinson. 2000. Traditional Management of Hunting in a Xavante Community in Central Brazil: The Search for Sustainability. In *Hunting for Sustainability in Tropical Forests*, edited by J. G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 375-394.

Linares, Olga F. 1976. "Garden Hunting" in the Neotropics. *Human Ecology* 4(4): 331-341.

Linares, Olga F. 1984. Peoples and Resources in the Tropics. *Science* 226: 962-964.

MacArthur, Robert. 1972. The Economics of Consumer Choice. In *Geographical Ecology*, edited by R. MacArthur. New York: Harper & Row. Pp. 59-69.

MacArthur, Robert and Eric Pianka. 1966. On Optimal Use of a Patchy Environment. *American Naturalist* 100(916): 603-609.

Martínez, Alejandro. 1998. Imagen y percepción de las poblaciones indígenas de Honduras. In *Rompiendo el espejo: visiones sobre los pueblos indígenas y negros en Honduras*, edited by M. Barahona, and R. Rivas. Tegucigalpa, Hn.: Edición Guaymuras. Pp. 59-64.

Mena V., Patricio, Jody R. Stallings, Jhanira Regalado B., and Ruben Cueva L. 2000. The Sustainability of Current Hunting Practises by the Huarani. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 57-78.

Milner-Gulland, E.J., and H. Resit Akçakaya. 2001. Sustainability Indices for Exploited Populations. *Trends in Ecology and Evolution* 16(12): 686-692.

Mittermeier, Russell A. 1991. Hunting and its Effects on Wild Primate Populations in Suriname. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson, and K.H. Redford. Chicago: University of Chicago Press. Pp. 93-110.

Moran, Emilio. 1995. Disaggregating Amazonia: A Strategy for Understanding Biological and Cultural Diversity. In *Indigenous Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson, Az.: University of Arizona Press. Pp. 71-96.

Moskitia Pawisa Apiska (MOPAWI). (n.d.). Retrieved November 15, 2003, from http://www.mopawi.org.hn [Internet Website].

Mosquitia Pawisa (MOPAWI) and Mosquitia Asla Takanka (MASTA). 1993. Tierras Indígenas de La Mosquitia Hondureña - 1992: Zonas de Subsistencia (Map). Researchers Peter H. Herlihy and Andrew P. Leake. Information obtained through 22 indigenous surveyors in collaboration with other professionals. Tegucigalpa, Hn: Instituto Geográfico Nacional (1:500,000, in colour).

Mosse, David. 1994. Authority, Gender and Knowledge: Theoretical Reflections on the Practice of Participatory Rural Appraisal. *Development and Change* 25: 497-526.

Natural Sciences and Engineering Research Council of Canada (NSERC). 2004. *Tri-Council Policy Statement: Integrity in Research and Scholarship.* Retrieved November 12, 2004, from http://www.nserc.gc.ca/sf_e.asp?nav=sfnav&lbi=p9 [Internet Website].

Nazarea, Virginia D. 1999. A View from a Point: Ethnoecology as Situated Knowledge. In *Ethnoecology: Situated Knowledge/Located Lives*, edited by V. D. Nazarea. Tucson, Az.: University of Arizona Press. Pp. 3-20.

Nietschmann, Bernard. 1969. The Distribution of Miskito, Sumu, and Rama Indians, Eastern Nicaragua. Paper read at Bulletin of the International Committee on Urgent Anthropological and Ethnological Research, at Vienna.

Nietschmann, Bernard. 1972. Hunting and Fishing Focus Among the Miskito Indians, Eastern Nicaragua. *Human Ecology* 1(1): 41-67.

Nietschmann, Bernard. 1973. *Between Land and Water: The Subsistence Ecology of the Miskito Indians, Eastern Nicaragua*. New York: Seminar Press. 279 pp.

Nietschmann, Bernard. 1989. *The Unknown War: The Miskito Nation, Nicaragua, and the United States*. Edited by J. Finn. 8? vols. Vol. 8, *Focus on Issues*. New York: Freedom House. 111 pp.

Nietschmann, Bernard. 1995a. Conservación, auto-determinación y el Area Protegida Costa Miskita, Nicaragua. *Mesoamérica* 29: 1-55.

Nietschmann, Bernard. 1995b. Defending the Miskito Reefs with Maps and GPS. *Cultural Survival Quarterly* 18(4): 34-37.

Page, Ben. 2003. The Political Ecology of *Prunus africana* in Cameroon. *Area* 35(4): 357-370.

Park, Peter. 1993. What is Participatory Research? A Theoretical and Methodological Perspective. In *Voices of Change: Participatory Research in the United States and Canada*, edited by P. Park, M. Brydon-Miller, B. Hall and T. Jackson. Toronto: The Ontario Institute for Studies in Education. Pp. 1-20.

Park, Peter. 1997. Participatory Research, Democracy, and Community. *Practicing Anthropology* 19(3): 8-13.

Parsons, James J. 1955. The Miskito Pine Savanna of Nicaragua and Honduras. *Annals of the Association of American Geographers* 45(1): 36-67.

Pattison, William D. 1963. The Four Traditions of Geography. *The Journal of Geography* 63: 211-216.

Paulson, Susan, Lisa L. Gezon and Michael Watts. 2003. Locating the Political in Political Ecology: An Introduction. *Human Organization* 62(3): 205-217.

Peet, Richard and Michael Watts. 1996. Liberation Ecology: Development, Sustainability, and Environment in an Age of Market Triumphalism. In *Liberation Ecologies: Environment, Development, Social Movements*, edited by R. Peet, and M. Watts. London: Routledge. Pp. 1-45.

Peluso, Nancy Lee. 1995. Whose Woods are these? Counter-Mapping Forest Territories in Kalimantan, Indonesia. *Antipode* 27(4): 383-406.

Peres, Carlos A. 1996. Population Status of White-lipped *Tayassu pecari* and Collared Peccaries*Tayassu tajacu* in Hunted and Unhunted Amazonian Forests. *Biological Conservation* 77(2-3): 115-123.

Peres, Carlos A. 2000. Evaluating the Impact and Sustainability of Subsistence Hunting at Multiple Amazonian Forest Sites. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 31-56.

Peres, Carlos A. 2001. Synergistic Effects of Subsistence Hunting and Habitat Fragmentation on Amazonian Forest Vertebrates. *Biological Conservation* 15(6): 1490-1505.

Perez, Carlos A. 1997. Participatory Research: Implications for Applied Anthropology. *Practicing Anthropology* 19(3): 2-7.

Pérez-Chiriboga, Isabel. 2002. *Espíritus de Vida y Muerte: los Miskitu hondureños en época de guerra*. Tegucigalpa, Hn.: Editorial Guaymuras. 336 pp.

Pulliam, H. Ronald. 1988. Sources, Sinks, and Population Regulation. *American Naturalist* 132(5): 652-661.

Redford, Kent H. 1991. The Ecologically Noble Savage. *Cultural Survival Quarterly* 15(1): 46-48.

Redford, Kent H. 1992. The Empty Forest. *BioScience* 42(6): 412-422.

Redford, Kent H. and John G. Robinson. 1987. The Game of Choice: Patterns of Indian and Colonist Hunting in the Neotropics. *American Anthropologist* 89(3): 650-667.

Redford, Kent H. and John G. Robinson. 1991. Subsistence and Commercial Uses of Wildlife in Latin America. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson and K.H. Redford. Chicago: University of Chicago Press. Pp. 6-23.

Redford, Kent H. and Allyn Maclean Stearman. 1993. Forest-Dwelling Native Amazonians and the Conservation of Biodiversity: Interests in Common or in Collision. *Conservation Biology* 7(2): 248-255.

Reichel-Dolmatoff, Gerardo. 1996. *The Forest Within: The World-view of the Tukano Amazonian Indians*. 229 vols. Devon, UK: Themis Books. 229 pp.

Reid, Fiona A. 1997. *A Field Guide to the Mammals of Central America and Southeast Mexico*. New York: Oxford UP. 334 pp.

Ridgely, Robert S., and John A. Gwynne, Jr. 1989. *A Guide to the Birds of Panama*. Princeton, NJ: Princeton University Press. 534 pp.

Rivas, Ramon. 1993. *Pueblos Indígenas y Garífuna de Honduras*. Tegucigalpa, Hn: Editorial Guaymuras.

Robinson, John G. 1993. The Limits to Caring: Sustainable Living and the Loss of Biodiversity. *Conservation Biology* 7(1): 20-28

Robinson, John G. and Elizabeth L. Bennett, ed. 2000. *Hunting for Sustainability in Tropical Forests*. New York: Columbia University Press.

Robinson, John G. and John F. Eisenberg. 1985. Group Size and Foraging Habits of the Collared Peccary, *Tayassu tajacu*. *Journal of Mammology* 66: 153-155.

Robinson, John G., and Kent H. Redford. 1986. Body Size, Diet, and Population Density of Neotropical Forest Mammals. *American Naturalist* 128: 665-680.

Robinson, John G. and Kent H. Redford. 1991. Sustainable Harvest of Neotropical Forest Animals. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson, and K.H. Redford. Chicago: University of Chicago Press. Pp. 415-429.

Ruddle, Kenneth and Walther Manshard. 1981. *Renewable Natural Resources and the Environment: Pressing Problems in the Developing World, Natural Resources and the Environment*. Dublin: Tycooly International. 396 pp.

Sauer, Carl O. 1925. The Morphology of the Landscape. *University of California Publications in Geography* 2(2): 19-54.

Sauer, Carl O. 1987. Now This Matter of Cultural Geography. In *Carl O. Sauer: A Tribute*, edited by M. S. Kenzer. Corvallis, Oregon: Association of Pacific Coast Geographers. Pp. 153-163.

Skole, D.L., W.H. Chomentowski, W.A. Salas and A.D. Nobre. 1994. Physical and Human Dimensions of Deforestation in Amazonia. *BioScience* 44(5): 314-321.

Smith, Derek A. 2003. Participatory Mapping of Community Lands and Hunting Yields Among the Buglé of Western Panama. *Human Organization* 62(4): 332-341.

Smith, Derek A. 2005. Garden Game: Shifting Cultivation, Indigenous Hunting, and Wildlife Ecology in Western Panama. *Human Ecology*. In press.

Smith, Nigel J.H. and Richard Evans Schultes. 1990. Deforestation and Shrinking Crop Gene-pools in Amazonia. *Environmental Conservation* 17(3): 227-234.

Smole, William J. 1976. *The Yanoama Indians: A Cultural Geography*. Austin, Tx.: University of Texas Press. 272 pp.

Sorensen, Troy C. and Linda M. Fedigan. 2000. Distribution of Three Monkey Species Along a Gradient of Regenerating Tropical Dry Forest. *Biological Conservation* 92(2): 227-240.

Sowls, L.K. 1983. *Tayassu tajacu* (Collared Peccary). In *Costa Rican Natural History*, edited by D. H. Janzen. Chicago: University of Chicago Press. Pp. 497-498.

Speth, William W. 1987. Historicism: The Disciplinary Worldview of Carl O. Sauer. In *Carl O. Sauer: A Tribute*, edited by M. S. Kenzer. Corvallis, Or.: Association of Pacific Coast Geographers. Pp. 11-39.

Sponsel, Leslie E. 1995. Relationships Among the World System, Indigenous Peoples and Ecological Anthropology in the Endangered Amazon. In *Indigenous Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson, Az.: University of Arizona Press. Pp. 263-294.

Stearman, Allyn MacLean. 1995. Neotropical Foraging Adaptations. In *Indigenous Peoples and the Future of Amazonia*, edited by L. E. Sponsel. Tucson, Az.: University of Arizona Press. Pp. 207-224.

Stearman, Allyn Maclean. 2000. A Pound of Flesh: Social Change and Modernization as Factors in Hunting Sustainability Among Neotropical Indigenous Societies. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 233-250.

Steward, Julian. 1955. *Theory of Culture Change: The Methodology of Multilinear Evolution*. Urbana, Ill.: University of Illinois Press. 244 pp.

ter Steege, Hans and David S. Hammond. 2001. Character Convergence, Diversity, and Disturbance in Tropical Rain Forest in Guyana. *Ecology* 82(11): 3197-3212.

Stiles, F. Gary and Alexander F. Skutch. 1989. *A Guide to the Birds of Costa Rica*. Ithaca, NY: Cornell University Press. 656 pp.

Tobler, Mathias W. 2002. Habitat Use and Diets of Baird's Tapir (*Tapirus bairdii*) in a Montane Cloud Forest of the Cordillera de Talamanca. *BIOTROPICA* 34(2-3): 468-474.

Toledo, Victor. 2002. Ethnoecology: A Conceptual Framework for the Study of Indigenous Knowledge on Nature. In *Ethnobiology and Biocultural Diversity*, edited by J. R. Stepp, F.S. Wyndham, and R.Zarger. Athens, Ga.: University of Georgia Press.

Townsend, Wendy R. 2000. The Sustainability of Subsistence Hunting by Siriono Indians of Bolivia. In *Hunting for Sustainability in Tropical Forests*, edited by J.G. Robinson and E.L. Bennett. New York: Columbia University Press. Pp. 267-281.

Unwin, Tim. 1992. *The Place of Geography*. New York: Wiley. 273 pp.

Vayda, Andrew and Bradley Walters. 1999. Against Political Ecology. *Human Ecology* 27: 167-179.

Ventocilla, Jorge. 1992. *Cacería y subsistencia en Cangandi, una comunidad de los indígenas Kunas.* Quito, Ec.: Hombre y Ambiente (No. 23). 188 pp.

Ventocilla, Jorge. 1995. Terrestrial Fauna. In *Plants and Animals in the Life of the Kuna*, edited by J. Ventocilla, H. Herrera and V. Núñez. Austin, Tx.: University of Texas Press. Pp. 30-42.

Ventocilla, Jorge and Rutilio Paredes. 1995. Hunting in Gangandi. In *Plants and Animals in the Life of the Kuna*, edited by J. Ventocilla, H. Herrera and V. Núñez. Austin, Tx: University of Texas Press.

Vickers, William T. 1991. Hunting Yields and Game Composition over Ten Years in an Amazon Indian Territory. In *Neotropical Wildlife Use and Conservation*, edited by J. G. Robinson, and K.H. Redford. Chicago: University of Chicago Press. Pp. 53-81.

Wallace, D.R. 1997. Central American Landscapes. In *Central America: A Natural and Cultural History*, edited by A. G. Coates. New Haven, Conn.: Yale University Press. Pp. 72-96.

Wehncke, E.V. et al. 2003. Seed Dispersal Patterns Produced by White-faced Monkeys: Implications for the Dispersal Limitation of Neotropical Tree Species. *Journal of Ecology* 91(4): 677-685.

Werner, Dennis. 1983. Why Do the Mekranoti Trek? In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames, and W.T. Vickers. New York: Academic Press. Pp. 225-238.

West, Robert C. and John P. Augelli. 1989. *Middle America: Its Lands and Peoples*. 3rd ed. Englewood Cliffs, NJ: Prentice Hall. 494 pp.

Whitfield, John. 2003. The Law of the Jungle. *Nature* 421: 8-9.

Wilcox, Bruce A. and Kristin N. Duin. 1995. Indigenous Cultural and Biological Diversity: Overlapping Values of Latin American Ecoregions. *Cultural Survival Quarterly* 18(4): 49-53.

Yost, James A. and Patricia M. Kelley. 1983. Shotguns, Blowguns, and Spears: The Analysis of Technological Efficiency. In *Adaptive Responses of Native Amazonians*, edited by R. B. Hames, and W.T. Vickers. New York: Academic Press. Pp. 189-224.