

The Robustness of Indigenous Common-property Systems to Frontier Expansion: Institutional Interplay in the Mosquitia Forest Corridor

Tanya M. Hayes

Departments of Environmental Studies and Public Affairs, Institute for Public Service, Seattle University,
901 12th Ave, PO Box 222000, Seattle, WA 09122-1090, USA

and
Center for the Study of Institutions, Population and Environmental Change, Indiana University,
Bloomington, IN, 47408-3799, USA

E-mail: hayest@seattleu.edu

Abstract

This article compares how indigenous residents in the Mosquitia Forest Corridor of Honduras and Nicaragua have responded to agricultural expansion in two distinct institutional environments: a reserve under public management and a reserve where the indigenous residents hold territorial rights. The article combines institutional analysis with ethnographically-based fieldwork to (1) identify whether the indigenous common-property systems in the Mosquitia remain robust when residents are confronted with private-property institutions and land markets introduced by colonists; and (2) examine the links between maintenance of the common-property systems and the broader institutional environment. The analysis pays particular attention to how the protected area policies in each reserve impact the transaction costs incurred in local rule-making and individual land use strategies in response to migrant farmers and ranchers. The findings suggest that the broader institutional environment, specifically the protected area policies and processes, significantly influence the transaction costs and risks involved in collective rule-making, and thereby impact the capacity of the indigenous residents to sustain their common-property systems.

Keywords: protected areas, social-ecological systems, colonisation, agricultural expansion, common-pool resource, forest reserves, resilience, adaptation, Latin America

INTRODUCTION

HOW TRADITIONAL PEOPLES respond to shocks such as major demographic shifts, new markets or technological change and the role that broader policy prescriptions have in influencing those responses is a vital question for environmental conservation and resource management (Richards 1997; Berkes *et al.* 2003; Dietz *et al.* 2003; Anderies *et al.* 2004). For those scholars and practitioners involved in forest management, whether traditional systems remain robust or collapse in the face of external disturbances is of immediate concern as new populations and markets push into what were once remote forest lands (Redford 1991; Grosvenor *et al.* 1992; Redford & Stearman 1993; Terborgh 2000; Rudel *et al.* 2002; Nepstad *et al.* 2006; Stocks *et al.* 2007). This article examines if and how indigenous residents adapt their common-property systems to frontier expansion and the impact that protected area governance has on their adaptation strategies.

In Latin America, frontier expansion, or the migration of farmers and ranchers to remote forest lands is the principal cause for deforestation in the region (Bryant *et al.* 1997; Geist & Lambin 2001). Frontier forests are some of the last tracts of forest that are of sufficient size to support a full range of native species and remain relatively undisturbed (Bryant *et al.* 1997). These forests are frequently the ancestral homelands of indigenous peoples who have governed the regions for centuries, often through a loosely designed system of common-property norms (Grosvenor *et al.* 1992; Dodds 1994; House 1997; Stocks *et al.* 2007).

Indigenous common-property institutions are an important component in the social-ecological systems that operate in the frontier. Ostrom (2007) defines social-ecological systems as consisting of four broad components: (1) a resource system; (2) specific resource units; (3) resource users; and (4) a governance system. These four components interact and produce outcomes in a par-

ticular time and place within a broader socio-economic, political and ecological context.

In frontier forests, a predominant social-ecological system is the forest, the forest products (consumptive and non-consumptive), the native residents and the residents' traditional common-property institutions. In many cases, the set of common-property institutions shared by the indigenous resource users have left large tracts of relatively intact forests and the land use norms have contributed to frontier forest protection (Grosvenor *et al.* 1992; Stevens 1997; Stocks 1998).

Migrant farmers and ranchers, however, threaten to disturb the traditional common-property system. The migrants are often *mestizo* peoples (peoples of mixed European and indigenous ancestry) who introduce private-property institutions that encourage individual ownership over forest lands and land sales. As new populations and land markets enter these previously remote regions, many wonder if the native governance systems will remain robust or whether they will deteriorate, and ultimately, undermine the ecological resilience of the forest in the region (Redford 1991; Richards 1997; Terborgh 2000; Putz *et al.* 2001; Bremner & Lu 2006).

In recent years, scholars of sustainability science and natural resource governance have given greater attention to understanding two important concepts: ecological resilience and institutional robustness (Anderies *et al.* 2004; Young *et al.* 2006; Ostrom 2007). While there is some debate about these terms, ecological resilience (Walker *et al.* 1981) assumes that an ecological system has equilibrium properties dependant on a variety of internal processes. The resilience of an ecological system is conceptualised as the amount of disturbance the system can absorb before it is transformed into a new system characterised by a different stability domain and set of controlling variables and processes (Holling 1973). Robustness also relates to the reaction of a system to disturbance, but of engineered systems such as airplanes, water aqueducts and power systems. Robustness is conceptualised as the capability of designed systems to continue performance after being hit with a diversity of disturbances (Carlson & Doyle 2002). Anderies *et al.* (2004) suggest that the concept of robustness is more appropriate for studying institutional arrangements (and other humanly designed systems) because there is no assumption that these systems have a 'natural' equilibrium and that the theory of robustness focuses on the capability of a system to continue to function when hit by a variety of external or internal disturbances. In this study, I use the concept of robustness to examine how the design of specific rules of a common-property institution helped or hindered indigenous residents' abilities to manage their land use system when confronted by disturbances such as new market and demographic pressures generated by *mestizo* encroachment.

The design and overall robustness of traditional common-property institutions, however, do not depend enti-

rely on decisions made by the indigenous residents. Most frontier residents and their institutions do not operate in isolation; rather, they are nested in broader national conservation policies. In analysing environmental systems, Cash *et al.* (2006) caution against ignoring cross-scale dynamics and note that the interaction between national and local policies across time and space may present significant opportunities and challenges in managing the environment. Furthermore, recent research in social-ecological systems suggests that links between actors at different institutional levels can significantly influence if and how local resource systems adapt to change (Cardenas *et al.* 2000; Berkes 2001; Adger *et al.* 2005; Cash *et al.* 2006; Young 2006). As of yet, however, we lack strong empirical understandings of how the broader institutional environment and specific policy prescriptions may impact the decisions that resource users make in response to an external disturbance, and in turn, whether a resource management system is capable of coping with change.

This article contributes to one piece of this puzzle by comparing indigenous responses to frontier expansion in two protected areas under different governance regimes: the Río Plátano Biosphere Reserve, Honduras, hereafter 'Río Plátano,' and the Bosawas Biosphere Reserve, Nicaragua, hereafter 'Bosawas'. Both reserves lie in the pathway of frontier expansion caused by *mestizo* farmers and ranchers moving to the region. The principal differences between the two reserves are the protected area property-rights policies and processes that were enacted in the mid-1990s. In Río Plátano, these governance changes gave the Honduran Ministry of Forestry greater authority over the reserve. In Bosawas, in contrast, the changes enabled the indigenous peoples to establish territorial rights to their lands.

Previous studies have found that since these policy changes, *mestizo* migration into the indigenous territories in Bosawas has virtually stopped. In contrast, *mestizos* continue to push into Río Plátano (Hayes 2007a; Stocks *et al.* 2007). This study aims to dig deeper into the processes that have occurred in the two reserves by looking at the institutional responses on the part of the indigenous residents to *mestizo* encroachment, specifically if, how and why their common-property institutions have changed. The objectives of this study are to (1) identify how the indigenous residents adapted (pre- and post-policy application) to *mestizo* expansion in the region; (2) determine the impact of the protected area policies on indigenous adaptation strategies; and (3) assess whether these adaptations have contributed to a robust common-property system.

In the following section, I provide a brief overview of the Mosquitia Forest Corridor and the two reserves. I then define some key terms and concepts used in the study, and present my research methodology. In the results, I present how the indigenous residents in the Mosquitia have responded (pre- and post-policy application) to *mes-*

tizo expansion in the region. The results and subsequent discussion point to how the two reserves' protected area policies and processes had different impacts on the costs and risks involved in local rule-making and, in turn, the robustness of the Miskito common-property system to frontier expansion.

Agricultural Expansion in the Mosquitia

The Mosquitia holds one of the world's most valuable concentrations of biological resources and represents the heart of the Mesoamerican Biological Corridor that runs from southern Mexico to Panama (Herlihy 1997; Miller *et al.* 2001). The region is approximately the size of New Jersey and is one of the most remote areas of Central America as it is geographically and politically isolated from mainland Honduras and Nicaragua, and mostly inaccessible by car.

The corridor consists of four protected areas that connect eastern Honduras to northern Nicaragua. Río Plátano and Bosawas are the two largest reserves. Each encompasses roughly 8000 sq km and they are located at opposing ends of the corridor¹. At the northern end of the corridor, the coastal region of Río Plátano contains beaches and lagoons and is dominated by pine savannah and marshes. The interior sector of Río Plátano is a hilly to mountainous region covered by very humid tropical forest (Herlihy 1997; House *et al.* 2002). To the south, the tropical forest continues into Bosawas, where the interior of the reserve is predominantly hilly to mountainous and the dominant ecosystems are humid and very humid tropical forest (UNESCO-MAB 1999).

The Miskito and Mayangna are the principal indigenous groups living in the Mosquitia. This study focuses on the activities of the Miskito peoples whose origins date back to the 1600s when the Amerindians living in the region began to mix with European colonists, pirates and African slaves on the shores of eastern Honduras and northern Nicaragua. The Miskito living in the corridor have historically remained fairly isolated and independent from the formal institutions of their respective governments, and depend primarily on subsistence farming and hunting for their livelihoods (Dodds 1994; Herlihy 1997; Stocks 1998).

The traditional common-property system of the Miskito is similar to that of many native peoples in Latin America (Stocks 1996, 1998; House 1997; Schwartzman & Zimmerman 2005). Although, historically, the Miskito did not develop formal governing structures or land use rules, the Miskito have managed their forests under a tacitly understood set of norms that provides social, economic and environmental benefits. The core characteristic of the Miskito common-property system is that all forest lands are held in common and residents share access and user rights to the forests. Forest boundaries are not physically demarcated as forests are considered to be available

to all native residents. Most of the interior forest lands are designated for hunting, and occasional timber harvests, and all residents are able to gather timber and non-timber forest products. In addition, land is not bought or sold, as it is to be passed down through generations (Dodds 1994; Herlihy 1997; Stocks 1998).

Frontier expansion onto indigenous lands in Río Plátano and Bosawas began in the late 1980s and early 1990s. The migrants settle on Miskito homelands by either invading or buying land. In many cases, colonists were initially encouraged by government development programmes. In 1995, the Honduran government declared the northwestern edge of Río Plátano a region for agrarian reform and encouraged thousands of families to move to the area. Although Río Plátano was declared a protected area in 1980, it was not actively managed (Herlihy 1997). Upon arriving at the edge of the reserve, many migrant families moved further inside Río Plátano (IUCN/ORMA 1995; Messen 1995). By 1997, there were approximately 2200 *mestizos* living in the cultural zone of the reserve (PBRP 1997/98).

Similarly, in Bosawas, migrants came after the civil war, in the early 1990s. During the 1980s, Bosawas was a region of heavy conflict between the Contras and Sandinistas. At this time, most of the Miskito and Mayangna peoples were either forced to serve in one of the militant groups or removed to camps in Nicaragua and Honduras. After the war, Bosawas was created as a government reserve in 1990. At the same time, however, Nicaraguan politicians were encouraging ex-Contra and ex-Sandinista combatants to relocate in 'development poles' on the edge of Bosawas (Cupples 1992; Stocks 1996). According to a study conducted by The Nature Conservancy (TNC), in 1980 there were only 191 *mestizo* families living in the southern region of Bosawas. By 1996, 1977 families had moved to the area (Hurtado de Mendoza 2001).

The migrants disturb the Miskito's common-property system in two important ways. First, unlike the Miskito who value shared access to the forests and forest products, the *mestizo* farmers do not recognise the fluid boundaries and common-property institutions of the Miskito. *Mestizo* farmers and ranchers perceive all lands to be open for appropriation unless they are otherwise physically demarcated (Stocks 1998). Upon arriving in the frontier, *mestizos* immediately demarcate their landholdings with markings on trees and clearings in order to establish individual ownership rights.

Second, the *mestizos* introduce an external market for land. Customarily, the Miskito do not sell land. In contrast, the *mestizos* actively buy and sell land. For the Miskito, the offer of money for land presents a much needed economic opportunity and provides incentives to sell what was previously considered to be part of the communities' land.

Río Plátano and Bosawas were created in 1980 and 1990, respectively, to conserve the region and stop agri-

cultural expansion. They remained, however, virtually unmanaged until the mid-1990s when the Honduran and Nicaraguan governments in conjunction with international and national conservation and development agencies implemented new reserve policies. Today, Río Plátano is divided into three management zones: a core zone for strict preservation, a buffer zone for the *mestizo* residents and a cultural zone for the indigenous residents. Bosawas consisting of six indigenous territories and a publicly managed buffer zone lies to the south. In this study, I compare protected area policies and Miskito adaptation strategies to *mestizo* encroachment in the cultural zone of Río Plátano to a Miskito territory in Bosawas.

Institutional Analysis to Understand Adaptation and Robustness

I apply the Institutional Analysis and Development framework to analyse how institutions, both formal and informal, have changed in response to the disturbances introduced by *mestizo* migrants (Ostrom 1990, 2007). Institutions are defined as the rules, norms and strategies that shape our decisions and our interactions (Ostrom 1990). Institutions are important indicators of how a traditional community responds to a disturbance because they are considered to be stable and often presumed to change only if some event disrupts the equilibrium and shocks the system (North 1990; Knight 1992; Snidal 1994). Nevertheless, at times, institutions do change.

How individual institutions change will, ultimately, impact the robustness of the overall institutional system. Anderies *et al.* (2004) define robustness as 'the maintenance of some desired system characteristics despite fluctuations in the behaviour of its component part or its environment' (citing Carlson & Doyle 2002). They and others (Young *et al.* 2006) emphasise that the robustness of a system depends on past adaptations, which may either help or hinder the system to withstand new perturbations and uncertainties (Anderies *et al.* 2004; Young *et al.* 2006).

The robustness of the Miskito common-property system depends on whether the institutional design of the system, and adaptations to that design, enable the Miskito to resist *mestizo* invasions and market pressures. Drawing on the works of Young *et al.* (2006) and Smit and Wandel (2006), I define adaptation as the changes that the Miskito make in their land use rules, norms or strategies to adjust to *mestizo* encroachment. I consider the Miskito common-property system to be robust to *mestizo* encroachment if adaptations enabled the residents to maintain the core characteristics of their institutional system in the face of *mestizo* market and land use pressures. These core characteristics are: (1) forests are held in common by all native residents who share access and user rights; and (2) land is not bought or sold.

In order to assess the robustness of the Miskito common-property system, I examine both *how* individuals

adapt to change and *why* they choose one particular adaptation strategy over another. I analyse *how* the Miskito common-property institutions have changed by comparing the decisions made by Miskito households and their respective communities in response to the *mestizo* migrants in the two reserves. I then examine how these adaptation strategies have impacted the overall robustness of their common-property system.

I analyse *why* the Miskito chose specific adaptation strategies by assessing the costs and benefits of different institutional changes and land use practices given the particular decision-making context. I pay particular attention to the inter-play between the broader institutional environment, namely, the protected area policies, and the Miskito governance initiatives, and analyse how the reserve policies enacted in the mid-1990s influenced the transaction costs incurred in Miskito collective decision-making.

Organising and rule-making can be taxing. Transaction costs that include gathering the information necessary to make a new rule, negotiating an agreement, monitoring and enforcement can be particularly challenging for residents in rural regions such as the Mosquitia where people have limited access to information, technology, money and personnel, and limited authority to create rules.

In frontier environments such as the Mosquitia, these costs are often incurred under great uncertainty of whether the rules produced will be recognised or complied with. In discussing rule-making, Ostrom (1990) emphasises the problems of supply, credible commitment and mutual monitoring. The dilemma is a delicate catch-22 in that rule-making entails significant transaction costs to the participants who must organise, negotiate, create and ultimately apply a rule. Individuals do not necessarily want to make rules and commit to monitoring those rules unless they are certain that they will be respected and that they will gain some benefit from its creation. Unfortunately, a rule will not be respected until it is made.

The broader institutional environment may, however, influence who bears the costs of rule-making, and the likelihood that a rule will be monitored and enforced (Ensminger & Knight 1997; Cardenas *et al.* 2000; Berkes 2001; Ostrom 2005; Cash *et al.* 2006; Young 2006). The following analysis examines how the reserve policies enacted in the Mosquitia influenced the collective decision-making of the Miskito and their coping strategies to address *mestizo* migration.

METHODS

The analysis and findings described in this article are part of a broader research project to understand the impact of different protected area property-rights policies on the ability to control agricultural expansion in the Mosquitia (Hayes 2007b). The study included land cover analyses and fieldwork in eight communities in the region. Fieldwork combined with satellite images comparing defores-

tation patterns in the two reserves found that, as of 2006, *mestizos* continued to migrate further into Río Plátano, whereas *mestizo* migration into Bosawas had virtually stopped. Furthermore, research in Río Plátano found that Miskito communities in the cultural zone have struggled to defend their lands from *mestizo* migrants (Hayes 2007a, b). This study aims to understand the internal dynamics of how the Miskito have changed their institutions in response to *mestizo* private-property practices and land markets and the impact of the broader protected areas policies.

Research Design

The different protected area policies enacted in Río Plátano and Bosawas provide an opportune setting to examine the impacts of external actors and their respective policies on indigenous responses to *mestizo* migration. The study uses a quasi-experimental design to examine Miskito responses to *mestizo* encroachment pre- and post-policy intervention (Shadish *et al.* 2002). In a quasi-experimental design, treatment is not randomly assigned. Rather, the researcher chooses two groups that are as similar as possible in all aspects except for the treatment that is under investigation. In the case of the Mosquitia, I chose to compare Río Plátano and Bosawas, and specific communities within, because of similar ecological, socio-economic and cultural characteristics. The principal difference, or treatment, I investigate is the application of different protected area policies by the respective governments and associated non-governmental organisations (NGOs) working in each reserve. To better tease out the impact of these policies on Miskito institutional robustness to *mestizo* migration, and to account for differences prior to their enactments, I use a pre-post test design to examine Miskito responses to *mestizo* encroachment in each reserve before and after the policy changes implemented in the mid-1990s.

In this study, I compare Miskito activities in the western region of the cultural zone, Río Plátano to a Miskito territory, Miskito Indian Tasbaika Kum (MITK), Bosawas. Data was gathered at the regional level and from two case study communities: Banaka, a Miskito community in the cultural zone, Río Plátano, and Pueblo Nuevo, a Miskito community in MITK, Bosawas. Figure 1 shows the study regions and the specific case study communities. Table 1 presents key demographic and political characteristics.

I chose to compare these two regions because first, they are both predominately Miskito, and second, they both began experiencing *mestizo* encroachment in the late 1980s and early 1990s. The cultural zone of Río Plátano is in the department of Gracias a Dios and encompasses 3895 sq km in the northern and eastern regions of the park. The zone is under the jurisdiction of the Honduran Ministry of Forestry. Approximately 21,320 people live in the cultural zone, the majority of who are Miskito

(PBRP 1997/98). To the northwest of the cultural zone is a buffer zone designated for *mestizos*.

MITK is one of six territories that form the core of Bosawas. It is a Miskito territory that covers approximately 681 sq km in the southwestern edge of Bosawas in the department of Jinotega. The territory lies between the River Coco that divides Nicaragua from Honduras to the west and a Mayangna territory to the east. Approximately 3454 people live in fourteen principal communities in MITK (TNC 1997). MITK is bordered to the south by a *mestizo* buffer zone on public lands in Bosawas.

As shown in Table 1, MITK is smaller than the cultural zone. Nevertheless, population densities in the MITK and the cultural zone are quite similar and both regions are located within protected areas that are roughly the same size. Also shown in Table 1, in the mid-1990s, *mestizo* population densities were similar in the buffer zones bordering the western region of the cultural zone and southern MITK.

I structured the study to control for factors such as roads or market access that might also influence *mestizo* migration and indigenous institutional change. Residents in Río Plátano and Bosawas are primarily subsistence farmers with minimal participation in outside markets; access to the region is primarily by boat or on foot, and most residents must travel a minimum of one full day to reach any moderately sized commercial centre. Although Río Plátano is more ecologically diverse than Bosawas, both reserves are predominately covered by tropical humid forests, and indigenous and *mestizo* residents both depend upon these forests for agricultural lands and forest products.

Figure 1
Río Plátano and Bosawas reserves, Mosquitia Forest Corridor

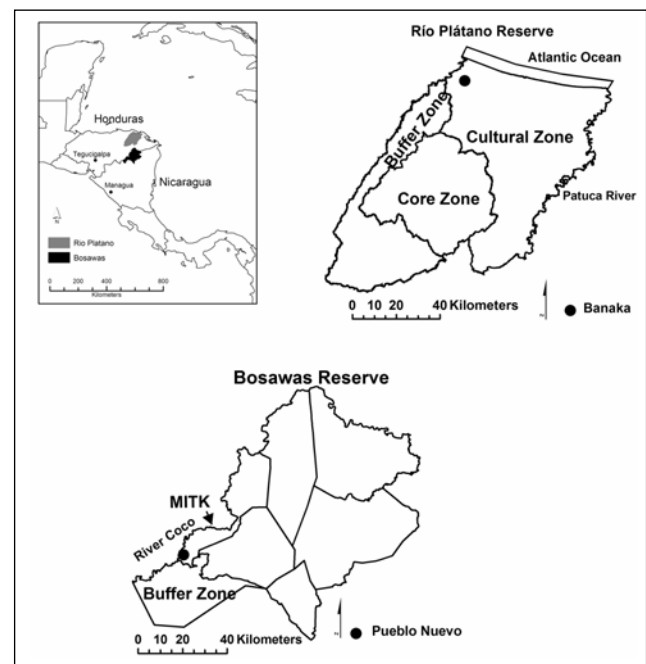


Table 1
Reserve characteristics

	Predominant ethnicity	Population	Area sq km	Population/sq km	Tenure regime
Cultural Zone, Río Plátano	Miskito	21,320	3895	5.47	Public
Buffer Zone (Sico-Paulaya), Río Plátano	<i>mestizo</i>	5019	676	7.42	Public
MITK, Bosawas	Miskito	3454	681	5.07	Territorial
Buffer Zone, Bosawas	<i>mestizo</i>	4193	569	7.37	Public

The population statistics are for 1997/98 for Río Plátano and 1995/96 for Bosawas (TNC 1997; PBRP 1997/98; Hurtado de Mendoza 2001). In each case the population censuses were conducted at the time of implementing the new protected area management plans and property rights regimes. The table also specifies the property rights regimes governing each region.

A challenge for any quasi-experimental study is ensuring that the two study groups are comparable. In assessing the comparability of the regions, it is important to note the possible impacts of the Nicaraguan civil war (1980–1990) on indigenous land use practices, community organisation and *mestizo*-Miskito relations. I tried to account for this difference by asking elders, community leaders and residents about impacts the war had on land use practices, integration with the market and community cohesion. I cannot attribute any significant differences in indigenous land use decisions to the war. In interviews with Miskito and *mestizos*, some felt that the war may have made the *mestizos* more amenable to negotiations with the Miskito; however, others felt that because of the war *mestizos* were well-armed and not afraid of combat. While I recognise that the civil war differentiates Bosawas from Río Plátano, I do not consider the war to threaten the validity of the results.

Case Study Sites

I chose the specific case study communities, Banaka, Río Plátano, and Pueblo Nuevo, Bosawas, because both communities have experienced similar pressures from *mestizo* migrants, and in interviews, elders expressed nearly identical traditional land use practices and norms. Banaka is located in the northwestern region of the cultural zone of Río Plátano and has approximately fifty houses. The community remains predominately Miskito, although the surrounding region is occupied by *mestizo* settlers. Pueblo Nuevo, Bosawas, consists of twenty houses and is the southern-most community inside the boundaries of the Miskito territory. Both communities are only accessible by river travel and residents primarily depend on subsistence farming and have remained relatively isolated from mainland economic activities.

As shown in Figure 1, each community is located close to the boundaries of the *mestizo* buffer zones in their respective reserves. In the mid-1990s, both of these buffer zones served as gateways for *mestizo* migrants to encroach on indigenous lands. In the 1990s, *mestizo* migrants began entering and settling in the northwestern region of the cultural zone, Río Plátano, and in Bosawas,

migrants came from the interior of Nicaragua and entered into the southern region of MITK.

Despite their similar geographical, socio-economic and cultural characteristics, however, as of 2006, Banaka and Pueblo Nuevo differed dramatically in their abilities to control *mestizo* encroachment. Satellite images and fieldwork in the region found that while *mestizos* have stopped entering the MITK, Banaka residents are now completely surrounded by *mestizo* settlements as colonists continue to push deeper into the Río Plátano (Hayes 2007a). A comparison of changing land use practices and norms in these two communities helps to explain why.

Data Gathering

Data were gathered from site visits during 2003–2006 in accordance with the International Forestry Resources and Institutions (IFRI) protocols. The IFRI is a validated framework to enable scholars to examine the impacts of diverse ways of owning and governing forests on protection and management activities and their consequences for forest condition (CIPEC 2004). In each reserve, I conducted individual and group interviews with a purposefully selected sample of indigenous leaders and residents, government officials and non-government personnel in the cultural zone of Río Plátano and in MITK, Bosawas. The interviews were semi-structured, and aimed to gather information on pre-policy responses to *mestizo* migration, the implementation of the reserve property-rights and management plans, and the current organisational and institutional activities of the Miskito peoples in each reserve. I also gathered archival data on reserve activities and the policy implementation processes.

In addition to the semi-structured interviews conducted at the regional level, in each case study community I conducted interviews and administered a structured questionnaire to households. I administered the questionnaire to approximately half of the total number of households in each community (twenty-four/fifty households in Banaka, and eight/twenty households in Pueblo Nuevo). The sample population was selected based on the geographic location of each house and gender.

The questionnaire aimed to compare the responses to *mestizos* made by individual Miskito households in each community and assess the robustness of their respective common-property systems. It was based upon previous interviews with Miskito elders and leaders about their land use customs and some of the challenges they perceived from *mestizo* migration. The questionnaire asked (1) if residents believed that their community was able to prevent *mestizos* from entering their lands; (2) about the resident's willingness to sell land to a *mestizo*; and (3) about the preference for communal forest lands or individual forest plots that prohibit communal use. As stated earlier, I consider the Miskito common-property system robust if residents continue to share access to the forest lands and refrain from land sales. Given the small size of the communities, and thus the relatively small number of questionnaire respondents, I further corroborate the questionnaire findings with interview responses from Miskito elders, community forest guards and community leaders.

FINDINGS

The following section describes (1) the pre-policy responses on the part of indigenous residents living in the cultural zone of Río Plátano and in MITK, Bosawas; (2) the policy changes implemented in each reserve in the mid-1990s; and (3) post-policy responses on the part of the Miskito. The post-policy responses examine the attitudes and activities of the Miskito residents living in the two case study communities: Banaka, Río Plátano, and Pueblo Nuevo, Bosawas.

Pre-policy: Miskito Responses to *Mestizo* Agricultural Expansion

In Río Plátano and Bosawas, the similarities between the Miskito residents' responses to the surge of migrants are striking. Upon learning of *mestizo* encroachment onto their homelands, the Miskito in both Río Plátano and Bosawas each organised to defend their lands, restrict land sales and exert their ancestral rights over the region.

In Río Plátano, in the late 1980s, when the Miskito began to realise that *mestizos* were moving onto their homelands, they created a region-wide organisation called the Land Vigilance Committee (Comite de Vigilancia de la Tierra). The Land Vigilance Committee worked with the indigenous association, Unity for the Mosquitia (MASTA), and the Honduran NGO, Agency for the Development of the Mosquitia (MOPAWI), to monitor outside intrusions, organise groups to tell outsiders that they were not welcome, and report any invasions to the authorities. In addition, the Land Vigilance Committee and MASTA explicitly forbade the native residents from selling land to *mestizos* and advocated for indigenous territorial rights to the region.

The Land Vigilance Committee organised sub-committees in approximately a dozen communities in the northern region of the cultural zone; one sub-committee was organised in the Miskito community, Banaka. The Banaka Land Vigilance Committee consisted of eight people who monitored the community's lands. While all monitoring activities were voluntary, MOPAWI supported the organisational development of the committee. Members of the original vigilance committee stated that the group was well organised and that whenever *mestizos* tried to enter, the group would inform them that they could not settle and would also inform MASTA and MOPAWI of their presence. In interviews, Banaka residents recalled that initially, the committee was successful in prohibiting *mestizos* from settling on surrounding lands, and several stated that, because of the early monitoring activities of the committee, Banaka remained predominantly Miskito.

In Bosawas, the indigenous residents responded to the *mestizo* migration in very similar ways to those in Río Plátano. In order to defend their lands from colonisation pressures, the Miskito and Mayangna of southwestern Bosawas joined forces to advocate for their rights to their lands. In 1993, the leaders from each group formed the indigenous organisation, Association for the Development and Progress of the Miskito and Mayangna Communities of Jinotega (ADEPCIMISUJIN). The goal of the group was to establish indigenous rights to their lands and defend them from *mestizo* colonisers. Centro Humboldt, an NGO in Managua, and two Nicaraguan politicians offered initial financial and legal support. Shortly thereafter, ADEPCIMISUJIN, with the help of TNC, also created rules that explicitly prohibited land sales to *mestizos* and organised forest guards to patrol their lands.

Policy Responses: Formal Institutional Changes

In Río Plátano, in the mid-1990s, the Honduran government responded to *mestizo* encroachment and the threats to the reserve by strengthening the Honduran Ministry of Forestry's management authority. The Ministry of Forestry received support from the German Bank of Reconstruction and Development and the German Society for Technical Cooperation. In 1997, the German and Honduran agencies created a joint organisation, The Biosphere Project, to develop a set of reserve policies that included a management plan to be administered by the Honduran Ministry of Forestry. The project began with a series of community meetings and land use mapping activities. Nevertheless, residents and reserve officials alike stated that the final plan (AFE-COHDEFOR 2000) did not include residents' rules, nor did it recognise any of the indigenous communities' initial conservation activities. The Ministry of Forestry's rules did explicitly prohibit new *mestizo* settlements after 1997, but the implementation of the plan did not include physical demarcation

of the indigenous lands or support for consistent monitoring.

In contrast to the focus on government management in Río Plátano, in Bosawas, TNC (and subsequently the Nicaraguan government) took a different approach to controlling *mestizo* agricultural expansion. TNC began by working with the indigenous residents to demarcate their lands and demand formal land rights from the Nicaraguan government. Under the guidance of Idaho State University professor Anthony Stocks, the process began with the indigenous communities mapping their territories (see Stocks 2003 for more details on the mapping process). The mapping was followed by physical demarcation along the frontiers most threatened by colonists, and TNC worked with ADEPCIMISUJIN to organise a group of forest guards to patrol the borders. Consultants also worked with the indigenous leaders and individual communities to create land use management plans and rules.

The demarcation process was highly contentious. Hearing of the indigenous plan to demand territorial property rights in Bosawas, the *mestizos* living in the buffer zone organised themselves to fight for *mestizo* land rights. Eventually, the *mestizo* and indigenous groups engaged in a series of negotiations that were facilitated by TNC and Centro Humboldt. In 1997, all parties agreed to and signed a set of accords that defined indigenous and *mestizo* property rights in the territories. Although the indigenous residents did not receive legal title until 2005, both *mestizos* and Miskito referred to the 1997 accords as ‘the law’ that created the indigenous territories.

Post-policy Responses: Robustness of Common-property Systems in Miskito Communities

In both Río Plátano and Bosawas, Miskito leaders made significant institutional changes to address *mestizo* expansion. First, they explicitly prohibited *mestizos* from settling on indigenous lands and organised groups to monitor their lands. Second, they prohibited land sales to *mestizos*.

As of 2006, the rules crafted by each indigenous association to maintain their land use customs and prohibit *mestizo* encroachment remained in place. The results from the case studies of resident attitudes toward *mestizo* encroachment and the respective land use strategies find, however, that post-policy intervention, many Miskito in Banaka, Río Plátano, no longer conformed to the common-property practices, and instead were adopting *mestizo* private-property institutions. In contrast, in Pueblo

Nuevo, Bosawas, the Miskito common-property system remained robust. The following findings highlight the differences between the two communities in Río Plátano and Bosawas with respect to attitudes toward community control of *mestizo* migration, participation in *mestizo* land sales and communal forest lands.

Community Perceptions of Ability to Control Mestizo Encroachment

As shown in Table 2, the Banaka residents were less likely than Pueblo Nuevo residents to believe that they could prevent *mestizo* encroachment. These results are further substantiated by the findings from interviews with members of the Banaka Land Vigilance Committee.

The Banaka residents’ responses reflect the difficulties that the community has encountered in monitoring their lands. Although Banaka had a successful Land Vigilance Committee in the early 1990s, the committee dissolved in 1997 after the Honduran Ministry of Forestry established its management plan for the reserve. Members of the original committee stated that with the onslaught of new colonists after the 1995 agricultural reform, they became frustrated and felt like they needed more support. When the Honduran Ministry of Forestry took over the reserve, they said they expected that the ministry would take over monitoring activities. It did not. In 2004, the ministry had two forest guards monitoring the cultural zone lands and in 2005–06 there were no guards in the zone.

The Banaka Land Vigilance Committee remained inoperative from approximately 1997 until 2004. In June 2004, MOPAWI and MASTA tried to re-invigorate the Banaka committee. As of 2006, however, the new vigilance committee was struggling to survive. In interviews, community residents and several members of the new committee expressed doubt about the ability to stop *mestizos* from settling. The committee president said that the group was unable to control *mestizo* encroachment due to lack of power and resources. He, like many other members, expressed frustration about the lack of support from the Ministry of Forestry. One member took out a list of GPS (Global Positioning System) coordinates he had sent to the Honduran Ministry of Forestry that showed new *mestizo* settlements. He complained that the ministry had yet to take action at any of the sites or follow-up on any complaint made by the committee.

Members listed a string of problems that included lack of pay and equipment, the danger in confronting *mestizos*, the inability to lose work days in their fields and indige-

Table 2
Community attitudes toward ability to control *mestizo* encroachment

Question	Response	Banaka, Río Plátano (n=24)	Pueblo Nuevo, Bosawas (n=8)
Can community prevent <i>mestizo</i> encroachment?	Yes	29%	88%
	No	71%	13%

nous land sales to *mestizos*. Others complained that without physical boundary markers and communal land titles, it was difficult to identify community lands and tell the *mestizos* they were invading.

In contrast to the pessimism expressed by the Miskito of Río Plátano, the Miskito of MITK, Bosawas, were generally confident that they could (and had) stopped *mestizo* expansion onto their lands. The respondents expressed confidence in the ability of ADEPCIMISUJIN and the forest guards to monitor their lands and enforce the land use rules created in 1997.

In Pueblo Nuevo, as in each community in MITK, two residents were selected to work as forest guards to monitor community activities and participate in the territorial boundary patrols. As of 2005, the guards continued to maintain the boundary clearings and monitor for *mestizo* encroachment as well as resident compliance with the territorial land management plan.

In the past, the guards were financially supported by TNC and as of 2005 they were funded primarily by the Nicaraguan NGO, Centro Humboldt. Several forest guards emphasised the importance of a stipend for their work and noted that they could not patrol for free.

The forest guards did not complain about their inability to prevent *mestizo* settlers from entering. They reported that, since the demarcation of the territorial boundary, they have had minimal problems with *mestizos*. If there are any disputes, they report the dispute to ADEPCIMISUJIN who investigates, works out the dispute with the *mestizos* and, when necessary, calls on Centro Humboldt to facilitate.

Adoption of Mestizo Private-property Institutions: Land Sales and Private Forests

Table 3 compares resident responses in Banaka and Pueblo Nuevo with respect to their willingness to sell land and desire to maintain their communal forests. The questionnaire responses and subsequent interview results illustrate how the different perceptions that residents held about their ability to prohibit *mestizo* encroachment influenced the strategies they adopted to defend their lands. In Banaka, where the majority had lost faith in their ability to defend their communal lands, many were adopting *mestizo* private-property institutions: engaging in land sales and demarcating individual, private forests.

Table 3 shows that a greater proportion of Miskito households in Banaka were willing to sell land than households in Pueblo Nuevo. In interviews, Banaka Land Vigilance Committee members cited land sales as one of the most difficult challenges to controlling *mestizo* expansion and they estimated that approximately ten Miskito families had sold land to *mestizos* in recent years. Although the land sales are illegal and counter to Miskito norms, several Banaka residents commented that the Miskito started to sell land because they saw others sell and not receive punishment. A hectare of land may sell for as low as 500 Honduran Lempira (approximately USD 26). Some noted, however, that, when emergencies arise or money is tight, land is often the only source of income. Others strongly criticised the land sales and complained that there was nothing they could do to stop their neighbours from selling.

In addition to being more willing to sell land, the Miskito of Banaka were much more likely to prefer individual forests than were those in Pueblo Nuevo. Given the growing uncertainty about continued access to forest, many Banaka residents said that they had adopted the *mestizo* custom of claiming forest land for individual use by marking trees and clearing boundaries. Although most residents agreed that it ran counter to Miskito customs, they said that by physically demarcating a forest they could ensure that no *mestizo* would invade and that a Miskito neighbour would not sell the land. Several Banaka residents recounted earlier times when they had gone up into the hillsides to cut mahogany for boats and found *mestizo* settlers restricting their access.

Whereas the customary common-property practices that maintained communal forests and prohibited land sales showed signs of deterioration in Banaka, those in Pueblo Nuevo, Bosawas, expressed support for their common-property practices and were resistant to land sales and the establishment of private forests. In interviews, land sales were strongly frowned upon by the Miskito of MITK and only one questionnaire respondent stated that he would consider selling land. All others responded that they would never sell land and that the indigenous residents living to the south outside of MITK had sold land to *mestizos* and now they were left with nothing.

In contrast to those in Banaka who stated that they had seen sales go unpunished, residents in Pueblo Nuevo said that it would be very difficult to sell land and not get

Table 3
Community adaptation strategies to mestizo encroachment

Question	Response	Banaka, Río Plátano (n=24)	Pueblo Nuevo, Bosawas (n=8)
Willing to sell land to <i>mestizo</i> ?	Yes	42%	13%
	No	58%	88%
Forest ownership preference?	Communal	8%	100%
	Individual	92%	0%

caught. In interviews, several Miskito in Pueblo Nuevo and *mestizos* living just south of MITK reported that a couple of years earlier, a Miskito had attempted to sell land to a *mestizo*. ADEPCIMISUJIN, however, learned about the sale and forfeited the transaction. The *mestizo* buyer was never permitted to occupy the land and he lost his money.

In Pueblo Nuevo residents stated that they were fairly confident that all complied with the land use rules created by the communities. All residents in Pueblo Nuevo preferred communal forest holdings and respondents argued that the forest was to be shared by all Miskito peoples. Residents did not express concern that *mestizos* would invade the forests or that their neighbours would sell land.

DISCUSSION:

IMPACTS OF INSTITUTIONAL INTERPLAY ON MISKITO COMMON-PROPERTY SYSTEMS

The results from Río Plátano and Bosawas illustrate two very different responses on the part of the Miskito people in reaction to *mestizo* encroachment. Despite the fact that the Miskito of Río Plátano and Bosawas both organised to defend their communal lands, in Banaka, Río Plátano, the Miskito common-property system is deteriorating whereas in Pueblo Nuevo, Bosawas, the Miskito common-property system remains robust. Why?

In Bosawas, the residents and leaders of MITK expressed great pride in their ability to defend their territory from *mestizo* settlers, their governing association and their recent acquisition of their territorial title. The peoples' ownership of their rules, rights and governance associations' points to a key ingredient in the success of Bosawas; residents believe that the land use rules, the forest guards and territorial association are their own creation and that they are legitimate governing mechanisms.

The initiative and success of the Miskito people is significant, nevertheless, we cannot overlook the influence that changes in the broader institutional environment, specifically the activities of external governmental agencies and NGOs, had on local rule-making and land use decisions. The impacts of the external actors and their respective policy processes on the legitimacy of Miskito institutions and the transaction costs of rule-making and monitoring further explains why the Miskito of Río Plátano struggle to defend their communal lands and retain their traditional land use customs, whereas the common-property system of the Miskito of Bosawas remains staunch.

Impact on Rule-making Legitimacy and the Creation of Credible Commitments

A principal difference between the Miskito of Río Plátano and those of Bosawas was whether their respec-

tive governments and the associated agencies working in the region recognised Miskito organisations and their rule-making authority. In her work on common-property resource management, Ostrom identifies external government recognition of resource users' minimal rights to organise as a key characteristic of successful arrangements (Ostrom 1990). Findings from Río Plátano and Bosawas suggest that, in Río Plátano, the Honduran government's disregard for the Miskito governance organisations and their right to make rules decreased the perceived legitimacy of Miskito governance associations and the likelihood that a rule would be enforced. This, in turn, made it all the more difficult for the Miskito of Río Plátano to form credible commitments to address *mestizo* encroachment.

Questionnaire results found that few Río Plátano residents had faith in their community's ability to monitor its lands, and their lack of confidence was further reinforced by the frustrations expressed by the Land Vigilance Committee about their inability to get their Miskito neighbours, *mestizos*, and the government to recognise their land use rules. Some Miskito leaders and non-governmental personnel argued that the new management plan squelched local institutions. Land Vigilance Committee members stated that when the Ministry of Forestry took over, they stopped monitoring and some Río Plátano residents contended that since the Ministry of Forestry owned the lands, there was no reason to comply with land use rules.

In contrast, in Bosawas, the Nicaraguan government recognised the Miskito governing bodies. Furthermore, the policy process implemented by TNC and Centro Humboldt created an environment whereby the Miskito people were perceived to be legitimate rule makers with the authority to enforce their land use regulations. TNC started by working with the indigenous residents to support and further define their property rights and land use rules. This process recognised Miskito decision-making authority, and eventually included *mestizos* in the creation of a property-rights agreement that was perceived to be binding.

Impact on Costs of Rule-making, Monitoring and Enforcement

As stated, the transaction costs in rule-making can be prohibitive. Interviews with Miskito leaders and residents highlighted the difficulties in gathering information on Miskito land rights, negotiating rules to address *mestizo* expansion, and monitoring and enforcing those rules. Table 4 summarises some of the principal costs incurred in collective rule-making in the Mosquitia. The Miskito in Río Plátano and Bosawas faced similar rule-making costs, nonetheless, they differed in the support they received to cover those expenditures.

Although the Biosphere Project initially engaged the Miskito residents in discussions about their land use pref-

erences, the discussions did not go beyond rough drafts of ideas and, ultimately, the project did not invest resources in working with the Miskito to negotiate and develop their land use rules, or to monitor and enforce the communities' forests. In contrast, in Bosawas, external agencies invested technology, personnel and money to facilitate Miskito rule-making, monitoring and enforcement.

First, TNC supplied technical and financial resources to map the indigenous territorial boundaries using GPS units, gather census data and create territorial land use plans. At a later date, Centro Humboldt helped the indigenous leaders compile all of the information necessary to obtain their territorial titles.

Second, in Bosawas, both TNC and Centro Humboldt were vital to the negotiation process. The external agencies covered costs of attending meetings and mediating conflicts. This was no small endeavour as the initial property-rights agreement was extremely contentious. Centro Humboldt provided lawyers to facilitate the original agreements and as of 2006, Centro Humboldt continued to maintain the accords by serving as a facilitator when conflicts emerged between the indigenous residents and the *mestizos*.

Lastly, a key component of the Bosawas process was that external agencies covered critical monitoring and enforcement costs. In addition to physically demarcating the territories, TNC also worked with ADEPCIMISUJIN to organise and capacitate a group of forest guards to monitor land use within the communities and undertake monthly patrols of the territorial boundaries. The forest guards were trained, equipped and paid by external agencies. This, combined with the authority to monitor and enforce the rules, reduced the risk of non-compliance and created an atmosphere where maintaining the Miskito common-property system was an effective strategy in response to *mestizo* expansion.

Table 4

Transaction costs in common-property rule-making in the Mosquitia

<p>Negotiation</p> <ul style="list-style-type: none"> • Arrange and attend meetings with actors (<i>mestizos</i>, indigenous residents and government personnel). • Agree on territorial boundaries, access rules, land use rules etc. Note that this may involve a substantial amount of conflict and risk due to volatile attitudes with respect to land rights. • Create and maintain conflict resolution mechanisms. • Attend government meetings to lobby for rights. <p>Information</p> <ul style="list-style-type: none"> • Gather information to define location of territorial/community boundaries and census of people living within them. • Gather information on current land use practices and monitor land use changes. <p>Monitoring</p> <ul style="list-style-type: none"> • Organise forest guards and actively monitor boundaries and land use rules. <p>Enforcement</p> <ul style="list-style-type: none"> • Apply sanctions.

CONCLUSIONS

This study aimed to identify how the Miskito adapted to *mestizo* expansion, determine the impact of the broader protected area policies on the adaptation strategies and finally, to assess the robustness of the Miskito common-property system. The findings from this comparative study are that indigenous peoples can and do change their common-property systems in response to market and demographic pressures introduced by *mestizo* agricultural expansion. How they change, however, may be significantly influenced by the broader institutional environment. In the case of the Mosquitia, the Miskito adaptation strategies and the resultant robustness of their common-property system, were impacted by how the reserve policies, implemented in the 1990s by national governments and the associated governmental and non-governmental agencies, influenced the costs of collective rule-making and the likelihood that Miskito rules would be respected.

In Río Plátano, the interaction between the formal policy instruments and the Miskito institutions produced an environment where residents perceived it unlikely that their communal forests would be effectively monitored and protected. Rather than risk time, money, land and one's personal safety in creating common-property rules and defending the communal forests, many residents were choosing to participate in land sales and adopt the *mestizo* private-property institutions in order to obtain economic benefits while securing their lands. Given the difficulties in rule-making, the lack of enforcement mechanisms and overall environment of non-compliance, the shift away from the common-property systems in favour of private-property institutions is not surprising.

The study finds, however, that Miskito common-property institutions do not necessarily collapse when confronted with *mestizo* markets and private-property institutions. Findings from Bosawas demonstrate how the Miskito can successfully adapt to *mestizo* migration and still maintain the core characteristics of their common-property system: inalienable rights to shared forest resources. The findings also illustrate how the broader reserve policies and processes complimented Miskito strategies to bolster their common-property system by recognising Miskito rule-making rights and by covering critical costs in collective rule-making.

The study findings compliment the broader land cover studies in the region (Hayes 2007a; Stocks *et al.* 2007; Hayes & Murtinho in press) by identifying how institutional dynamics in the communities have either contributed to, or prohibited, continued *mestizo* migration in the region. The study also highlights some of the challenges traditional resource users may face in trying to make new rules to address external disturbances and the ways in which external agents and the broader institutional environment may mitigate some of these obstacles.

This study demonstrates that we cannot ignore the broader institutional environment that common-property systems are nested within, and that specific interactions between local resource users and external actors may be critical in contributing to the design of robust traditional governance systems for social-ecological systems. As shown in Table 4, external support may be needed to gather information about the social and ecological dimensions and characteristics of a particular social-ecological system, negotiate new rules, monitor rules and apply enforcement mechanisms. As traditional governance systems become incorporated into broader political systems, external support may also be needed to enhance the legitimacy of existent traditional institutions and recognise the right of local decision makers to make new rules to address changing conditions. The findings suggest that external actors wishing to contribute to the robustness of common-property institutions should pay attention to the transaction costs involved in collectively decided institutional changes and identify ways in which they can ameliorate some of these costs. In this way, institutional interplay may provide significant opportunities to conserve frontier forests and enhance the ability of traditional peoples to cope with future disturbances and uncertainties.

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Note

1. In Bosawas, 8000 sq km constitutes the six indigenous territories that make up the core zone of the reserve. It does not include the buffer zone that was later added. Total area of the reserve including the buffer is approximately 20,000 sq km.

REFERENCES

- Adger, W.N., K. Brown and E.L. Tompkins 2005. The Political Economy of Cross-scale Networks in Resource Co-management. *Ecology and Society* 10(2): 9.
- AFE-COHDEFOR (Honduran Ministry of Forestry). 2000. Plan de Manejo Reserva del Hombre la Biosfera del Río Plátano. Proyecto Manejo y Protección de la Biosfera del Río Plátano, Tegucigalpa, Honduras.
- Anderies, J.M., M. Janssen and E. Ostrom. 2004. A Framework to Analyze the Robustness of Social-ecological Systems from an Institutional Perspective. *Ecology and Society* 9(1): 18.
- Berkes, F. 2001. Cross-scale Institutional Linkages: Perspectives from the Bottom-up. In: *The Drama of the Commons* (eds. E. Ostrom, T. Dietz, N. Dolšak *et al.*), pp. 293–321. National Academy Press, Washington DC, USA.
- Berkes, F., J. Colding and J. Folke. (eds). 2003. *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press, Cambridge, UK.
- Bremner, J. and F. Lu. 2006. Common Property among Indigenous Peoples of the Ecuadorian Amazon. *Conservation and Society* 4(4): 499–521.
- Bryant, D., D. Nielsen and L. Tanglely. 1997. *The Last Frontier Forests: Ecosystems and Economies on the Edge*. World Resources Institute, Washington, DC, USA.
- Cardenas, J.C., J. Stranlund and C. Willis. 2000. Local Environmental Control and Institutional Crowding Out. *World Development* 28(10): 1719–1733.
- Carlson, J.M. and J. Doyle. 2002. Complexity and Robustness. *Proceedings of the National Academy of Sciences* 99(1): 2538–2545.
- Cash, D.W., W.N. Adger, F. Berkes *et al.* 2006. Scale and Cross-scale Dynamics: Governance and Information in a Multilevel World. *Ecology and Society* 11(2): 8.
- CIPEC (Center for the Study of Institutions, Population and Environmental Change). 2004. *International Forestry Resources and Institutions Research Program Field Manual*. Indiana, USA.
- Cupples, J. 1992. Ownership and Privatization in Post-revolutionary Nicaragua. *Bulletin of Latin American Research* 11(3): 295–306.
- Dietz, T., E. Ostrom and P. Stern. 2003. The Struggle to Govern the Commons. *Science* 302: 1907–1912.
- Dodds, D. 1994. *The Ecological and Social Sustainability of the Miskito Subsistence in the Río Plátano Biosphere Reserve, Honduras: The Cultural Ecology of Swidden Agriculturalists in a Protected Area*. Ph.D. thesis. University of California, Los Angeles, USA.
- Ensminger, J. and J. Knight. 1997. Changing Social Norms: Common Property, Bridewealth and Clan Exogamy. *Current Anthropology* 38(1): 1–24.
- Geist, H. and E. Lambin. 2001. What Drives Tropical Deforestation? A Meta-analysis of Approximate and Underlying Causes of Deforestation Based on Subnational Case Study Evidence. Lucc Report Series. Lucc International Project Office, Louvain-la-Neuve, Belgium.
- Grosvenor, G.M., A.R. de Souza, M. Chapin *et al.* 1992. The Coexistence of Indigenous Peoples and the Natural Environment in Central America: A Special Map Supplement to Research and Exploration. National Geographic Society, Washington DC, USA.
- Hayes, T.M. 2007a. Does Tenure Matter? A Comparative Analysis of Agricultural Expansion in the Mosquitia Forest Corridor. *Human Ecology* 35(6): 733–247.
- Hayes, T.M. 2007b. *Forest Governance in a Frontier: An Analysis of the Dynamic Interplay Between Property Rights, Land-use Norms and Agricultural Expansion in the Mosquitia Forest Corridor of Honduras and Nicaragua*. Ph.D. thesis. Indiana University, Bloomington, USA.
- Hayes, T.M. and F. Murtinho. (in press). Are Indigenous Forest Reserves Sustainable? An Analysis of Present and Future Land-use Trends in Bosawas, Nicaragua. *International Journal of Sustainable Development and World Ecology*.
- Herlihy, P. 1997. Indigenous Peoples and Biosphere Reserve Conservation in the Mosquitia Rainforest Corridor, Honduras. In: *Conserva-*

- tion Through Cultural Survival (ed. S. Stevens), pp. 99–129. Island Press, Washington DC, USA.
- Holling, C.S. 1973. Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics* 4: 1–23.
- House, P. 1997. Forest Farmers: A Case Study of Traditional Shifting Cultivation in Honduras, Network Paper 21a. Overseas Development Institute, Rural Development Forestry Network, London, UK.
- House, P., A. Padilla, O. Munguia *et al.* 2002. Diagnostico Ambiental: Reserva del Hombre y la Biosfera del Río Plátano. MOPAWI, AFE-COHDEFOR, UNAH & TNC, Tegucigalpa, Honduras.
- Hurtado de Mendoza, L. 2001. Migración Mestiza en BOSAWAS. *Wani* 26: 36–45.
- IUCN/ORMA (International Union for the Conservation of Nature/Regional Office for Mesoamerica) 1995. *Resumen Ejecutivo el Estado de Conservación de la Reserva a de Biosfera Río Plátano*. IUCN, Tegucigalpa, Honduras.
- Knight, J. 1992. *Institutions and Social Conflict*. Cambridge University Press, Cambridge, UK.
- Messen, A. 1995. Expectativas Creadas por la Declaración de Zona de Reforma Agraria de los Valles Sico-Paulaya. Presented at the offices of the United States Information Service, Tegucigalpa, Honduras, 1995.
- Miller, K., E. Chang and N. Johnson. 2001. Defining Common Ground for the Mesoamerican Biological Corridor. World Resources Institute, Washington DC, USA.
- Nepstad, D., S. Schwartzman, B. Bamberger *et al.* 2006. Inhibition of Amazon Deforestation and Fire by Parks and Indigenous Lands. *Conservation Biology* 20(1): 65–73.
- North, D. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge University Press, New York, USA.
- Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, New York, USA.
- Ostrom, E. 2005. *Institutional Diversity*. Princeton University Press, Princeton, USA.
- Ostrom, E. 2007. A Diagnostic Approach for Going Beyond Panaceas. *Proceedings of the National Academy of Sciences* 104(39): 15181–15187.
- PBRP (Proyecto Manejo y Protección de la Biosfera Río Plátano). 1997/98. Río Plátano Biosphere Census. Author, Tegucigalpa, Honduras.
- Putz, F.E., G.M. Blate, K. Redford *et al.* 2001. Tropical Forest Management and Conservation of Biodiversity: An Overview. *Conservation Biology* 15(1): 7–20.
- Redford, K.H. 1991. The Ecologically Noble Savage. *Cultural Survival Quarterly* 15(1): 46–48.
- Redford, K.H. and A.M. Stearman. 1993. Forest-dwelling Native Amazonians and the Conservation of Biodiversity: Interests in Common or Collusion? *Conservation Biology* 7(2): 248–255.
- Richards, M. 1997. Common Property Resource Institutions and Forest Management in Latin America. *Development and Change* 28(1): 95–117.
- Rudel, T.K., D. Bates and R. Machinguiasli. 2002. Ecologically Noble Amerindians? Cattle Ranching and Cash Cropping among Shuar and Colonists in Ecuador. *Latin American Research Review* 37(1): 144–160.
- Schwartzman, S. and B. Zimmerman 2005. Conservation Alliances with Indigenous Peoples of the Amazon. *Conservation Biology* 19(3): 721–727.
- Shadish, W.R., T.D. Cook and D.T. Campbell. 2002. *Experimental and Quasi-experimental Designs for Generalized Causal Inference*. Houghton Mifflin Company, Boston, USA.
- Smit, B. and J. Wandel. 2006. Adaptation, Adaptive Capacity, Vulnerability. *Global Environmental Change* 16: 282–292.
- Snidal, D. 1994. The Politics of Scope: Endogenous Actors, Heterogeneity and Institutions. *Journal of Theoretical Politics* 6(4): 449–472.
- Stevens, S. 1997. New Alliances for Conservation. In: *Conservation Through Cultural Survival* (ed. S. Stevens), pp. 33–62. Island Press, Washington DC, USA.
- Stocks, A. 1996. The Bosawas Natural Reserve and the Mayangna of Nicaragua. In: *Traditional Peoples and Biodiversity Conservation in Large Tropical Landscapes* (eds. K. Redford and J. Mansour), pp. 1–30. America Verde Publications, Washington DC, USA.
- Stocks, A. 1998. Indigenous and Mestizo settlements in Nicaragua's Bosawas Reserve: The Prospects for Sustainability. Presented at the Annual Meeting of the Latin American Studies Association, Chicago, USA. 24–26 September 1998.
- Stocks, A. 2003. Mapping Dreams in Nicaragua's Bosawas Reserve. *Human Organization* 62(4): 344–356.
- Stocks, A., B. McMahan and P. Taber. 2007. Indigenous, Colonist and Government Impacts on Nicaragua's Bosawas Reserve. *Conservation Biology* 21(6): 1495–1505.
- Terborgh, J. 2000. The Fate of Tropical Forests: A Matter of Stewardship. *Conservation Biology* 14(5): 1358–1361.
- TNC (The Nature Conservancy) 1997. Miskitu Indian Tasbaika Kum: Historia y Situación Actual de las Comunidades Miskitas del Alto Coco. Author, Arlington, Virginia, USA.
- UNESCO-MAB (United Nations Educational, Scientific and Cultural Organization-Man and Biosphere Program). 1999. UNESCO-MAB Biosphere Reserves Directory. URL: <http://www2.unesco.org/mab/br/brdir/directory/biores.asp?code=NIC+01&mode=all> (accessed April 2008).
- Walker, B.H., D. Ludwig, C.S. Holling *et al.* 1981. Stability of Semi-arid Savanna Grazing Systems. *Journal of Ecology* 69: 473–498.
- Young, O. 2006. Vertical Interplay among Scale-dependent Environmental and Resource Regimes. *Ecology and Society* 11(1): 27.
- Young, O., F. Berkhout, G.C. Gallopin *et al.* 2006. The Globalization of Socio-ecological Systems: An Agenda for Scientific Research. *Global Environmental Change* 16: 304–316.

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