**Abstract**

The effectiveness of protected areas at achieving nature conservation goals varies widely, but the reasons for this variation are understudied. We argue that an important, but often neglected, factor is the history of institutional development that pre-dates protected area establishment. Through a comparative analysis of pathways of institutional development in Calakmul and Maya Biosphere Reserves, internationally adjoining protected areas in Mexico and Guatemala, we demonstrate that differences in farmer and community-level conservation behavior between the two reserves are the result of differences in land tenure systems that pre-date reserve establishment. Differences in land tenure systems resulted in a lower population density, greater tenure security, and greater economic and political equality in the Calakmul Biosphere Reserve. All of these factors influenced farmers and communities in the Calakmul Biosphere Reserve to have more favorable attitudes towards conservation, conserve more forest on both individual and community managed land, and to create more conservation reserves on both land types. These differences are rooted in the system of land distribution and political organization during the 1970s and 1980s, before protected area establishment, when both areas were agricultural frontiers. As a result of these political processes that pre-date reserve creation, farmers and communities in Calakmul hold more land and hold it more equitably, have less access to surplus labor for expanding commercial production, and have a political system that shares benefits from forest conservation more equitably when compared to Maya. Our work highlights the value of understanding historical political and institutional conditions in the design and development of effective protected areas. Protected areas located in areas with greater economic and political equality may be more effective at conserving nature.

**Highlights**

* Differential effectiveness of protected areas is the result of preexisting political and economic conditions
* Protected areas which have greater levels of economic and political equality may be more effective at nature conservation.
* Developing effective conservation plans requires understanding the historical development of local political institutions

**Keywords**

**Protected areas; conservation; governance; institutions; Mexico; Guatemala**

**1. INTRODUCTION**

A growing body of evidence demonstrates that many protected areas are not effective at protecting the ecosystems within their borders, and some are merely “paper parks” (Andam et al., 2013; Andam et al., 2008; Andam et al., 2010; Bhola et al., 2016; Brandon et al., 1998; Bruner et al., 2001; Hayes, 2006; Hayes and Ostrom, 2005; Laurance et al., 2012; Naughton-Treves et al., 2005; Porter-Bolland et al., 2012; Ruiz-Mallén et al., 2015). Recent attempts to analyze the reasons for the success or failure of protected areas are limited. Government protected area managers report that they lack sufficient funding and are hampered by broader governance failures within the societies they operate (Bruner et al., 2001; Di Minin and Toivonen, 2015; Leverington et al., 2010; Watson et al., 2014). But the effectiveness of protected areas varies even when political and economic conditions appear constant, implying that this answer is at best incomplete. Yet, while there is extensive analysis of the biophysical gaps in protected areas (Diamond, 1975; Pimm et al., 2014; Venter et al., 2014), there is to date little detailed analysis of the reasons why some protected areas are more effective than others at protecting the resources within their boundaries (Ban et al., 2013). Given frequent calls by conservationists and policy mandates from international bodies to increase protected areas around the world (Bhola et al., 2016; Convention on Biological Diversity, 2011; Wilson, 2017; Xu et al., 2017), and widespread evidence that protected areas can have negative consequences for people living in or near them (West et al., 2006), it is imperative that conservationists develop a stronger understanding of the factors that influence protected areas’ ability to achieve their goals.

This paper utilizes a case study of an ecologically and culturally important set of adjoining protected areas, the Calakmul and Maya Biosphere Reserves, to examine the causal processes that lead to contrasting protected area outcomes. Together these two Biosphere Reserves are called The Maya Forest of Mexico and Guatemala. We argue that the effectiveness of these protected areas is influenced by institutional legacies that pre-date protected area formation. In our case, differences in the processes of frontier settlement and granting of formal and informal land rights play a strong role in influencing the relationship between protected areas and land users within the protected area boundaries. As a result of a clearer and more equitable distribution of land on the Mexican side of the border, where a strong system of collective property ownership has been consistently supported by state institutions, farmers there engage in more conservation activities on their own land than farmers on the Guatemalan side. Contrasting with Mexico’s common land property, in Guatemala land is owned privately and under one of the most unequal land distribution system in the continent (Sundberg, 2003). Communities on the Guatemalan study area lack the political organization commonly found in Mexico, which supports collective action and empowers individuals.

Our argument in this paper has important practical implications. We argue that institutional legacies, of the kind that influence the effectiveness of protected areas in the Mayan forest, are potentially visible to protected area designers, and should thus be taken into account alongside biophysical and economic concerns in the creation of protected areas. If regions where people possess more secure property rights, property is more equitably distributed, and political processes are more representative are more likely to be well protected, then protected area designers can increase the efficacy of protected areas by locating new protected areas in places which already have supportive institutional contexts. Protected area managers in areas lacking these conditions may also be able to improve the effectiveness of their management by helping secure property rights and increase political representation and economic equality for those living in or near the protected area. The evidence from Calakmul, and from successful conservation efforts in parts of the Maya, indicate that collective property ownership may be a particularly effective way of supporting greater equality, democratic participation, and conservation effort on the part of protected area residents, particularly when it receives institutional support from protected area managers and other elements of the government. This is in direct contrast to policies in many protected areas, where emphasis is placed on undermining the property rights of resident households and communities, with the goal of depopulating the protected area in favor of land claims of the central state. The land tenure systems that contributed to greater economic and political equality in the Calakmul Biosphere Reserve in Mexico also contributed to more conservation oriented farmer-level behavior. Our work thus supports recent studies that find that examining social data might significantly change the placement of protected areas (Karimi et al., 2017), and that there is a relationship between economic inequality, political representation, and the designation of protected areas (Kashwan, 2017b).

Our argument also has important theoretical implications for those who study the role of institutions in human-environment relations. While there is a large literature applying institutional approaches to understand conservation outcomes (Cox et al., 2016; Fleischman et al., 2014; Poteete et al., 2010; Tucker, 2010), much of it focuses on static analyses of institutional settings during one or two time snapshots. Our argument shows that long-term trajectories of historical development matter in determining conservation outcomes, and thus lends support to greater application of institutional approaches that complement rational choice with historical institutionalism (Hall and Taylor, 1996), and more broadly, of the importance of historical analysis in contemporary environmental policy (Castree, 2017). This argument is consistent with broader calls for developing a political economy of institutions approach for analyzing human-environment relations (Kashwan, 2017a).

* 1. **Institutional Legacies and human behavior**

Many environmental social scientists are familiar with the analysis of institutions in the study of collective action (Cox et al., 2016; Ostrom, 1990; Poteete et al., 2010), but may be less familiar with other institutional research traditions. The well-known collective action studies of Ostrom and others built on the bounded rational choice framework developed in political science and economics in the 1970s and 1980s (Ostrom, 2007; Ostrom et al., 1994). In particular, this research called into question earlier studies that used a narrow view of rationality to argue that cooperative behavior should not occur (Olson, 1965), by showing that under conditions in which actors were able to communicate, sanction, and interact repeatedly, cooperation was in fact rational (Henrich et al., 2004; Ostrom et al., 1994), and could be reinforced through institutional constraints (Ostrom, 1990). In this bounded rational choice institutionalism, institutions are seen as “the rules of the game,” and individual behavior is conceptualized in game theoretic terms of strategic interaction, with an understanding that human cognition is subject to limitations that prevent humans from behaving as the strict rational calculators of earlier rational choice theories (Jones, 2001; Kahneman, 2011; North, 1990; Ostrom, 2005).

While not necessarily disagreeing with a game theoretic view of strategic interaction, historical institutionalists, at least within political science (Hall and Taylor, 1996), tend to be less concerned with explaining individual behavior than with explaining large-scale political patterns that emerge over long time frames (Pierson, 2003). Such patterns emerge not merely through strategic interaction between individual actors, but through path dependence, wherein choices made at one time constrain choices further down the line (Arthur, 1994; Pierson, 2000). Furthermore, historical institutionalists in political science emphasize the way that institutional path dependence is shaped by the way institutions shape political alliances and movements that further constrain – or enable – future choices (Carpenter, 2001; Evans et al., 1985; Skocpol et al., 2000). The emphasis in this literature is on institutions as “the formal or informal procedures, routines, norms and conventions embedded in the organizational structure of the polity or political economy” (Hall and Taylor, 1996).

While historical institutionalism has been less widely applied to the study of human-environment interactions, its applications show that it can be a powerful tool for understanding conservation related outcomes. For example, Kashwan (2017a) points to long trajectories of colonial and post-colonial politics to explain the existence of greater democratic control of conservation in Mexico relative to India and Tanzania. While individual events – such as the decision to make land redistribution central to efforts to build political power in Mexico during the Great Depression – can be explained using the game theoretic approaches popular among rational choice institutionalists, the overall outcome – strong community control over forests throughout Mexico today – was built not only on this one decision, but also on the earlier foundation of the Mexican revolution, which redistributed political power among elite coalitions – and also much later when, in the 1980s, economic restructuring led the Mexican state to terminate forest concessions and redistribute forest management rights to forest-owning communities (who held political power as a result of agrarian reforms initiated in the wake of the revolution). Along similar lines, Schoon (2013) compares two transboundary protected areas in southern Africa to show how an initial bottom-up approach to international cooperation has enabled much more effective ground-level coordination when compared to a top-down approach. In short, in the view of historical institutionalists, it is the pathways of institutional change, often borne through decades of political conflict, that explain current institutional conditions.

**1.2 Empirical studies of protected area effectiveness**

 In contrast to the views of institutionalists who emphasize strategic interactions, institutional constraints, and over-time development, scholars examining the efficacy of protected areas in protecting resources within their boundaries have primarily used cross sectional research designs to identify correlations between management effectiveness and other factors. Several studies have collected survey data from protected area managers or local experts (Bruner et al., 2001; Laurance et al., 2012), or collated self-studies of protected area management and effectiveness (Coad et al., 2015; Gill et al., 2017; Leverington et al., 2010). These studies report that consistent and high levels of funding and active on-the-ground enforcement activity correlate with better outcomes. The findings on the importance of local enforcement from survey data are consistent with research on forest conservation at the community level (Chhatre and Agrawal, 2008; Coleman, 2009; Gibson et al., 2005; Wright et al., 2016), as well as in large marine protected areas (Ban et al., 2017), however government protected areas may be no better protected than areas conserved by local communities (Hayes, 2006; Porter-Bolland et al., 2012). Local involvement in governance also positively affects outcomes (Persha et al., 2011). Some studies point to biophysical factors, such as large spatial extent and isolation as complements to enforcement (Chhatre and Agrawal, 2009; Edgar et al., 2014).

 For the purpose of understanding why some protected areas work better than others, these studies have limitations. Official self-reports, as used by Bruner et al. (2001), Leverington et al. (2010), and others, are likely to be biased, since officials are more likely to report positive results about their work, and are also likely to report that they could do more with more funding, regardless of current funding (Meier and O’Toole, 2013). Studies conducted at the community level report more reliable indicators of management success, such as forest conditions as measured by independent researchers (Coleman et al., 2011). However, community level studies focus at a small spatial scale and on settled communities as opposed to agricultural frontiers, and thus it is not clear how findings from such studies apply to larger landscapes with remote areas that are lightly used by surrounding communities, as are present in many protected areas. Furthermore, while cross sectional designs can locate correlations between factors such as funding, enforcement, community involvement or isolation, they cannot establish causality (George and Bennett, 2005). If isolation or local involvement is correlated with better protection, is isolation or local involvement a product of protected designations, or vice versa? These are fundamentally questions about historical development. Historical explanations are at the core of many forms of causal arguments accepted in the social sciences (Beach and Pedersen, 2016), and thus their absence from this literature is a major oversight.

**2. BACKGROUND: THE MAYA FOREST**

Calakmul & Maya Biosphere Reserves cover lands that were settled and then abandoned during the collapse of the Classic Maya civilization, approximately 900 CE. Calakmul is located in Southern Campeche, Mexico and Maya in northern Petén, Guatemala. These protected areas compose an ecological unit called Selva Maya, extending over 28,833 square kilometers straddling the Mexico-Guatemala border (Primack et al., 1997), and provide a biological corridor linking Mexico and Central America (CONAP, 2001b; INE, 1999). The Selva Maya is a conservation hot spot covered with old growth tropical forest that was reestablished over approximately 1000 years of scant land use change following the Mayan collapse around AD 800-1000 (CI, 2012; Klepeis and Turner, 2001; Turner et al., 2003).

From 900 CE until the 1970s, human uses in the Maya forest were largely confined to extraction of timber and non-timber forest products with minimal deforestation (Schwartz, 1987; Turner et al., 2004). To fulfill land demands and protect their frontiers both governments encouraged migration to the Selva Maya beginning in the late 1960s (Ponciano, 1997; Sundberg, 1998). Encouraged by the opportunity of getting land, indigenous and non-indigenous people from different regions within Mexico (Calakmul, 2012) and Guatemala (Grandia, 2009; Ybarra et al., 2012), migrated to the region, leading to widespread deforestation.

In the late 1980s deforestation came to the attention of national and international organizations and both countries designated biosphere reserves (Bray and Klepeis, 2005). In 1989 the Calakmul Biosphere Reserve was created to protect 7,231 KM2, representing 0.003% of Mexico’s territory and 14% of Campeche State (CONANP, 2000). In 1990 the Maya Biosphere Reserve was established protecting 21,129.40 KM2. Maya represents ~20% of Guatemala’s surface and ~63% of Petén’s (CONAP, 2001b). Despite this protection, the conservation of this forested region and continuous production of ecosystem services is uncertain as land use change continues in both sides of the border (Alonso-Fradejas, 2015; Ellis et al., 2017a; Ellis et al., 2017b; Escalón, 2017; Jordan et al., 2015; Monzón-Alvarado et al., 2012; Rodriguez Solórzano, 2014; Steven et al., 2017).

The Maya Biosphere Reserve in Guatemala is divided into nucleus, multiple use and buffer zones, under the coordination of the National Council of Protected Areas (CONAP). The nucleus zone consists of several independent national parks. While some national parks have stable land cover, others have seen dramatic loss of forest since designation (Escalón, 2017). The multiple use zone is subdivided into several forest concessions, some of which are community managed. Concession holders extract timber and non-timber forest products, but are not permitted to engage in agriculture inside of the concession. The Association of Forest Communities from Petén (ACOFOP) represents the common interests of the community forest concessions. As with the national parks, some concessions have been more successful than others in preventing land use change. Local communities inhabit the buffer zone, which has also seen heavy deforestation. Some communities have members participating in the forest concessions on the east side of the Maya Biosphere Reserve, but most inhabitants of the buffer zone are not involved with the concessions.

The smaller Calakmul biosphere in Mexico is divided into a nucleus and buffer zone; it does not have a multiple use zone. The National Commission of Protected Areas (CONANP) manages the nucleus zone. The buffer zone is inhabited and managed by local communities. The Calakmul biosphere reserve is managed through a single administrative unit. Although land cover in the nucleus zone has been fairly stable, the buffer zone has experienced large land use change derived from the expansion of subsistence and commercial agriculture, agricultural subsidies and more recently small scale cattle ranching (Busch and Vance, 2011; Chowdhury, 2006, 2007; Keys, 2004).

**3. METHODS**

**3.1 Data Collection**

From August 2007 to August 2009 the first author conducted field research in 46 randomly selected communities, 30 from Calakmul and 16 from Maya. The communities studied in Calakmul are in the buffer zone, except for two with some land falling within the core zone. Communities in Maya are spread among the buffer zone, multiple use zone and some have some land within national parks. Figure 1 shows the approximate location of these communities.

In each community the first author interviewed three types of community members: 1) formal community authorities; 2) key informants, such as community leaders; 3) randomly selected heads of households – a total of 353 interviewees. All interviewees provided information about the demographic, economic, and ecological characteristics of their family and land. Interviewees provided information about their household, in addition to in depth knowledge about the institutions and governance operating at the community and biosphere reserve level. The data collected during the interviews enable both quantitative and qualitative analysis of conservation actions and the governance and institutional factors influencing farmers’ behavior. Since all of them work in agriculture we will refer to this group as farmers in this paper. The first author also interviewed 53 people representing councils, forest concessions, governmental, non-governmental, and donor organizations associated with conservation, social welfare and rural development goals in both biosphere reserves. These organizations represented the biosphere reserves, as well as municipal, state and federal governments. These interviewees provided in depth knowledge related to the institutions defining the participation mechanisms available in each biosphere reserve. The first author also observed councils operating at the community, region, municipality, and biosphere reserve level. Follow-up interviews were performed during revisits to Calakmul in 2014 and 2015, and Maya in 2016.

**Figure 1: Calakmul & Maya Biosphere Reserves**

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**3.2 Measuring conservation outcomes**

 Just as protected areas may be established to achieve multiple goals, there are many potential measures of the effectiveness of protected areas. We focus on one measure of effectiveness in our analysis: the conservation behavior of individual farmers. Farmers and communities in this region possess de facto rights to make management decisions over modest areas of land (typically ranging from 20-300 hectares for individual farmers, ranging up to tens of thousands of hectares for the larger communities). Farmers and communities may choose to deforest these lands to provide room for pastures, permanent fields, or swidden cultivation, or they may choose to maintain them in forest in order to hold them in reserve for the future and/or for the harvesting of various forest products, such as timber, honey, or wild meat. Based on data farmers provided, conservation outcomes are measured at the farmer and community level. At the farmer level we used three indicators to assess conservation behavior: 1) *farmers’ willingness to conserve*: farmer’s stated willingness to conserve old growth forest without receiving economic compensation (0=none to 3=high), 2) *farmers’ reserve*: farmers’ voluntary creation of a designated forest reserve within their plot (yes/no) and 3) *farmers’ forest*: percentage of farmers’ plot covered with old growth forest (number of hectares covered with old growth forest/ plot total number of hectares). While the first indicator is only an expression of conservation commitment, the second and third indicators are indicators of conservation behavior, that show whether people conserve or not. Together these three indicators provide a good sense of farmers’ position towards forest conservation. Although self-reports of area cleared may be biased, the absence of cadastral surveys in most of this region make obtaining independent estimates of land clearing by individuals prohibitively expensive and, given the presence of illegal activities in parts of the region (Steven et al., 2017), potentially dangerous.

At the community level we measured conservation outcomes using 2 indicators: 1) *community forest*: percentage of the community covered with old growth forest, and 2) *community reserve*: community creation of a formal forest reserve within community land. Community forest was estimated based on the perception of households of the number of hectares of old growth forest remaining in the community. Every interviewee was asked to estimate the number of hectares covered with old-growth forest in the community and the percentage of the community land that has been cleared. Farmers also reported the presence or absence of a community forest reserve and the state of the community forest reserve -consolidated or in progress. Relying on farmer’s estimates was the best assessment of conservation area available and the answers provided by farmers were similar, which allows using an average of their answers with confidence about the reliability of the data.

Using multiple indicators for conservation commitment at the farmer and community level, as well as using actual conservation outcomes at the individual and community level helps to crosscheck the consistency of farmers’ answers. For instance, there could be contradiction between conservation actions and revealed willingness to conserve. This could be the case when people are conserving forest and yet say they are not willing to conserve because they wish to receive compensation for their conservation. Alternatively, some people might state a willingness to conserve to avoid verbal confrontation with conservation policies even as they continue clearing (Martin et al., 2017).

Our measures of the effectiveness of protected areas do not refer to each biosphere reserve as a whole, nor to the uninhabited and sparsely inhabited core zones and Maya’s multiple use zone. We are measuring the conservation efforts of individuals and communities, which occupy large areas of these biosphere reserves. Having large numbers of resident farmers inside of protected areas is typical of protected areas around the world, and thus many protected areas need to work with farmers to maximize their conservation behaviors. Just as the conservation behaviors of individuals and communities vary greatly across the study area, some sparsely inhabited areas have retained forest cover and intact wildlife populations, while others have seen rapid deforestation in recent years, a problem we return to in the discussion.

**Table 1: Description of variables**

|  |  |  |
| --- | --- | --- |
| **Variable name** | **Description** | **Measurement** |
| Farmers’ willingness to conserve | Revealed farmers’ willingness to conserve old growth forest without receiving economic compensation | 0= none, 1 = low, 2= medium, 3 = high |
| Farmers’ reserve | Farmers’ voluntary creation of a forest reserve within his plot | 0= no, 1 =yes |
| Farmers’ forest | Percentage of farmers’ plot covered with old growth forest | Self-reported number of hectares covered with old growth forest divided by plot total number of hectares |
| Community forest | Percentage of the community covered with old growth forest | Average response by community farmers interviewed |
| Community forest reserve | Community creation of a formal forest reserve within community land  | 0= no, 1= in progress, 2 = consolidated |

**3.3 Tracing Institutional Pathways**

In order to understand how institutional pathways explain divergent outcomes, we utilize a technique known as process-tracing. Process tracing “is an analytic tool for drawing descriptive and causal inferences from diagnostic pieces of evidence—often understood as part of a temporal sequence of events or phenomena.” (Collier, 2011, p. 824) The technique relies on reconstructing sequences of events to understand how causal mechanisms operate, and can be used both for theory development or, as in this case, for explaining the outcomes of a case (Beach and Pedersen, 2016; George and Bennett, 2005). Process tracing underlies a large body of research in the environmental social sciences (Vanhala, 2017). For example, Kashwan (2017a) uses process tracing to understand how politics shapes institutional pathways which in turn shape conservation outcomes. In order to trace the process which led to divergent conservation outcomes, we build an analytic narrative in sections 4.2 and 4.3 which presents events in the settlement and conservation of the Maya forest in historical perspective, drawing on our interview sources, described above, as well as secondary data whenever available.

**4. RESULTS**

**4.1 Conservation Outcomes**

Farmers are more willing to conserve forest in Calakmul than in Maya. Table 2 shows that 50.4% of farmers in Maya define their willingness to conserve between none and low and 49.6% between medium and high. By contrast 69.3% of the interviewees in Calakmul stated their willingness to conserve between medium and high, with 40.7% stating their willingness is high. Differences between willingness to conserve in Calakmul and Maya are significant at the 99% confidence level as (Wilcoxon-Mann-Whitney two sample test).

 **Table 2: Households’ willingness to conserve (%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Biosphere Reserve** | **None** | **Low** | **Medium** | **High** |
| Calakmul | 18.2 | 12.5 | 28.6 | 40.7 |
| Maya | 17.4 | 33 | 21.5 | 28.1 |

It is possible that farmers overstate their conservation commitment when they express it in words. However, conservation behavior is also higher among farmers in Calakmul than in Maya. Table 3 shows that in Calakmul 60% of the households interviewed have voluntarily set apart a piece of their plot for conservation purposes and have no plans to clear it. In Maya only 38% of the households have defined voluntary forest reserves in their plots. It is also more common to find plots with larger percentage of old growth forest in Calakmul than in Maya. Thirty seven percent of the farmers in Calakmul keep over 50% of their plot covered with old growth forest. In Maya only 18% of the farmers keep over 50% of their plot covered with old growth forest. Combined these three indicators suggest forest conservation at the farmer level is systematically higher in Calakmul than in Maya (These differences are statistically significant at 99% confidence per independent sample t test and a z test). Average plot size is modestly higher in Calakmul than in Maya (50 and 42 hectares), but we explain in the following pages that there is more than size explaining the larger forest conservation effort farmers make in Calakmul.

 **Table 3: Households’ conservation actions**

|  |  |  |
| --- | --- | --- |
| Biosphere reserve | Farmers’ reserve  | Farmers’ forest >50% of plot |
| Calakmul | 60% | 37%  |
| Maya | 38% | 18% |

The community level findings echo the findings at the farmer level. On average, communities in Calakmul and Maya have conserved 49% and 25% of their land in old growth forest respectively. The communities studied in the two biosphere reserves are roughly about the same size. On average Calakmul’s studied communities are 10,310 hectares and Maya’s 12,560 hectares. Conservation at the community level is also measured through community forest reserves. In Calakmul 67% of the studied communities had either already established a forest reserve (53%) or were in the process of establishing one (14%). Only 33% of the communities had no community consensus or interest in creating a forest reserve. In contrast, community forest reserves are uncommon in Maya. Among the sampled communities 69% had no reserve, 5% were working to get one and only 26% had one. These differences are significant at the 99% confidence level (per t tests and the Wilcoxon Mann-Whitney test).

**4.2. Institutional Paths in Calakmul and Maya Biosphere Reserves**

Past studies of this region have focused on the role agricultural development has played in deforestation, a focus that, like ours, places the decision-making of individual farmers at the center (Bray et al., 2008; Chowdhury, 2007; Chowdhury and Turner, 2006; Ellis et al., 2017a; Ellis et al., 2017b; Furumo and Aide, 2017; Geoghegan et al., 2001; Keys, 2004; Loening and Sautter, 2005; Turner et al., 2016; Turner et al., 2004; Turner et al., 2001). Yet this focus cannot explain why farmers in Guatemala are less conservation oriented than those in Mexico. There are no fundamental agronomic or cultural differences between the people and forests of Calakmul and Maya that could explain why farmers in Mexico are more conservation oriented. On both sides of the border soils are poor, rainfall is seasonal, and karstic bedrock limits superficial water. Both areas became agricultural frontiers in the 1960s, meaning that there are no pre-existing cultural, political, or economic conditions that can explain why differences emerged. Both areas became subject to similar conservation regimes only 1 year apart. If anything, Mexico’s higher quality infrastructure – Calakmul is connected by well-maintained roads to several cities and major ports – would make it a more appealing target for large-scale agricultural development which is in fact leading to high rates of forest loss in neighboring municipalities in Campeche (Ellis et al., 2017b).

We argue that differences in farmers’ conservation behavior can instead be explained by paths of institutional development. This argument is supported by the past work of some scholars in the region (Bray et al., 2008; Haenn, 2005, 2006). Although the settlement of Calakmul and Maya was driven by similar economic and political pressures in the two countries, including land shortages, poverty, and civil conflict, different land tenure systems led to significant differences in who moved to the region, what kinds of property rights they held and where, how equitable those rights were, and what kinds of political institutions governed them. These differences in turn shaped the political and economic opportunities that new settlers focused on – and as a result, led to very different patterns of land use.

*4.2.1 Land tenure institutions*

Mexico’s land distribution system insured that Calakmul was settled by groups of communally organized, economically marginal peasants. These groups obtained equal plots of land in a hybrid of common and private property, and held secure title. Mexico’s land tenure institutions, resulting from the agrarian reform of the 20th century, helped poor but organized landless farmers get land for free in ejidos (Calakmul, 2009; Haenn, 2006). Ejido land is owned collectively, with each member (ejidatario) receiving rights to a percentage of community lands. Based on that percentage ejidatarios calculated the number of hectares each of them could have and distributed the land accordingly (Haenn, 2006 describes in detail how this process played out in several of Calakmul's ejidos, and how collective property rights were reinforced by agrarian reforms in the 1990s). Some ejidos decided to distribute all the land among the ejidatarios and others decided to distribute only some of the land and keep the rest communally.

While the government recognizes and respects the ability of ejidatarios to subdivide their land internally, the boundaries of individual plots within the ejido are neither mapped nor formally recognized outside of the ejido (Haenn, 2006). Ejido land is legally owned in common and all decisions related to land use must be made among the ejidatarios. Collective ownership of poor quality and/or remote lands was not appealing to those who had other economic opportunities, and thus, Calakmul’s settlers were almost uniformly from the poorest economic strata. Although reforms in the 1990s allowed ejidos elsewhere to privatize their common lands, this element of the reform was not applied to Calakmul because of the government’s concern that privatizing ejido lands would increase deforestation (Haenn, 2006).

In contrast, the system of land distribution in Guatemala attracted a more economically diverse set of settlers who were not organized communally, and held private property, often without secure title (CONAP, 2001a; Kaimowitz, 1995; Schwartz, 1990). The Guatemalan government sold land to individuals who were not organized at the community level, creating private property. People from Petén were supposed to have highest priority. Peasants from other parts of the country were second in priority and people who wanted to establish large farms or cattle ranches had the lowest priority (Schwartz, 1987). However, land prices were differentiated to reflect land quality and in practice, only well-off people were able to afford the most desirable land. This was exacerbated by the land sales agency, which was corrupt and biased in favor of wealthy cattle ranchers (Kaimowitz, 1995; Schwartz, 1987). In consequence, land holdings are very unequal in size and quality in Maya – a common problem throughout Guatemala (Clark, 2000; Sundberg, 2003). Unable to buy land, some people chose to become *de facto* landowners by participating in the informal land market, by grabbing land directly, or through speculators who sold them land. To defend their “land claims” land grabbers cleared the land and sometimes used force to defend their land. Violence, high transaction costs and high prices were factors discouraging poor and disempowered groups of migrants from acquiring land and limiting their options to work in others’ land.

*4.2.2 Institutions influence on economic and demographic configurations*

The sharp contrast between Mexican and Guatemalan institutions guiding the land distribution and land tenure for the new settlements indirectly affected land use change and conservation at the household and community level by shaping economic, political, and demographic differences. Farmers in Calakmul own more land than farmers in Maya, which gives them the option to clear forest and still keep a relatively large proportion of their plot covered with forest. These larger plot sizes are a direct result of the process of land distribution under Mexico’s agrarian reform, which limited migration by granting rights to a limited number of ejidatarios. Farmers in Calakmul cleared forest gradually over the years after they arrived. Many farmers told the first author that as new landowners they were driven by their desire to work the land. Soil fertility was higher, and weed pressure lower, on newly cleared swiddens, and farmers received financial support for clearing land (Keys, 2004). But once old swiddens had succeeded to young secondary forest/ old fallows, it was easier for farmers to clear fields that had young secondary forest on them and to work on lands with less stumps and roots than to undertake the very difficult labor of clearing old-growth forest, preventing them from cutting 100% of their plot. Old fallows were easier to clear than mature forest and had similar benefits in terms of fertility (Bray and Klepeis, 2005; Turner et al., 2001). This is consistent with Turner et al.’s analysis of forest recovery (2001). During the period when jalapeño chili emerged as a major cash crop, high pest pressure and greater availability of capital encouraged further clearing of old growth forests (Bray and Klepeis, 2005; Keys, 2004), however commercial chili production ceased to be a major land use after the early 2000s. Cattle ranching was limited by the scarcity of superficial water supplies as well as by the limited capital available to subsistence farmers. Some ejidos chose to keep some of their land as a communal holding, as the land they were given was more than sufficient to provide all ejidatarios a subsistence livelihood.

In contrast, the land tenure system of northern Petén encouraged the entrance of well-capitalized large landowners. The presence of large landholders is critical for forest conservation differences between Calakmul and Maya because they built extensive cattle ranches in the region. These large landholders had financial means to transform the forest into pastures. And while only 9% of households in Calakmul did not own land, 36% percent of households in Maya were landless, providing a reserve of cheap labor for wealthy landowners to hire.

Land tenure systems also shaped differences in population size and distribution. Communities as well as households grew larger in Maya than in Calakmul. There are a total of 204 communities in Maya and 81 in Calakmul. Mexico’s allocation of land to ejidos helped to limit the number of people that came to the region (Bray and Klepeis, 2005). Each ejido was created for a specific number of farmers based on the size of the land that was allocated to each ejido. Farmers told the first author that once the total number of ejidatarios (farmers with land rights) was completed people who were interested in getting land organized or joined another group of ejidatarios to create a new ejido. There were no incentives to stay in ejidos that were already complete because there were opportunities to get land titles in other ejidos in the Calakmul region. There were no opportunities to claim land in complete ejidos because the law protected the rights of ejidatarios against encroachment. Limiting the population of each ejido meant that each ejidatario received a relatively large de facto land holding. Although both Calakmul and Maya were frontiers remote from state authority, ejido rules appear to have been more widely respected in Calakmul than property rules in Maya, perhaps because the Mexican state during this period was relatively more capable and stable, or because Mexican peasants strongly believed in the agrarian reform as an outcome of a revolution which their ancestors fought for (Haenn, 2006). Ejido land tenure rules thus constrained communities’ size, and insured that farmers were able to maintain large plot sizes. The number of communities was also constrained by the creation of the biosphere reserve in 1989 and a constitutional amendment in 1992 that halted land distribution and hence the creation of new communities.

In Petén land allocation was uneven. According to field informants, the policy was to allocate 5 to 15 caballerias (224 to 672 hectares) to cattle ranchers and from 1 to 5 (44.8 to 224 hectares) to farmers, but in practice each buyer could get as much as he wanted and divide it later on, if he wished. Land accumulation was large, but also land fragmentation. Many small lots were created over the years. The Maya Biosphere Reserve was created in 1990 and like Calakmul it constrained the creation of new communities, but contrary to Calakmul, Petén did not have the institutional means to constrain demographic growth beyond birthrate within communities, resulting in further division of lands, and smaller plot sizes.

*4.2.3 Institutional influences on security of land tenure and community organization*

Guatemala’s land privatization, based on discriminatory prices, high transaction costs favoring large landholders, and lack of rule of law led to intense deforestation during the settlement period. In Petén small farmers cleared more than small farmers in Calakmul due to their need to secure their formal or informal land rights. Farmers with legal land rights told the first author that they often had to make sure illegal settlers did not encroach their land. Other small farmers ensure their land claims by clearing and confronting anyone who also wanted the land, becoming de facto landowners.

According to the interviewees, tenure uncertainty was not an issue for Calakmul’s farmers during this period, and it was unnecessary to clear land to establish claims. The law gave ejidatarios secure rights and the power to stop others from encroaching. Newcomers did not challenge the rights of ejidatarios already established because their interest was in land rights and they were able to get them until 1992 when constitutional amendments halted land distribution (Bray et al., 2008). Prior to this reform, ejidatarios were not able to sell their land rights. In practice these reforms reinforced limitations on the number of ejidatarios in Calakmul, even while allowing for legal land exchanges (Haenn 2006). After 1992, Calakmul was functionally closed to new migrants. The allocation of plots within ejidos is an internal agreement among ejidatarios and not recognized legally by the government. Legally, farmers do not own an specific piece of land, but a percentage of the community land without specific location. In consequence communities in Calakmul are relatively small, and up to the present time most of the families in the ejidos are either landowners or relatives of landowners.

Collective ejido tenure required Mexican farmers to create community based governance structures through which all ejido members participate in decision making. Our observations of community meetings and interviews with ejidatarios indicate that while not everyone engages at the same level, either because they are not inclined to do so or because they feel intimidated by fellow community members, all ejidatarios have the right to participate in the decision-making and to become community leaders. The ejido governance structure, while far from idyllic (Navarro-Olmedo et al., 2016), facilitates social participation, human and political capital development, equality among ejidatarios, and social organization. Within ejidos farmers manage their plots autonomously. Nonetheless, as some ejidos require members who wish to sell their land or extract wood to inform or request permission from the community council.

 By contrast, In Petén community members are either private landowners or landless. There are no mechanisms that bring them together to make decisions at the community level. The lack of community structures where people must come together to discuss community affairs reduces the spaces available for people to gain information, build human, social and political capital and to participate in community decision making. As a result, land decision-making is fragmented and based on unequal access to information and resources. As we describe in section 4.3.1, below, poorer access to decision-making fora have left residents of Maya with fewer opportunities to learn about new livelihood opportunities, make collective management decisions, or engage with conservation initiatives, contributing to their lower level of conservation behavior.

**4.3 Conserving the Maya Forest**

Beginning in the 1980s, biodiversity conservation efforts became important in the Maya Forest. Yet, these efforts had different impacts on conservation behavior in each country because of the differences in land tenure described above. Differences in land tenure, and differences in the pattern of habitation that were the result of differences in land tenure, mean that opportunities for local people to be involved in land use decision-making differ greatly between the two reserves, and these opportunities in turn influence individual and collective conservation behaviors.

From the 1960s, when settlement began, until the 1980s, the objective of the Mexican and Guatemalan governments was the development of agricultural societies. Land cover change in Southern Campeche and Northern Petén captured the attention of multiple national and international conservation and donor organizations in the 1980s, which led to new stage in the economic and institutional history of the Selva Maya (Berger, 1997; Galleti, 1997; Klepeis and Turner, 2001; Sundberg, 1998). The hallmark of these efforts was the establishment of the Calakmul and Maya protected areas following UNESCO’s man and biosphere guidelines.

*4.3.1 Differing dynamics of participation*

Although both Biosphere Reserves are managed in a top-down fashion, both reserves also work through bottom-up political processes to achieve conservation goals. However the nature and effects of these bottom-up processes differ greatly between the two reserves. These differences are largely the result of pre-conservation era institutional differences between the two countries, described above. We argue that differences in the ways that people participate in these bottom-up processes explain much of the difference in individual behavior we observe. In particular, Calakmul, through the ejido institutional structure and the existence of multiple councils, provides individuals and communities greater opportunities to participate in making decisions about local land use than Maya. Consistent with evidence from other parts of the world (Persha et al., 2011; Wright et al., 2016), households in Calakmul who are able to actively participate in decision-making processes are likely to deforest less (Rodriguez Solórzano, 2014).

 Formal participatory governance structures in the Maya Biosphere Reserve emerged as a result of international pressure, and while they have seen some success, involve only a small portion of the reserve’s residents. The concept of the UNESCO biosphere reserve emphasized community participation as a key method to achieve natural resource sustainability (Bridgewater, 2016; Stoll-Kleemann et al., 2010), and this created an expectation of community involvement that was realized when USAID provided funding for the creation of community-based concessions in the multiple-use zone (Nittler and Tschinkelm, 2005). Concession members have access, extraction, and management rights over several forest products. Extraction is based on management plans prepared using technical criteria for sustainable forest management. Concession members decide how to use and/or distribute the revenues derived from the commercialization of forest products. Concession members also decide the organization of the concessions. Concessions have had mixed results: some concessions were canceled after large forest losses. Yet, some concessions have successfully balanced the conservation of forests with the production of sustainable livelihoods (Radachowsky et al., 2012). The community-based concession model has been recognized & honored globally as a model for sustainable development. However, most households living in the reserve are not part of, and receive no benefits from, the concessions. Most households in the Maya Biosphere Reserve multiple use and buffer zones have limited opportunities to participate in natural resource decision making, and receive few benefits from the Reserve. The political system in the region remains dominated by a small number of powerful groups, some supported by criminal enterprises that contribute to deforestation (insightcrime.org, 2011).

Limited efforts have been made to include people in decision-making in particular national parks. In 2006 the president of Guatemala established the Mesa Multisectorial de la Zona Natural y Cultural Mirador/Río Azul. The objective of this group was to provide a space where actors representing the government, community groups, NGOs, and the private sector could consolidate strategic alliances that supported a common agenda for the conservation and development of the region (Asociación Balam, 2007). Another effort was made in Yaxha-Nakum-Naranjo National Park. This park was created in 2003 (CONAP, 2006) with support from the KFW German Bank. The Bank proposed that together with the park the government created an advisory council. The park and council were created together, but the council became active two years later in 2005. Both of these councils have limited powers, and limit the kinds of community members who can be involved in ways that prevent the councils from effectively representing the broader community.

By contrast, political participation in Calakmul is multidimensional, growing from both top-down and the bottom up, and involving most households within the biosphere reserve. Communities in the buffer zone hold collective title to their land and are empowered to manage the land they own collectively. Only three out of 81 communities have legal permission to harvest timber from their lands, and the technical and organizational capacity of these three communities is far below that of the forest concessions in Petén. However, many of the communities make decisions about collectively managed lands. Even though formal ejido governance structures exclude most women and younger male community members (Navarro-Olmedo et al., 2016), there are far more people who have opportunities to make local level decisions than in Maya, and participation in ejido level decision-making helps local leaders cultivate political skills which can be utilized more broadly (see also Chowdhury, 2010).

Broader scale participatory opportunities are also available in Calakmul, linking communities to regional, state, and national government. The first such opportunity was the Agriculture, Forestry, and Pastures Regional Council (CRASX for its Spanish acronym), established in 1991. This Council was created through a federal government initiative that aimed to govern outside of the formal bureaucratic structure, with the goal of building political support for the ruling party in the region. CRASX involved leaders from the communities in the management of national and international resources coming to the region to support natural resources conservation. Although CRASX had overall political goals as part of a broader, top-down political project, it also introduced conservation ideas among farmers, and trained local leaders to be more effective (Haenn, 2005). The success of CRASX also left some communities feeling excluded from the process, and their protests resulted in the creation of a second group, organized more organically from within the communities, the Regional Indigenous and Porpular Council of Xpujil (CRIPX for its Spanish acronym), which shared decision-making authority with CRASX for a time. These councils were important during the 1990s because at that time the region was sufficiently remote that conventional government institutions were largely absent from the region.

The Calakmul municipality, overlapping the Reserve boundaries, was created in 1996. While formally democratic, the municipality, was more centralized and less open to citizen participation than earlier councils. The participatory legacy of CRASX and CRIPX persists in local politics: the people who participated in those councils learned the benefits of participation and enhanced their capabilities for finding spaces for participation. For example, in 2006 the Calakmul Biosphere Reserve and the German cooperation agency (GIZ) supported the operation of the Municipal Council for Sustainable Rural Development (CMDRS for its Spanish acronym), with the objective of increasing local participation in municipal finance and land use decisions to strengthen the link between environment and development in Calakmul. Early leaders in this council were those who had been involved in CRASX and CRIPX, although the CMDRS was also successful at incorporating new voices. Like its predecessors, CMDRS provided a forum wherein community leaders could get access to information about economic and political opportunities. Because of Calakmul’s status as a biosphere reserve, many of these opportunities relate to conservation, and thus, participation in these councils provides a means by which community leaders learn about conservation. For example, the councils have provided information about alternative livelihoods such as bee keeping, which not only enable farmers to cultivate smaller fields, but also provide an incentive for forest conservation, as the highest quality honey in the region comes from bees that forage in the forest.

**5. CONCLUSIONS**

The ability of people to conserve forests is constrained both by their property rights and their ability to participate in the processes which provides new economic and political opportunities. Residents of the Maya Biosphere Reserve began the conservation era with more unequal and less secure property rights, as well as poorer quality community governance arrangements, contributing to poorer individual level conservation outcomes than in Calakmul. However, these differences have been exacerbated over time as Calakmul has provided most farmers greater opportunity to enhance their human and political capital and build livelihoods less dependent on frontier forest clearance, while in Maya, these opportunities have been confined to the small numbers of individuals involved in the successful forest concessions. This difference is in part the result of the relatively higher levels of political and economic inequality built into the land distribution process in Petén, but it also the result of the greater political space afforded by the modern Mexican state in Calakmul, relative to similar opportunities available in the Maya Biosphere Reserve. Land owners with greater economic and political opportunities in Calakmul are more likely to engage in conservation because the most profitable opportunities (such as honey production) involve moving away from forest clearing (Rodriguez Solórzano, 2014). Honey production in Calakmul has greatly expanded in recent years, providing a wide variety of people a way to profit from forest conservation. While the most successful community-based forest management in the region is the forest concessions in Maya Biosphere Reserve, benefits from these concessions are limited to a very small subset of the inhabitants of the reserve. Thus, while some concessions are very successful, most reserve inhabitants do not benefit, and there is less incentive for reserve inhabitants to pursue conservation on their own land or in their community.

The constraints we describe in this paper are not primarily the result of contemporary public policy. They are the results of decades of institutional development that has left strong path dependencies. Higher rates of conservation in Mexico can be traced back to roots in the Mexican revolution, as well as policies adopted over the succeeding century. Scientists who study why some conservation projects are more effective than others need to pay attention to these long-term institutional legacies, or else they are likely to produce biased results. Similarly, practitioners seeking to create new or improve existing protected areas should pay attention to the role institutional legacies play in shaping incentives for conservation. We have shown that secure property rights for communities and individuals, combined with institutions that encourage collective action and public engagement can, over long time frames, contribute to increased incentives for conservation on privately managed land. In places without these attributes, increasing conservation on privately managed land may be significantly more costly, and developing secure property rights and community-based collective action may require long-term institutional reforms.

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