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Forest concessions in the Maya Biosphere Reserve, Guatemala: A decade later

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ABSTRACT

In the Multiple-Use Zone of Guatemala's Maya Biosphere Reserve, the usufruct rights to timber and non-timber forest resources were granted through concession agreements to 12 community organizations and two private timber companies in the late 1990s and early 2000s. After more than a decade, some concessions are successfully managing forests for multiple uses while others have had limited success or failed completely. This paper provides a management unit-based analysis and evaluation of the evolution of these forest concessions. First, we present a critical assessment of the current state of ecological integrity, socio-economic development, governance, and financing within each of the 14 forest concessions, using a series of quantitative and qualitative indicators. Next, we categorize the different trajectories that the concessions have experienced, and describe the key biophysical, socio-economic, and market events and drivers that may have influenced their outcomes. Lastly, we provide suggestions for the continued consolidation of multiple-use forest management practices in the Maya Biosphere Reserve, and draw out lessons for multiple-use forest management elsewhere in the tropics.

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1. Introduction

In the past few decades, conservation activities have shifted radically from command-and-control strategies toward more inclusive, people-oriented philosophies. This shift was instigated on the one hand by the growing recognition that strict protectionism was in many cases failing, leading to a loss in ecological and institutional resilience (Holling and Meffe, 1996; Berkes, 2004). On the other hand, it was recognized that rural communities are often the most impactful and impacted actors within natural systems (Western and Wright, 1994; Folke et al., 2005). This widely observed "pathology of natural resource management" and a call for increased social justice led many to believe that incentive-based, participatory strategies were the optimal solution to human–environment conflicts (Ghimire and Pimbert, 1997).

In the 1980s and 1990s, integrated conservation and development projects (ICDPs), often taking the form of community-based conservation or community-based forest management, were extensively promoted as one such way to achieve conservation objectives while improving the livelihoods of local stakeholders (Schelhas et al., 2001). By providing alternative sources of income directly linked to wellbeing of natural systems, it was argued, stakeholders would cease to utilize environmentally destructive practices for income and would protect the natural resources upon which their new livelihoods depended. Multiple-use forest management was a logical strategy for maximizing environmental and socio-economic benefits by addressing both commercial and subsistence needs through the extraction of timber and non-timber forest products (NTFPs) (Panayotou and Ashton, 1992). However, despite many attempts to implement ICDPs for multiple-use management worldwide and substantial investment from donor organizations, very few projects have achieved their goals (Kellert et al., 2000; Barrett et al., 2001, 2005; McShane and Wells, 2004).

Two arguments have been put forth to explain the widespread failure of ICDPs (Berkes, 2004). Some argue that economic development and conservation may be inherently incompatible in conservation projects (Redford and Sanderson, 2000; Browder, 2002; McShane and Wells, 2004). Others contend that most ICDPs were implemented inadequately, failing to fulfill basic necessary conditions such as: devolution of authority and rights to local people, sufficient technical and institutional capacity, economic viability, fair distribution of revenue, reconciliation between local and global interests, and resilience of ecological processes and social institutions (Adams and Hulme, 2001; Barrett et al., 2005; Murphree, 2002; McShane and Wells, 2004; Robinson and Redford, 2004; Sayer and Campbell, 2004; Stoian et al., 2009; Wells et al., 2004). ICDPs based upon multiple-use forest management have also had to contend with the extra challenge of seeking compatibility among diverse forest uses and stakeholders, entailing technical,

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social, economic, and political implications (Guariguata et al., 2010), leading some to argue that industrial forest concessions are likely to be more efficient and effective than community-based forest management (Karsenty et al., 2008).

Despite the challenges of integrating conservation and development goals, most conservation and poverty reduction efforts today include aspects of both (Garnett et al., 2007). Today environmental sustainability is conceptualized as an essential pillar of development, and is listed as one of the United Nations' Millennium Development Goals (Jensen, 2010). Furthermore, the global challenges of poverty and environmental degradation are projected to augment in the foreseeable future (Hillebrand, 2008). For all of these reasons, there is increasing pressure for improved understanding of the drivers of success and failure in ICDPs, as well as practical lessons for their design and implementation (Sayer and Campbell, 2004; Campbell et al., 2010).

Guatemala's Maya Biosphere Reserve (MBR) provides an ideal opportunity to extract lessons about the use of multiple-use forest management for integrating conservation and development goals. In the Multiple-Use Zone (MUZ) of the MBR, the usufruct rights to timber and non-timber forest resources were granted through concession agreements to 12 community organizations and two private timber companies in the late 1990s and early 2000s. Several studies have documented the status and trends of the concession system in the MBR, generally concluding that community forest concessions have been a successful model for achieving both conservation and development (e.g. Gretzinger, 1998; Nittler and Tschinkel, 2005; Carrera et al., 2004; de Camino and Breitling, 2008; Bray et al., 2008). However, recent events, including the failure of several concessions, justify a deeper, updated analysis of concession performance.

This paper provides an analysis of the evolution of the MBR concessions over a period of more than a decade. First, we describe the concession granting process and initial conditions in each of the 14 concessions, as well as the management practices utilized both for timber and non-timber forest products. Next, we present a critical assessment of the current state of governance, ecological integrity, and socio-economic development in each of the forest concessions, using a series of quantitative and qualitative indicators. Subsequently, we provide a categorization of the different trajectories the concessions have experienced, with narratives describing the key factors that may have influenced their success or failure. Finally, we provide suggestions for the continued consolidation of multiple-use forest management practices in the MBR, and draw out lessons for ICDPs elsewhere in the tropics.

2. Establishment of Forest Concessions in the Maya Biosphere Reserve

2.1. The Maya Biosphere Reserve

Until the 1960s, the lowland Petén region of northern Guatemala was home to only a handful of small forest villages and timber companies dependent upon the extraction of forest resources such as mahogany (*Swietenia macrophylla*) and *chicle* (*Manilkara zapota* tree resin used to produce chewing gum). Due to its isolation the department was treated as a quasi-independent state, largely ignored by national politics, and from 1959 to 1989 was governed by a para-statal authority, *Empresa de Fomento y Desarrollo Económico de Petén* (FYDEP), with the responsibility of stimulating colonization and economic growth. As a result of the program – especially after the first road was opened to the region – the population of the Petén increased by 9% annually (Fort and Grandia, 1999) until the pressures of slash-and-burn agriculture and logging threatened to destroy the entire forest within 30 years, according to projections (Sader, 1999).

In 1990, with encouragement from conservation and aid organizations, the Guatemalan government established the MBR in order to control forest destruction (Sundberg, 1998; Nittler and Tschinkel, 2005). At just over 2-million hectares, the MBR covers more than half of the Petén department and nearly a fifth of Guatemala's territory, including the heart of Mesoamerica's largest remaining forest and important vestiges of the ancient Maya civilization. The goal of the reserve was to "combine the conservation and sustainable use of natural and cultural resources in order to maximize the ecological, economic, and social benefits for Guatemala" (CONAP, 1992).

The reserve is divided into three zones. The core zone (36% of the MBR) consists of national parks and biotopes and is reserved for scientific investigation and low impact tourism. The buffer zone (24% of the MBR) forms a 15 km-wide band along the entire southern border of the reserve. The MUZ (40% of the MBR), includes 848,440 hectares in which sustainable, low-impact land uses are allowed. The core areas are distributed mainly around the reserve's periphery, leaving the MUZ to function as the *de facto* heart of the reserve in terms of maintaining large-scale ecological processes (Fig. 1).

2.2. The concession granting process

The Guatemalan protected area service, CONAP, was created in 1989 – less than 1 year before the MBR was established – and for years lacked the capacity and experience to effectively manage such a large area. In the early 1990s, conflict escalated between local communities and state agencies due to the restriction of access to resources within the new protected area, and forest destruction continued unabated (Carrera and Prins, 2002: Finger-Stich, 2003). The conflicts spurred CONAP to initiate the option of sub-contracting the management of MUZ units to third-party organizations through forest concessions.

At the same time, peace agreements were being drafted to end Guatemala's 36-year armed conflict. The 1996 Peace Accords mandated increased democratization, decentralization of power and resources, and participatory development, including the establishment and strengthening of participatory arrangements, such as cooperatives. The chapter "Agrarian Situation and Rural Development" called for increased access to land and the sustainable use of land resources, specifically requiring that "by 1999, (the Guatemalan government) allocate to small and medium-sized farmers' groups legally incorporated as natural resources management ventures, 100,000 hectares within multiple-use areas for sustainable forest management" (ASESA, 1996).

As a result of the backfiring of command-and-control strategies, the requirements of the Peace Accord, and offers of financial support from USAID, CONAP prioritized the granting of forest concessions to organized community groups that had historically inhabited or extracted resources from the area. The six communities living within the MUZ were given the highest priority for concession rights to their areas of historical influence, buffer zone communities were given second choice, and after much controversy over their inclusion, two private timber companies were relegated to last choice (Nittler and Tschinkel, 2005).

In order to apply for a concession, legally established community organizations were required to demonstrate historical use and/or capacity to manage forest resources sustainably. Communities had to be well-organized internally, and be accompanied by an NGO of their choice that would provide the technical skills needed to comply with management requirements, such as elaborating management master plans, annual work plans, and environmental impact analyses, developing financial management and forest

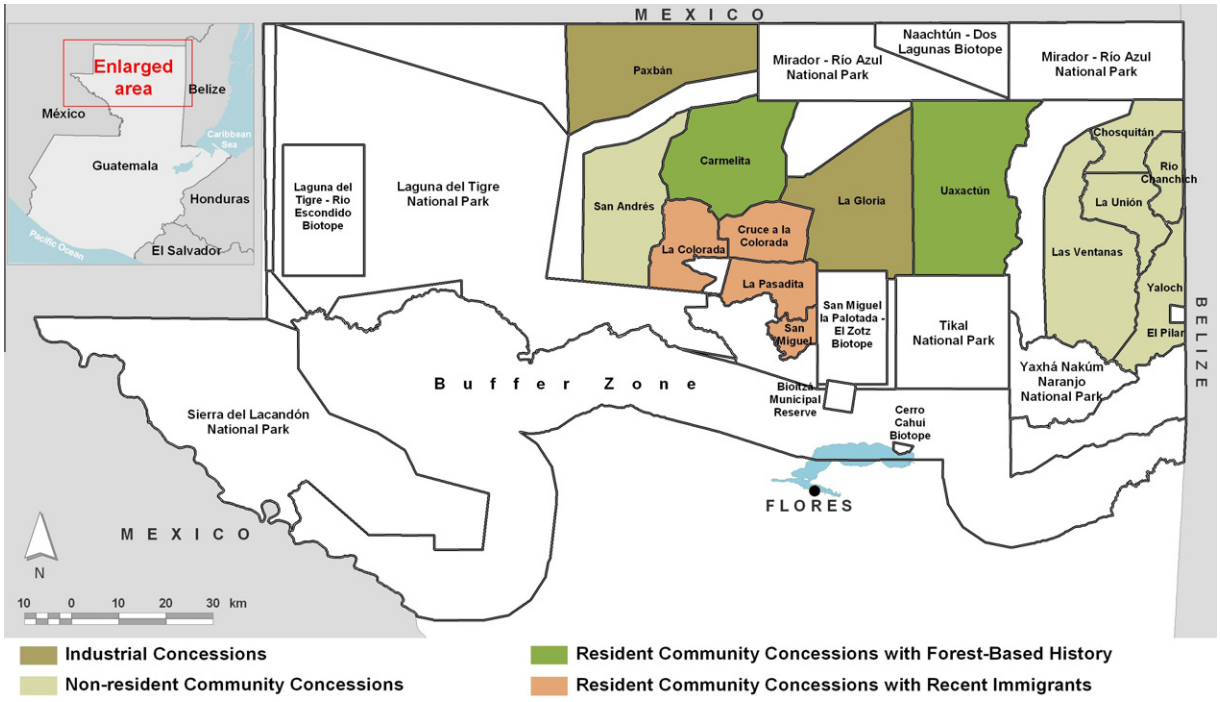

Fig. 1. Map of the Maya Biosphere Reserve in Petén, Guatemala indicating the different types of forest concessions of the Multiple-Use Zone (shaded polygons).

protection skills, and attaining third-party forest certification within 3 years. Concessionaires were also required to pay a modest per-hectare lease fee. Community concessionaires were permitted to manage all above-ground forest resources including NTFPs and wildlife, whereas the industrial concessionaires were only allowed to manage timber. Forest concessions were granted for 25-year periods that are renewable assuming demonstrated compliance with contractual obligations.

2.3. Initial conditions in concessions

In total, 14 concessions (12 community and two industrial) were granted between 1994 and 2002, ranging from approximately 7000 to 83,000 hectares, and covering more than 500,000 hectares of the MUZ. The concessions can be categorized as follows:

(1) *Industrial concessions (2):* Extended to private companies for timber management only, including *La Gloria* and *Paxbán*. In these concessions, other parties may be given extraction rights for NTFPs and wildlife.
(2) *Non-resident community concessions (6):* Granted to community organizations from the buffer zone of the MBR including *Las Ventanas*, *Chosquitán*, *Yaloch*, *La Unión*, *Río Chanchich*, and *San Andrés*. Since these concessions do not include existing communities there is no urbanization or agriculture within them.
(3) *Resident community concessions with forest-based history (2):* Centered around the communities of *Carmelita* and *Uaxactún*, both established more than a century ago as *chicle* harvesting centers. These communities have historically relied on income from NTFPs – especially *chicle*, *xate* (*Chamaedorea* spp.) palm fronds, and allspice (*Pimenta dioica*) (described below).
(4) *Resident community concessions with recent immigrants (4):* Centered around communities established just before, or just after the establishment of the MBR including *Cruce a la Colorada*, *La Colorada*, *La Pasadita*, and *San Miguel*. Most inhabitants immigrated from other parts of Guatemala with agricultural and cattle-based economies.

Details on initial conditions in each of these categories are described in Table 1.

3. Multiple-use management in forest concessions of the MBR

Community forest management in the MBR has been a constantly evolving process since the first experimental concession was granted in 1994. In large part, changes have reflected new institutional and policy arrangements, technical support, changing market conditions, and learning by concession organizations and state authorities. One key factor in this evolution was the creation of a second-level umbrella association, *Asociación de Comunidades Forestales de Petén* (ACOFOP) in 1995, to represent the interests of the community forest enterprises, especially in terms of capacity building, political representation, and market negotiation. ACOFOP's role has evolved over time, and has been especially important for advocacy against threats to land tenure security (Taylor, 2010). Dozens of international and Guatemalan NGOs have also played different roles in supporting community concessions during the past 15 years. During the first decade of the concession experience, ACOFOP, accompanying NGOs, and the community forest enterprises received tens of millions dollars of external assistance from USAID and other sources.

3.1. Timber management

At the outset, most of the focus on forest management was dedicated to timber. Though the local tree community is relatively diverse, only two precious hardwood species, mahogany (*S. macrophylla*) and Spanish cedar (*Cedrela odorata*), initially accounted for almost all of the commercially sold timber – even though much of

Table 1
Initial conditions in forest concessions of the Maya Biosphere Reserve.

		Industrial concessions ($N = 2$)	Non-resident community Concessions ($N = 6$)	Resident community concessions with forest-based history ($N = 2$)	Resident community concessions with recent immigrants ($N = 4$)
Year contracts granted	Range	1999	1997–2002	1997–2000	1994–2001
Year certified	Range	2001–2003	1998–2004	1999–2001	1999–2005
Year contracts expire	Range	2024	2022–2027	2022–2025	2022–2026
Concession area (ha)	Mean	66,152	32,514	68,678	17,098
	Range	65,755–66,548	12,218–64,973	53,797–83,558	7039–22,067
Number of members	Mean	N/A	129	167	69
	Range		27–342	109–224	39–122
Number of beneficiaries	Mean	N/A	708	916	380
	Range		149–1881	600–1232	215–671
Area per member (ha)	Mean	N/A	339	433	275
	Range		190–668	373–494	154–460

the forest had already been high-graded. More recently, secondary species such as *Calophyllum brasiliense*, *Bucida burseras*, *Vatairea lundellii*, *Aspidosperma stegomeris*, *Lonchocarpus castilloi*, *Metopium brownei*, and *Astronium graveolens* have also been marketed in increasing volumes. Even with the diversification of marketed species, harvest intensities in the MBR are among the lowest worldwide at 1.2–3.0 m^3/ha.

Harvest planning activities consist of 25-year management plans including concession-wide forest inventories, 5-year harvest plans with more detailed inventories, and detailed annual operation plans (POAs) including a complete census of marketable species. Forest management techniques follow reduced-impact logging guidelines such as planning of roads, skid trails, and landings, directional felling, liberation of lianas, and use of lightweight machinery (Putz et al., 2008), with 25–40 year cutting cycles and post-harvest silviculture in some cases. All concessions achieved Forest Stewardship Council certification by Smartwood in fulfillment of their contractual obligation.

Initially, some community concessions sold standing timber and only participated marginally in harvesting operations, but gradually, as concessionaires gained technical capacity and access to capital, they participated in the entire processing chain including logging, milling, and transport. Many concessions bought their own sawmills and equipment. Several value-added initiatives were implemented such as carpentry and processing of decking, parquet, and tongue-and-groove products (Nittler and Tschinkel, 2005). In 2003, the second-level enterprise, FORESCOM, was created in order to collectively process and market timber and finished products with the aim of negotiating better prices and contractual conditions. Forest management details are described in Table 2.

3.2. Non-timber forest products (NTFPs)

The forests of the MBR contain a relatively high density of commercially valuable NTFPs, including *xate* palm fronds, *chicle* gum resin, and allspice. *Xate* is the local name for several species of forest understory palms of the genus *Chamaedorea*. The wilt-resistant fronds are collected, sorted, and shipped to Europe and the United States where they are used in floral arrangements. *Chicle* is the processed tree latex of *M. zapota*. *Chicle* harvesters make diagonal cuts in the trees' bark which guide dripping sap into a sack and later reduce the liquid over a fire in camp (Reining et al., 1992). Most *chicle* produced by concessions has been exported to Japan. Allspice is the fruit of a native tree (*P. dioica*) with highly aromatic oils. Fresh fruits are removed from cut limbs or occasionally entire felled trees and later dried. Allspice has mainly been exported to Europe and the United States. During the lifetime of the concessions, *xate* sales have increased or remained stable, while *chicle* and allspice have experienced declines in commercialization due to market fluctuations and degradation of the resource base. Other NTFPs sold on domestic markets include: the seeds of the tree *Brosimum alicastrum*, which are used in baked goods, *Desmoncus* spp. palm vines and *Monstera* spp. aerial roots which are woven into furniture, *Sabal mauritiiformis* palm leaves which are traditionally used as roof thatch, *Aechmea magdalenae* fibers used by artesans, as well as dozens of medicinal plants. Many NTFPs do not provide direct income, but reduce the cost of living significantly by substituting commercial products.

3.3. Other forest uses

Several other forest uses complement and compete with timber and NTFP management. Subsistence hunting is practiced

Table 2
Management details for forest concessions of the Maya Biosphere Reserve.

		Industrial concessions ($N = 2$)	Non-resident community concessions ($N = 6$)	Resident community concessions with forest-based history ($N = 2$)	Resident community concessions with recent immigrants ($N = 4$)
Area under timber management (ha)	Mean	60,933	23,414	53,349	13,101
	Range	58,899–62,967	9189–44,633	34,152–72,545	4800–17,621
Area under strict protection (ha)	Mean	6856	9092	13,725	1768
	Range	6856	2985–31,894	9314–18,135	1100–3497
Mean annual harvest area (ha)	Mean	1882	680	400	472
	Range	1800–1963	360–1120	400	80–705
Annual harvest volume, primary species (m^3)	Mean	2494	857	820	231
	Range	2383–2606	647–1015	719–922	68–428
Annual harvest volume, secondary species (m^3)	Mean	2689	553	364	302
	Range	2383–2996	317–1079	246–482	120–382
Harvest intensity (m^3/ha)	Mean	2.8	2.1	3.0	1.1
Cutting cycle (years)	Mean	27.5	30.8	40.0	35.0
	Range	25–30	25–40	40.0	25–60
Number of paid forest rangers	Mean	9.0	3.7	5.5	3.0
	Range	6–12	2–8	4–7	0–6

throughout most concessions, and an innovative community-based Ocellated Turkey (*Meleagris ocellata*) sport hunting project has operated in three concessions since 2000 (Baur et al., 2012, this issue). Archaeological research and restoration has been undertaken in several concessions, providing local jobs. Tourism, especially focused on the ancient Maya archaeological sites of Uaxactún and El Mirador, has consistently been promoted in concessions. However, large-scale tourism development plans have been a major source of conflict (Radachowsky and Castellanos, in press). Recently, a conservation agreement was drafted between conservation organizations and the Uaxactún concession to provide incentives for adherence to agricultural zoning and control of deforestation and forest fires, and another is being considered for Carmelita. Payments to concessions for Reducing Emissions from Deforestation and Forest Degradation (REDD) have been discussed for several years, but have not yet been implemented. Small scale traditional swidden agricultural techniques are permitted, and a few projects have promoted improved agricultural techniques. Development and enforcement of internal norms and zoning for agriculture has been a complicated and conflictive issue. In resident forest concessions with recent immigrants large-scale cattle ranching expanded despite legal prohibitions. Other illicit forest uses include human trafficking, marijuana cultivation, commercial hunting, archaeological looting, and land speculation.

4. The state of forest concessions in the MBR: a decade later

In this section, we present a critical assessment of the current state of governance, ecological integrity, and socio-economic development in each of the forest concessions, using a series of quantitative and qualitative indicators. Except where cited otherwise, data is derived from authors' monitoring efforts during the past decade.

4.1. Governance

Of the 14 forest concessions granted, only 10 are still fully active. Two resident community concessions with recent immigrants (*La Colorada* and *San Miguel*) were cancelled by CONAP due to contractual incompliance. The remaining two resident community concessions with recent immigrants (*La Pasadita* and *Cruce a la Colorada*) have not formally been cancelled, but CONAP has repeatedly suspended their permission for annual harvests, conditioning future harvests upon fulfillment of preconditions demonstrating increased contractual compliance. All of the failing concessions have experienced a similar pattern of rapid population increase and turnover, coupled with rampant illegal land appropriations affecting between 30% and 50% of the concession areas. All four of these concessions have also been impacted by the establishment of large cattle ranches, some of which are owned by powerful families linked to organized crime. The combination of these processes has resulted in overt social conflict, violence, and a high rate of environmental crimes.

For example, in 2008 NGO and governmental personnel encountered a clear cut of 1100 hectares in the *La Colorada* concession. The area had been deforested by a crew of 100 paid day laborers, and bordered a cattle ranch whose owner was rumored to be involved in organized crime. A CONAP survey revealed that only two of the concession's original 42 families remained; the rest had fled after illegally selling state-owned forest tracts. Soon thereafter, the concession was cancelled due to mismanagement, residents were evicted from the area, all cattle ranches were removed from the area, ranch infrastructure was destroyed, and a control post manned by park guards, police, and army was installed in the former concession. In the *Cruce a la Colorada* concession, conflicts between ranchers and community concession managers in 2010 led to death threats to concession members and culminated in the assassination of a community leader. The violence forced many villagers to leave the concession and instilled fear among those who remained, further deteriorating any possibility of improving concession management.

In non-resident concessions and resident community concessions with forest-based histories, land appropriation and other environmental crimes have largely been controlled by concession managers. However, several concessions have experienced severe financial management problems, including substantial commercial and tax debt. Poor financial management and lack of transparency have created internal conflict and threaten the sustainability of some concessions. Since the concessions are granted on state-owned land, Guatemalan law stipulates that concession members can legally be held liable both for financial mismanagement and back taxes. Governance indicators for the forest concessions are described in Table 3.

4.2. Ecological integrity

In recent years, forest cover has been disappearing at an average rate of 1.18% annually within the MBR. Although much of the forest loss has occurred in the buffer zone (36% deforested since 1986), rates have also been increasing dramatically in national parks and in some parts of the Multiple-Use Zone (Fig. 2). The mean rate of deforestation in the 14 concessions was 0.45% annually between 2001 and 2009. However, there is a great deal of variability between concession types. The mean deforestation rate in the four resident concessions with recent immigrants was 1.54% per year as opposed to a mean rate of only 0.008% in the remaining 10 concessions. Deforestation rates have been highest in *La Pasadita* (2.31%), *La Colorada* (1.52%), *San Miguel* (1.31%), and *Cruce a la Colorada* (1.05%) due to land speculation and conversion for cattle

Table 3
Governance indicators for forest concessions of the Maya Biosphere Reserve.

		Industrial concessions ($N = 2$)	Non-resident community concessions ($N = 6$)	Resident community concessions with forest-based history ($N = 2$)	Resident community concessions with recent immigrants ($N = 4$)
Concession Contract Status		All active	All active	All active (one with conditions)	2 cancelled, 2 suspended
Certification Status		All active	All active	All active	2 suspended
Financial management and Transparency		N/A	3 good, 2 medium, 1 poor	1 medium, 1 poor	2 poor, 2 cancelled
Level of internal conflict		Low	Low	Medium	Extremely high
Percentage of concession area affected by land grabbing	Mean	2.5%	0.0%	5.0%	45.0%
	Range	0–5.0%	0%	5%	30.0–50.0%
Estimated number of cattle, 2009	Mean	0	0	25	475
	Range	0	0	0–50	150–1000
Registered environmental crimes	Mean	3.0	0.8	6.5	18.0
	Range	0–6	0–3	6–7	10–22

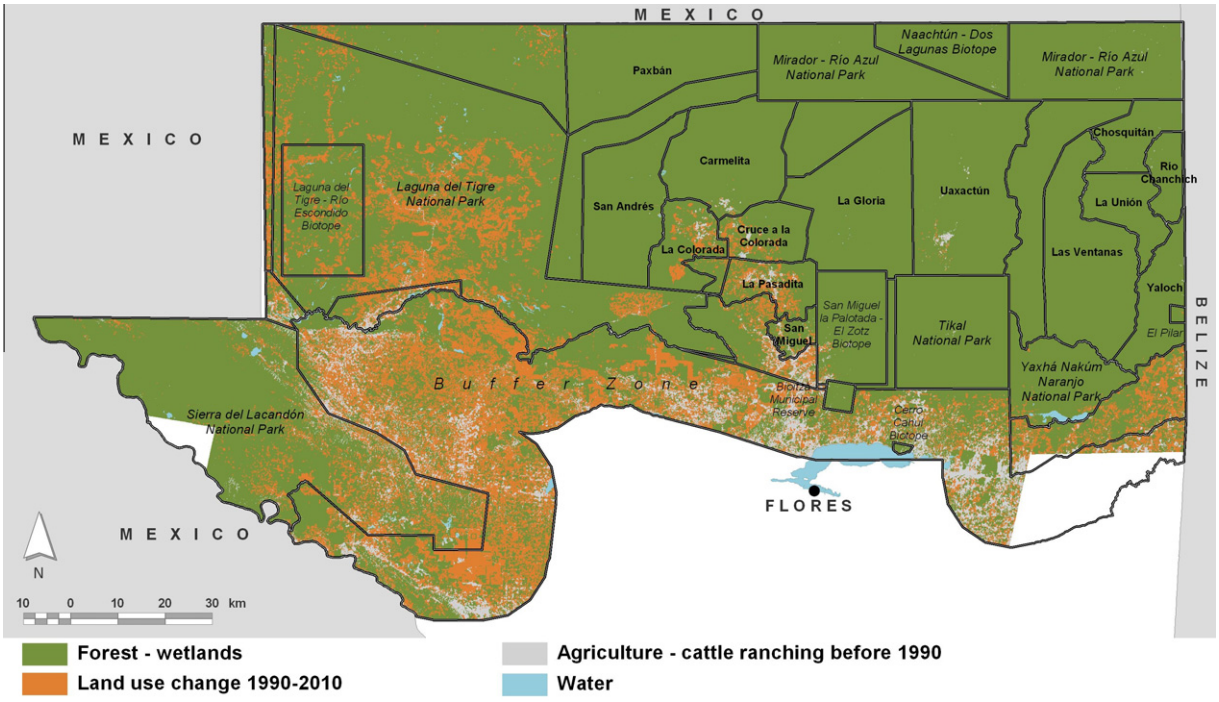

Fig. 2. Map of deforestation in the Maya Biosphere Reserve since its establishment in 1990. In the concessions, impacts have been especially severe in the resident community concessions with recent immigrants, including Cruce a la Colorada, La Colorada, La Pasadita, and San Miguel.

ranches. Most deforestation in the remaining concessions has been related to small-scale swidden agriculture.

Forest fires show a similar spatial pattern (Fig. 3). Historically, fire was not a part of the ecology of the Petén's forests. In fact, no natural wildfires have ever been reported in the region. However, fires started for clearing of agricultural fields and pastures or to sabotage protected areas now regularly escape and burn vast tracts of forest, especially during El Niño events when the forest is exceptionally dry and susceptible. The effects of forest fires on understory microclimate increase the likelihood that they will burn again. Between 2000 and 2010, the mean annual number of MODIS active fire "hotspots" was 16.8 in resident concessions with recent immigrants, compared to a mean of only 1.3 hotspots per year in the remaining 10 concessions. Similarly, the mean annual

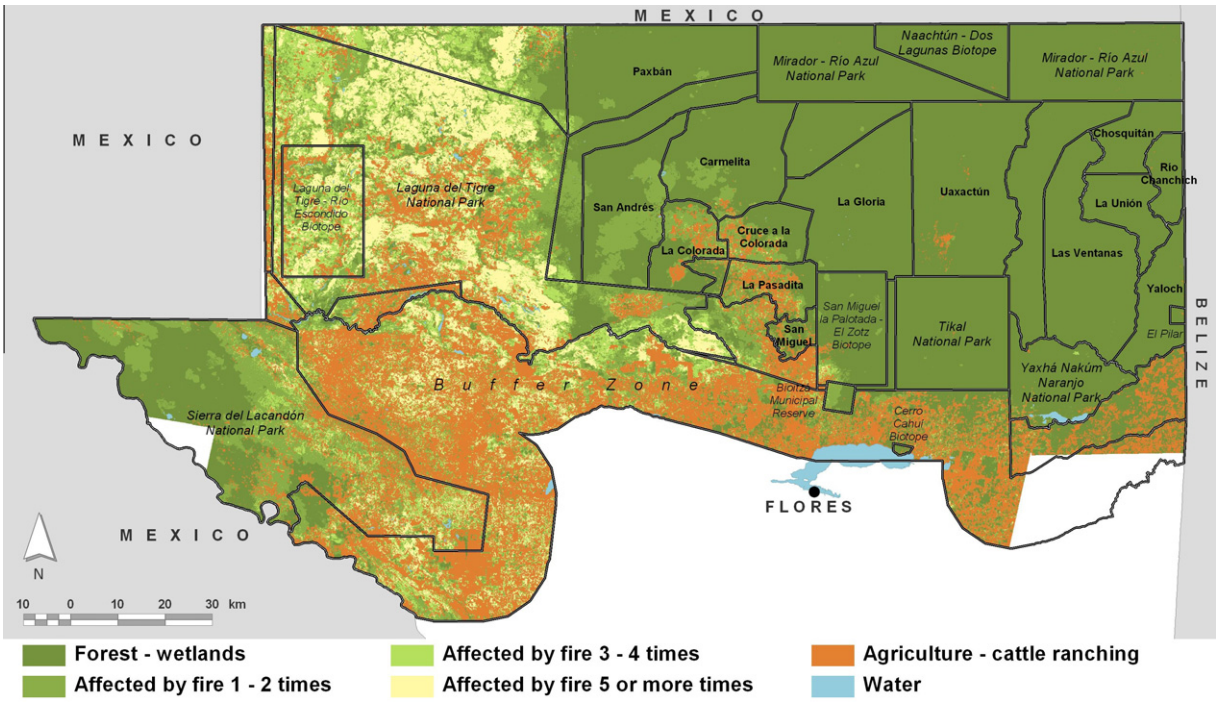

Fig. 3. Map of forest fire occurrence in the Maya Biosphere Reserve since its establishment in 1990. As with deforestation, fire impacts have been especially severe in the resident community concessions with recent immigrants, including Cruce a la Colorada, La Colorada, La Pasadita, and San Miguel.

area burnt was 925.7 ha, or 5.04% of resident concessions with recent immigrants, compared to a mean of only 225.6 ha per year, or 0.42% of the remaining 10 concessions.

In a comprehensive study of logging impacts, Radachowsky et al. (2004) found that direct ecological impacts of timber management in the concessions are relatively minor. In general, logged areas showed slightly greater canopy openness, lower canopy height, a higher density of seedlings, and a higher density of dead fallen trees than unlogged areas. Of the large vertebrates, only the howler monkey (*Alouatta pigra*) was found at significantly lower rates in logged areas. Bird, butterfly, and dung beetle community changes appear to be driven mostly by the addition of new species in logged areas, rather than the exclusion of existing species. This evidence suggests that increased habitat heterogeneity caused by logging roads and gaps may attract new species, thereby increasing species richness without sacrificing forest interior specialists, as has been found in other studies of low intensity reduced-impact logging (Putz, 2011). However, with the commercialization of other secondary species and increased harvest intensities, impacts may be more severe and should be re-evaluated.

Some NTFPs have shown signs of overexploitation. For example, for many years *xate* was harvested through a contractor system, in which independent businessmen financed collection camp costs and paid workers for *xate* based on volume harvested. Leaves were shipped to sorting houses in urban areas, where as many as 76% of leaves were discarded due to poor quality (Radachowsky and Ramos, 2004). Contractors and middlemen captured most revenue, and *xate* populations were declining rapidly due to overharvesting (Wilsey and Radachowsky, 2007). For example, in the Uaxactún concession, adult *Chamaedorea oblongata* density decreased more than 2% and juvenile density by more than 13% in just 1 year (Radachowsky and Ramos, 2004). Beginning in 2004, the market system was reformed with support from NGOs and CONAP, and today most *xate* extraction is managed directly by community forest enterprises through formal management plans. *Xate* harvesters are now paid according to the number of exportable fronds harvested, providing an incentive to leave unmarketable, but biologically productive, leaves on wild plants. In order to increase local capture of revenue, the selection and packing process is now conducted in community sorting houses. In 2008 several concessions attained Forest Stewardship Council certification for *xate* management.

Chicle exports have undergone a dramatic decline during recent decades due to decreased demand, lack of available capital for harvests, and uncharacteristically dry conditions during some harvest seasons, which reduces the harvestable quantity of resin. No recent local studies have examined wild *M. zapota* populations, but Reining et al. (1992) estimated that trees have a mortality rate of 5–10% with a 5-year tapping cycle. Allspice exports have also been heavily impacted by decreased demand, as well as unpredictable supply since it is a masting species with fruiting dependent upon climatic conditions.

The impacts of hunting are difficult to ascertain. Using transects, Radachowsky (2004) estimated densities of nine of the 11 most important game species within the MBR concessions. Four species showed significant negative relationships with human access: Crested Guan (*Penelope purpurascens*), Great Curassow (*Crax rubra*), Red Brocket Deer (*Mazama americana*), and White-lipped Peccary (*Tayassu pecari*). Brocket deer densities were eight times lower in areas of high human access than in areas with difficult access, while large terrestrial bird densities were three times lower. A consistent negative relationship was observed between human access and game meat availability. In areas with difficult access, as much as 90 kg/km^2 of game meat was recorded for the three game species considered (Guan, Curassow, and Brocket deer). In areas of high access, less than 25 kg/km^2 were available. These findings suggest that subsistence and commercial hunting have a tremendous impact on game species populations in the reserve. Such trends are worrisome for several reasons. First, the long-term viability of wildlife populations under such high levels of human pressure is uncertain. Second, meat for subsistence is less available near communities, potentially threatening an important protein source for community members. Third, diminished prey bases increase predation pressure by top carnivores such as Jaguar and Puma on livestock and dogs, exacerbating human–wildlife conflicts. Indicators of ecological integrity in the forest concessions are described in Table 4.

4.3. Socio-economic impacts

Within community forest concessions, economic activities are varied. In most concessions, the extraction and commercialization of timber and non-timber forest products are by far the most important economic activities. However, in community concessions with recent immigrants, cattle ranching and other agriculture are the main sources of income.

Current estimates of aggregate annual revenue in the MBR are more than $13,000,000 (USD) from certified timber (CONAP, 2011a; Radachowsky and Ramos, in preparation; FRAME, 2006; Rosales, 2010). Harvest and management activities for timber and NTFPs have been reported to generate more than 3000 jobs annually, representing more than 300,000 person-days (Gustavo Pinelo, pers. com.). In 2003 Chemonics International estimated that the average annual income per concession member was $1140, including dividends and wages. This is equivalent to approximately 6 months of average income for rural Petén, and entailed an average of only 39 days of labor (not considering time spent in

Table 4
Indicators of ecological integrity in forest concessions of the Maya Biosphere Reserve.

		Industrial concessions ($N = 2$)	Non-resident community concessions ($N = 6$)	Resident community concessions with forest-based history ($N = 2$)	Resident community concessions with recent immigrants ($N = 4$)
Annual deforestation 2001–2009 (ha)	Mean	3.1	0.7	17.3	268.7
	Range	1.3–5.0	0.2–2.4	17.2–17.5	92.2–433.8
Percent of concession deforested annually	Mean	0.00%	0.00%	0.03%	1.54%
	Range	0.00–0.01%	0.00–0.01%	0.02–0.03%	1.05–2.31%
Annual number of fire hot spots 2000–2010	Mean	1.4	0.8	2.7	16.8
	Range	1.3–5.0	0–4.5	2.1–3.3	6.7–31.5
Area burnt annually (ha) 1998–2010	Mean	151.5	225.8	299.2	925.7
	Range	17.7–285.3	0.0–1353.8	18.1–580.3	204.2–1311.7
Percent of concession burnt annually	Mean	0.23%	0.43%	0.55%	5.04%
	Range	0.03–0.43%	0.00–2.61%	0.02–1.08%	2.90–6.97%
Fragmentation (km edge/km2 area)	Mean	0.02	0.05	0.22	3.47
	Range	0.01–0.03	0.01–0.10	0.19–0.24	2.43–4.90
Mean distance from permanent roads (km)	Mean	19.5	27.0	14.7	3.5
	Range	16.2–22.8	12.1–45.4	13.1–16.2	2.3–4.7

organizational meetings). Benefits are distributed more widely throughout communities, including to non-members, through day labor. For timber operations only, a total of 51,309 person-days of labor were paid in 2003, worth approximately $360,000 (Chemonics International, 2003). Most employment came from sawmill operations (55%), followed by harvest (29%), and pre-harvest activities (16%).

The revenue generated by NTFP extraction in the MBR is also substantial with estimates of $5700,000 annually from *xate* alone (CONAP, 2011b). Mollinedo (2002) estimated that NTFP harvests in the community of Carmelita generate over $2300 per family per year. In the community of Uaxactún, *xate* harvesting alone currently accounts for 32% of all reported income, not including the income derived from sorting and processing. Most importantly to the local economy, *xate* is available year-round as a backup income source when timber-related and other employment options are unavailable. Furthermore, many non-market NTFPs such as firewood, thatch palms, medicinal plants, and game meat are used locally, thereby reducing family expenditures.

Agricultural practices vary dramatically across concession types. In industrial and non-resident concessions, there is no agricultural use. In resident community concessions with forest-based histories, small-scale swidden agriculture and animal husbandry are practiced for local consumption. In concessions with forest-based histories, cattle ranching is restricted. Approximately 40 head of cattle currently exist within the Carmelita concession (one per 20 inhabitants), and there are no cattle in Uaxactún. In contrast, in community concessions with recent immigrants, there are an estimated 1200–1500 head of cattle, representing more than one cow per two inhabitants. In *Cruce a la Colorada*, the only concession with recent immigrants that has continued legal forestry operations, 77% of income is derived from agriculture, and most inhabitants work as day laborers for wealthy absentee ranchers. This contrasts markedly from the resident community concessions with forest-based histories, in which more than 60% of all income is derived from forest products and less than 5% from agriculture.

In the communities themselves private commercial ventures such as general stores, maize mills, and restaurants/bars also form an important part of the local economy. Approximately 6% of community members benefit directly from such small-scale commercial enterprises. Additionally, tourism provides up to 4% of each community's revenue depending upon its geographic position and access to archaeological sites. It is impossible to quantify income derived from illegal activities, but illegal land sales, timber poaching, human trafficking, looting of archeological sites, and other prohibited activities provide significant revenues for some concession inhabitants – especially in resident concessions with recent immigrants.

Since no longitudinal studies have been undertaken, it is difficult to provide a quantitative measure of the impact of forest concessions on inhabitants' quality of life. A comparison of historically forest-based versus recent immigrant resident concessions provides interesting insights on livelihood impacts. Forest-based concessions have experienced annual population increases of approximately 2%, while immigrant concessions have increased at a rate of 9%. Basic Necessities Surveys (BNS) conducted in 2009 and 2010 using the methods of Davies and Smith (1998) showed that immigrant resident concession *Cruce a la Colorada* has a mean index of access to basic necessities of only 0.40, compared to 0.51 and 0.55 in the resident forest-based concessions of Uaxactún and Carmelita. Many concessions, including non-resident community concessions such as San Andrés, also provide social services including life insurance and emergency medical services for members, educational support and scholarships, and support for community infrastructure and events. Indicators of socio-economic conditions in the forest concessions are described in Table 5.

5. What happened? Drivers of success and failure in forest concessions

The concessions were not designed as a randomized experiment, and confounding factors prohibit simple attribution of different outcomes to concession types or models. For example, community concessions with recent immigrants tended to be smaller, were approved earlier in the concession granting process, included private landholdings at the time of establishment, and are spatially auto-correlated along a route with historically unrestricted access. Still, the different concession types have experienced very distinct trajectories and several lessons can be extracted from their complex histories.

In general, the two industrial concessions have retained strong internal governance. Timber management has been undertaken efficiently and responsibly, and one can assume that they have been profitable with adequate financial management. Deforestation has been minimal, but since industrial concessionaires do not have control over NTFPs and cannot restrict access to third parties, some hunting, looting, and occasional forest fires have occurred. The industrial concessions do not have the implicit goal of improving socioeconomic conditions for local people, but have produced jobs for some inhabitants of the reserve and nearby urban areas. The relative commercial success of industrial concessionaires can probably be attributed to their history of commercial forest management, advanced capacity, plentiful capital, and the well-developed model of private logging concessions.

Table 5
Socio-economic conditions in forest concessions of the Maya Biosphere Reserve.

		Industrial concessions ($N = 2$)	Non-resident community concessions ($N = 6$)	Resident community concessions with forest-based history ($N = 2$)	Resident community concessions with recent immigrants ($N = 4$)
Estimated mean socioeconomic level		N/A	Medium	Medium	Poor
Primary sources of income		Timber	Timber	*Xate* palm, Timber	Cattle ranching, Agriculture, Timber
Estimated population per community 2010	Mean Range	N/A	N/A	1237.5 803–1672	702.6 380–1095
Annual population increase 2006–2009	Mean Range	N/A	N/A	1.7% 1.3–2.1%	9.2% 5.7–11.8%
Percentage of residents who are direct beneficiaries of the concession	Mean Range	N/A	N/A	74.2% 73.7–74.7%	40.6% 40.6–61.5%
Percentage of members who are women	Mean Range	N/A	13.2% 0–23.7%	39.4% 36.6–42.2%	16.4% 4.2–29.9%

In the six non-resident community concessions, deforestation and forest fires have likewise been minimal. Income from forest management has been significant, and most concessions are today highly capitalized, having invested in sawmills and equipment. However, one of these concessions has experienced severe financial management problems, and although in extreme debt, continued to provide annual dividends to concession members. Non-resident community concessions have had several advantages over resident concessions. The members have deliberately and voluntarily chosen to work together for a common goal. Since the concessions lack villages, they have not had to tend to conflicts derived from agricultural re-zoning or the disparate interests between concession members and non-members.

In the two resident community concessions with forest-based histories, deforestation and forest fires have also been controlled adequately, although hunting continues to place pressure on wildlife populations. Forest management has provided significant income and social benefits to both concession members and non-members. However, in both concessions, weak financial management and transparency have resulted in substantial debt and internal community conflicts. The development and application of norms for agricultural use within the concessions has also been extremely difficult and increased intra-community conflict. Due to their forest-based histories and their position as entry points to major archaeological sites, these two concessions have received the most support from NGOs and government, often serving as pilot communities for projects. Despite substantial progress, major challenges remain in order to improve local livelihoods and to ensure the sustainability of forest management operations.

All four resident community concessions with recent immigrants have experienced devastating ecological impacts due to the establishment of new, mostly illegal cattle ranches. The incursion of large ranchers has also resulted in increased poverty, essentially creating a system of serfdom for many inhabitants. Such colonization is probably due to several factors. First, many villagers were skeptical of forest management and felt pressured into accepting the concession model in order to remain in the area, in part because they came from other parts of Guatemala with an agricultural background. A project attempting to zone agricultural use in the concessions from 2003 to 2005 stimulated land speculation, and was exacerbated by corruption within community organizations, as well as pressure from powerful external actors rumored to be linked to organized crime. The governance problems had a snowball effect, resulting in violent conflict and aggravating any attempts to keep the concession organizations running properly. Today, two of the four concessions with recent immigrants have lost their contracts, and it is very likely that the remaining two will also fail.

6. Conclusions

The experience from the MBR demonstrates that under some circumstances, multiple-use forest management through concessions can fulfill the goals of ICDPs by providing significant, sustainable income streams to concession members and protecting the natural resources upon which they depend. However, it also clearly demonstrates that improper concession management can lead to ecological degradation, increased poverty, and debilitated governance systems. The success of multiple-use forest management in concessions depends upon the specific conditions and processes in each concession (Bray et al., 2008). Concession management is an ongoing, adaptive process that must take into account both internal dynamics and external factors, and must bridge social, ecological, and economic domains.

Five of the most frequently cited conditions for achieving conservation and development through multiple-use management include: Devolution of authority and local rights; technical and institutional capacity; economic viability and distribution of revenue; reconciliation between local and global interests; and resilience of ecological processes and social institutions (Murphree, 2002; Adams et al., 2004; McShane and Wells, 2004; Barrett et al., 2005; Robinson and Redford, 2004; Sayer and Campbell, 2004; Wells et al., 2004). Furthermore, Campbell et al. (2010) argue that there is "an emerging consensus that at the heart of achieving positive outcomes are a core of institutional issues involving landscape governance, trust building, empowerment, and good communication, all implying long-term commitment by, and flexibility of, external actors".

In the MBR, all successful concessions have managed to fulfill most of these basic conditions, although some continue to face challenges. For example, poor financial management capacity and high turnover in concession management positions weaken institutional resilience in at least three of the 10 remaining concessions. Discrepancies between the interests of different actors also threaten to undermine the concessions, although interests do not cleanly follow a global/local dichotomy. Large-scale development projects, particularly efforts to designate a "Mirador Basin National Monument" as a new protected area category that would supplant several existing concessions, have furthered uncertainty over land tenure security and resource rights, while also increasing distrust between concessionaires, national and international promoters, and governmental institutions. Poor governmental oversight and law enforcement, as well as a lack of timely and politically acceptable sanctions helped set the stage for a downward spiraling of governance and a culture of impunity in failing concessions. Governance problems in failing concessions spilled over into nearby concessions, instigating landscape-level impacts. Market fluctuations, especially during the 2008–2010 global economic downturn, had important impacts on concession revenues, but these were partially offset by increased product diversification, including timber from secondary species, finished timber derivatives and NTFPs. In retrospect, the goals of most conservation organizations and aid agencies may have been overly optimistic and short-sighted, especially in recognition of Guatemala's complex institutional and political context.

Several adaptive efforts have been undertaken to address weaknesses and mitigate threats in concessions. For example, the "*Mesa Multisectorial*", also known as the Mirador-Rio Azul roundtable, was developed to manage conflict and build consensus over conservation and tourism development in the eastern MBR. Inter-institutional efforts have been stepped up to establish a series of control posts, recuperate illegally usurped areas, and increase law enforcement in the MUZ. Inter-institutional efforts have also been strengthened to build financial management capacity and to restructure mechanisms for financial audits and monitoring. Efforts also continue to diversify and add value to the current forest product portfolio. Lastly, conservation agreements have been drafted to allow conservation organizations to support concession management through clear contracts.

The MBR provides several lessons for multiple-use forest management elsewhere in the tropics:

(1) *Concessions as "communities of practice":* In the MBR, community concessions whose members voluntarily and willingly chose to obtain and manage forest concessions together have experienced the greatest success and least internal conflict. In the case of some resident concessions with recent immigrants, locals were coerced into obtaining forest concessions in order to retain their right to settle in the area. These concessions have failed completely.

In resident concessions with forest-based histories, only some villagers decided to partake in concession management, and in some cases tension between concession members and non-members continues to affect concession performance. Successful concession management depends upon voluntary association and decision over whom one goes into business with.

(2) *Concessions as businesses:* External actors dedicated enormous effort and resources to improving concessionaires' technical capacity for forestry planning and operations in the MBR. However, very little attention was given to business management and administrative capacity, or ensuring the state's capability for auditing and sanctions. Today, poor financial management practices and acquired debt may be the greatest threat to concession sustainability.

(3) *Diversification and resilience:* Concessions with greater product diversification have been less susceptible to market uncertainties. Concessions with diversified sources of income including NTFPs (especially *xate*) and sport hunting could more easily weather market fluctuations for individual products.

(4) *The myth of self-financing:* In the MBR, forest management has helped to cover the majority of the costs of conservation in concessions including patrols and fire prevention and control. However, in areas with extreme governance issues, even efficiently managed timber concessions may require subsidies in order to mitigate threats and outcompete illicit forest uses. In the MBR, conservation organizations have co-financed community forest management through clear agreements that provide conservation incentives and technical support, regular compliance monitoring, and multiple-sector participation. Especially as other environmental services are integrated into markets, such overlapping conservation financing mechanisms may become increasingly important to community forestry.

(5) *Long-term commitment and flexibility:* External actors must be careful not to be overly optimistic and recognize that ICDPs often require a long-term commitment on the order of decades, with flexibility for adaptive management (Stoian et al., 2009). Spaces for inter-sector dialog and consensus building can help direct and ensure complementarity of investments, as well as promote social learning and help evaluate success from a variety of perspectives.

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