

2000-2013

Deforestation Trends in the Maya Biosphere Reserve, Guatemala



USAID
FROM THE AMERICAN PEOPLE

**CLIMATE, NATURE
and COMMUNITIES
in Guatemala**



**Rainforest
Alliance**



**The Nature
Conservancy**
Protecting nature. Preserving life.



Authored by:

Benjamin D. Hodgdon
Rainforest Alliance

David Hughell
Rainforest Alliance

Victor Hugo Ramos
Consejo Nacional de Áreas Protegidas/Wildlife Conservation Society

Roan Balas McNab
Wildlife Conservation Society

SUMMARY

Deforestation Trends in the Maya Biosphere Reserve, Guatemala



Forest canopy of the MBR from atop the ruins of Tikal

Photo by Charlie Watson

Covering close to 2.1 million hectares, Guatemala's Maya Biosphere Reserve (MBR) is the largest protected area in Central America and home to around 180,000 people, as well as globally important biodiversity and cultural heritage. Established in 1990, the reserve is also the site of an internationally significant example of multiple-use forest management with the twin aims of conservation and social development. This paper analyzes deforestation trends in different management zones of the MBR during the period 2000-2013 and looks within these zones to identify trends among specific management units.

The MBR is divided into three different zones allowing for varying degrees of resource management: (1) the Core Zone (36 percent of the reserve), consisting of national parks and "biotopes," allowing only for scientific research and tourism; (2) the Multiple-Use Zone (40 percent), in which low-impact natural resource management activities are permitted; and (3) the Buffer Zone (24 percent), a 15-kilometer band along the southern border of the MBR, where a range of land management activities, including agriculture, are allowed.

In the Multiple-Use Zone (MUZ), the Guatemalan government granted usufruct rights to 12 community organizations and two private industrial firms in the late 1990s and early 2000s to manage concessions for timber and non-timber forest products. The decision to allow for concessions was a controversial one since many doubted the ability of production forestry—particularly in the hands of community groups—to conserve natural forests. To achieve and maintain the concession contract, forestry concessions were required to comply with the standards of the Forest Stewardship Council (FSC).

Some 15 years after the majority of concessions were awarded, deforestation trends in the MBR during 2000-2013 were analyzed and broken down by administrative classification, as well as other variables. In summary the analysis found that:

- The deforestation rate across the entire MBR was 1.2 percent annually during the 14-year period, lower than the average rate of deforestation in Guatemala as whole, which stood at 1.4 percent from 2000 to 2010
- Deforestation rates were 1.0 percent in the Core Zone, 0.4 percent in the MUZ and 5.5 percent in the Buffer Zone
- In active FSC-certified concessions, the deforestation rate was close to zero
- Deforestation trends in the diverse array of Core Zone protected areas were widely variable; some units had zero deforestation while western parks in particular experienced high rates of conversion
- The highest deforestation rates outside the Buffer Zone were found in areas of the MUZ with resident populations that had no concession agreements (2.2 percent)
- Significant deforestation was also observed in MUZ areas where concessions have been cancelled due to management plan non-compliance (1.8 percent), as well as in Core Zone protected areas with resident communities (1.6 percent)
- During the final year of the study period, there was an uptick in deforestation in Core Zone protected areas with resident populations



Workers at a community run sawmill in the MBR

Photo by Rainforest Alliance

- Increased investment in the governance of concessions, non-concession MUZ units and Core Zone protected areas must be made to control mounting conversion pressure throughout the MBR.

Since its establishment, the MBR has received considerable external support from a range of donors and technical assistance providers, a level of investment that might not be sustained. The trends, conclusions and recommendations advanced here should be referenced by policymakers, donors and development practitioners in strategizing future support for natural resource conservation and economic development among Petén communities, as well as forest communities globally.

Although the significant contextual heterogeneity that occurs in the MBR makes broad generalizations difficult, the following conclusions can be drawn:

- FSC-certified forest management has effectively conserved forest cover in about a quarter of the MBR, while also producing significant socio-economic benefits for local communities.
- Community concessions can conserve forest at least as well as protected areas, especially when there is a strong commitment to forestry culture.
- Cancelled or suspended concessions that have seen high rates of deforestation can be recovered, but achieving this requires significant political will and sustained investment, meaning that the future of such areas remains uncertain.
- Core Zone protected areas and MUZ biological corridors located in less-accessible areas that face low conversion pressure have seen limited to zero deforestation.
- Core Zone units that have been successful in maintaining forest cover in the face of significant conversion pressure have done so by investing heavily in controlling access and developing effective patrolling strategies.

Based on deforestation trends to date and the above broad-scale conclusions, the following recommendations are advanced:

- FSC-certified concessions should be extended beyond the end of current contract periods, and options for granting longer-term rights should be explored.
- Other areas of the MUZ that could support community-based forestry should be identified and proposed as new concessions and/or as extensions to existing concessions.
- Cancelled or suspended concessions that have brought deforestation pressures under control should be re-concessioned.

Methods

Since 1986, the Center for Monitoring and Evaluation (CEMEC) of Guatemala's National Council of Protected Areas has been processing LANDSAT satellite imagery and using geographic information systems (GIS) to assess changes in forest cover. Spatial data layers were overlaid with MBR management zones and units in order to determine vegetative cover for the following years: 2000, 2007, 2010, 2011, 2012 and 2013. To calculate deforestation rates, we applied the equation described by Puyravaud (2003), which is derived from the Compound Interest Law:

$$\text{rate} = (1 / (\text{end year} - \text{begin year})) * \ln (\text{end forest area} / \text{beginning forest area}).$$

To assess and compare deforestation rates, results were then compiled and analyzed based on the following parameters:

- Management zones: Core Zone, MUZ, Buffer Zone
- Concession status: valid or cancelled
- Resident communities: present or absent
- Duration of community residence in concession unit: <30 years or >50 years

Text was drafted with reference to a range of widely available published and grey literature on the MBR.



The reserve is a storehouse of globally important biodiversity

Photo by CIPEC Guatemala

Map 1
Guatemala's
Petén Department,
showing the MBR



Introduction

Situated in the Selva Maya—a tropical forest expanse spanning Belize, Guatemala and Mexico—the Maya Biosphere Reserve (MBR) forms the heart of the largest block of broadleaf tropical forest in Mesoamerica. Its nearly 2.1 million hectares are home to a wide array of globally important biodiversity and iconic wildlife species, including jaguar, puma, tapir and scarlet macaw. This natural endowment is complemented by the reserve's impressive cultural heritage, including the vestiges of ancient Maya cities—most notably Tikal—a reminder that the area was once the heartland of the Maya civilization.

During the first half of the 20th century, the most important economic activity in the Petén was chicle (*Manilkara* spp.) extraction. Over time, the unregulated harvest of precious hardwoods grew

in importance, but the region remained largely disconnected from the rest of the country. In 1957, the Guatemalan government began to promote colonization in order to integrate the region into the national economy, and the Petén began to experience high rates of deforestation. By the 1980s, the civil war in Guatemala caused significant upheaval and migration into and out of the Petén.

Deforestation intensified, with large areas of forested land converted to farmland and cattle ranches. Partially in response to such developments, the National Council of Protected Areas (CONAP) was established in 1989. The following year, the MBR was created via legislative Decree 05-90.

Table 1
Use zones in the
MBR

Use Zone	Area (ha)	% of reserve land area
Core Zone	767,000	36
Multiple-Use Zone	848,400	40
Buffer Zone	497,500	24
Total	2,112,900	100

The reserve consists of a Core Zone of protected areas, a Multiple-Use Zone where controlled forest extraction is allowed, and a 15-kilometer-wide Buffer Zone at the southern edge of the reserve (Table 1).

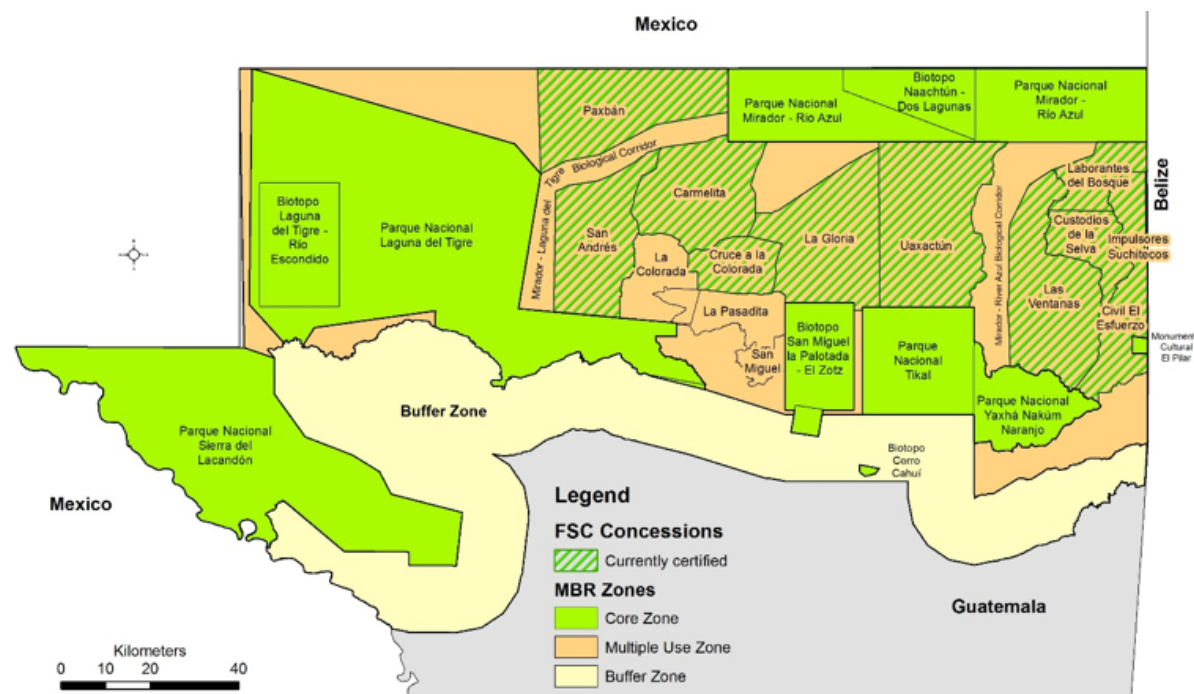
Over a third of the MBR was established as the Core Zone, a peripherally distributed mosaic of strict-protection forest and other habitats, “biotopes” and archaeological sites. In this zone, natural biological processes are to be left untouched and reserved for scientific research and recreational use. No permanent human settlements, farming or cattle ranching are permitted. Contrary to the model for most biosphere reserves, it is notable that the MBR’s Core Zone areas are distributed largely around the edges of the reserve, instead of at its geographic core.

Covering 40 percent of the MBR and located at the heart of the reserve, the Multiple-Use Zone (MUZ) is made up primarily of forest concessions for sustainable forest management that have been allocated to a host of local communities, as well as two private companies. Additionally, the MUZ consists of three biological corridors established to ensure

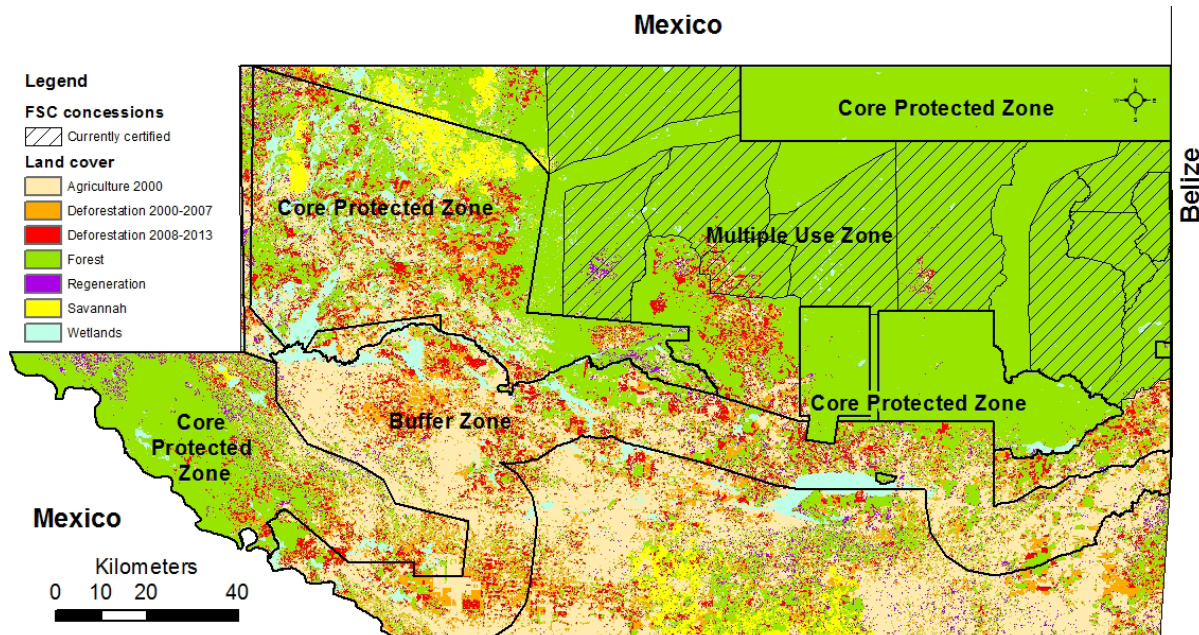
connectivity between Core Zone national parks (corridors are shown in light orange on Map 2).

A belt of land on the southern edge of the MBR’s Core and Multiple-Use zones, totaling just under a quarter of the reserve, is designated as the Buffer Zone. A range of land management activities are permitted in the Buffer Zone, including agriculture—provided that approval is secured from state authorities. Additionally, the MBR’s overall management plan calls for environmental education and technical extension activities in this zone, with the aim of stabilizing land use and reducing pressure on adjacent natural forest areas.

Land ownership is permitted in all parts of the reserve but is governed differently in each management zone. In the Core Zone and MUZ, properties that were acquired and legalized prior to 1990 may be recognized, although inhabitants must follow regulations according to the MBR management plan. In the Buffer Zone, new land titles can be issued. Although land management in the Buffer Zone should follow certain regulations in principle, activities have not been controlled in practice.



Map 2
Use zones and
concessions in the
MBR



Creation and Development of Forest Concessions

The MBR's designation as a reserve initially brought about demonstrations by communities demanding access to forest resources. In 1995, such movements coalesced into the Association of Petén Forest Communities (ACOFOP), which was founded to resolve forest conflict through the negotiation of increased rights for communities (Gomez and Mendez 2004). ACOFOP began negotiating concessions for member communities, an aim that encountered considerable resistance. Government agencies and industrial interests were highly skeptical of community capacity to manage natural forest. Some conservation NGOs argued that all of the reserve should be off-limits to timber harvesting (Nittler and Tschinkel 2005).

Through a multi-year consultation process overseen by CONAP, it was agreed that some communities would be allowed to apply for concessions. With the approval of a series of forest-planning activities, 25-year contracts would be granted, handing over exclusive rights to resources in the concession (Gretzinger 1998). Additionally, CONAP made it a requirement that, within three years of granting a concession, all operations would need to achieve (and then maintain) FSC certification.

The first concession was granted in 1994. Over the following eight years, 11 more community concessions were approved, as well two industrial concessions run by private-sector firms. The bulk of these were awarded in the late 1990s and early 2000s. Map 2 and Table 2 shows a breakdown of approved forest management units in the MBR, as well as their status².

Among the concessions, there is significant diversity. Following Radachowsky et al. (2012), concessions can be grouped into four categories:

- i. Industrial concessions, granted to two private companies
- ii. Non-resident community concessions, granted to six community organizations from the Buffer Zone that do not live in the forest concession
- iii. Resident community concessions with histories of forest management, granted to two communities established in the early 1900s
- iv. Resident community concessions with recent immigrants, granted to four communities that were established at around the time of the MBR's creation, made up largely of migrants from other regions of Guatemala whose livelihoods were reliant on agriculture and livestock

Core Zone Protected Areas

The Core Zone is made up of 12 units, including six national parks, four biotopes, one cultural monument and one municipal reserve. Like the MUZ, there is significant variation among Core Zone protected areas in terms of resident population, remoteness and pressure for conversion. It is also notable that there is a high degree of variability in terms of investment and management activities among Core Zone areas. In some areas—for example, Tikal National Park—there is a strong government presence and investment in protection activities. In others, investment and presence are highly limited.

² In addition to the concessions, seven cooperatives in the western part of the reserve were also granted the right to manage forests. Because they are not part of the concession model, these cooperatives were not considered here, but their histories and current prospects deserve attention in deriving lessons from community forestry in the MBR.

Table 2
Community
& Industrial
Concessions in
the Multiple-Use
Zone

Community Concessions			
No.	Name	Area (ha)	Year Approved
1	San Miguel*	7,039	1994
2	La Pasadita **	18,817	1997
3	Carmelita	53,797	1997
4	Impulsores Suchitecos	12,217	1998
5	Laborantes del Bosque	19,390	2000
6	Uaxactún	83,558	2000
7	San Andrés	51,939	2000
8	Árbol Verde	64,974	2000
9	La Colorada *	22,067	2001
10	Cruce a La Colorada	20,469	2001
11	Custodios de la Selva	21,176	2002
12	Civil El Esfuerzo	25,386	2002
Subtotal - Community Concessions		400,829	
Industrial Concessions			
No.	Name	Area (ha)	Year Approved
1	Baren Comercial Ltd. (La Gloria)	66,548	2000
2	Gibor, S.A. (Paxbán)	65,755	2000
Subtotal - Industrial Concessions		132,303	
Total (Community & Industrial)		533,132	

* Concession cancelled ** Management plan suspended

Buffer Zone

As noted above, the Buffer Zone is a 15-kilometer band running along the entire southern edge of the MBR. It is included in the present analysis because it is officially part of the MBR, and because the trends observed there serve as a useful, if imperfect, kind of proxy for deforestation in the Petén broadly. Since forest conversion in the Buffer Zone is not controlled, the extremely high deforestation rates observed in this area over the period analyzed cannot be taken as an indication of management failure. Other trends in the Buffer Zone—such as land titling—deserve more analysis but are not treated in this paper.

External Support

In the MBR, the strong presence of and assistance

from a range of donors, as well as international and local NGOs cannot be understated. The financial and political backing of donor agencies—above all USAID—as well as charitable organizations, such as the Ford Foundation, was central in the establishment and approval of concessions. With the concessions in particular, significant investments by a large number of groups were made to organize communities, undertake forest management planning and secure the approval of concession contracts. Among other agencies—including Centro Maya, Conservation International, Naturaleza para la Vida and CATIE—the Rainforest Alliance has been active in supporting the concessions since their establishment, with certification services as well as enterprise and market development. The Wildlife Conservation Society has been active in supporting protected areas and concessions, as well as offering institutional support to CONAP.

Though not yet compiled, a full inventory of the support offered to the MBR would be useful to undertake. To provide some sense of scale, however, USAID investments alone likely exceed \$50 million since the reserve's establishment.

Results

Table 3 below summarizes deforestation trends in the MBR from 2000 through 2013. Overall, during the period analyzed, deforestation in the MBR stood at 1.2 percent. This is lower than the rate of deforestation in Guatemala as a whole from 2000 through 2010, when it was 1.4 percent (FAO 2011).

It is widely accepted that the chief driver underlying deforestation in the MBR is livestock ranching. The establishment of oil palm plantations appears to be a growing threat as well, particularly because they displace the rural poor from non-protected areas into the reserve, and because these plantations occupy lands that could otherwise serve for cattle ranching. Many operations that result in forest conversion in and around the MBR are reported to have connections to organized crime (McSweeney et al. 2014), a situation that has also become increasingly common in other frontier



Forest conversion in the Buffer Zone of the MBR

Photo by Rainforest Alliance

areas of Central America. A more detailed analysis is underway to examine the drivers of deforestation in the reserve.

The bulk of the deforestation observed during the analyzed period took place in the Buffer Zone. Given that forest conversion in the Buffer Zone is not officially prohibited—and is also largely uncontrolled—this trend will not be considered in this paper.

Group	n	2000-2007	2007-2010	2010-2011	2011-2012	2012-2013	2000-2013
Core Zone							
No residents	7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Residents	5	1.0%	2.9%	1.2%	1.0%	2.2%	1.5%
MUZ - Concessions							
Industrial	2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Non-resident community	6	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%
Resident community >50	2	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
Resident community <30	4	0.7%	4.8%	0.9%	0.4%	0.0%	1.6%
MUZ - No Concessions							
No Residents	7	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Residents	7	1.7%	2.9%	2.6%	3.3%	2.4%	2.2%
Buffer Zone	1	4.9%	7.4%	5.8%	5.0%	4.1%	5.5%
Totals	41	1.0%	1.8%	1.0%	0.9%	1.0%	1.2%

Table 3
Deforestation (annual % change) in management units of the MBR over time

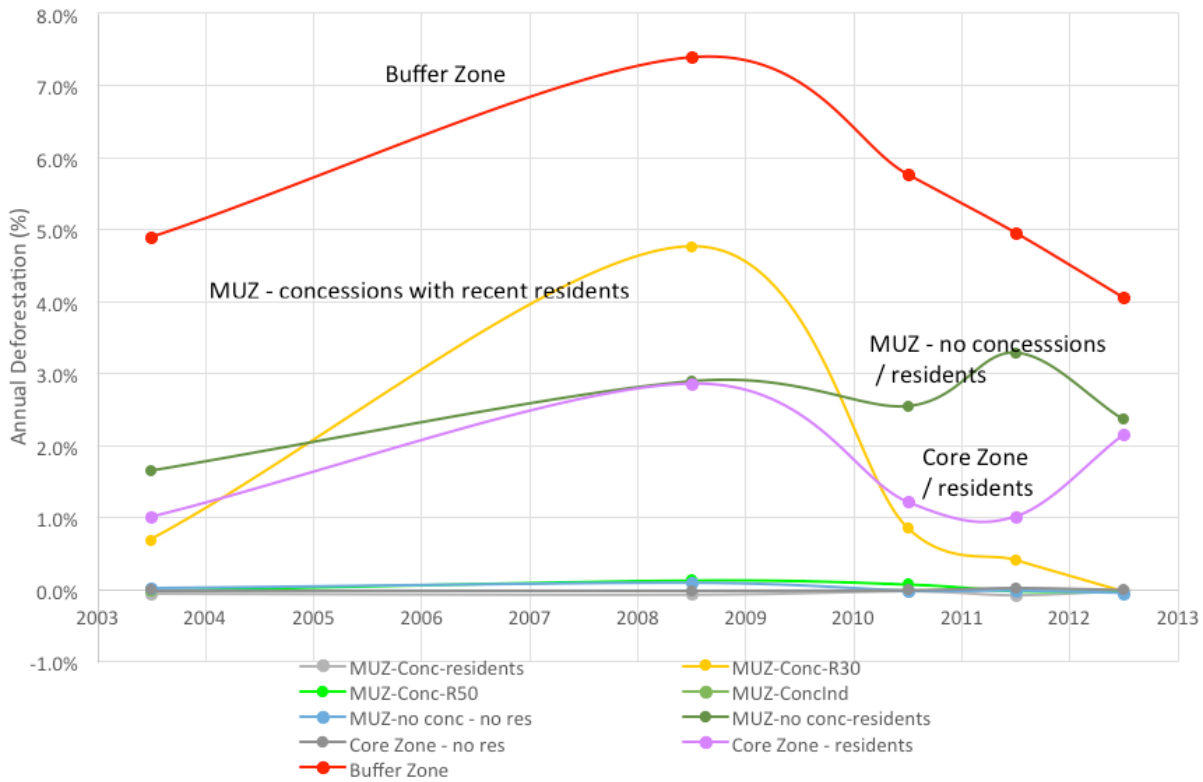


Figure 1
Deforestation trends in variable management units

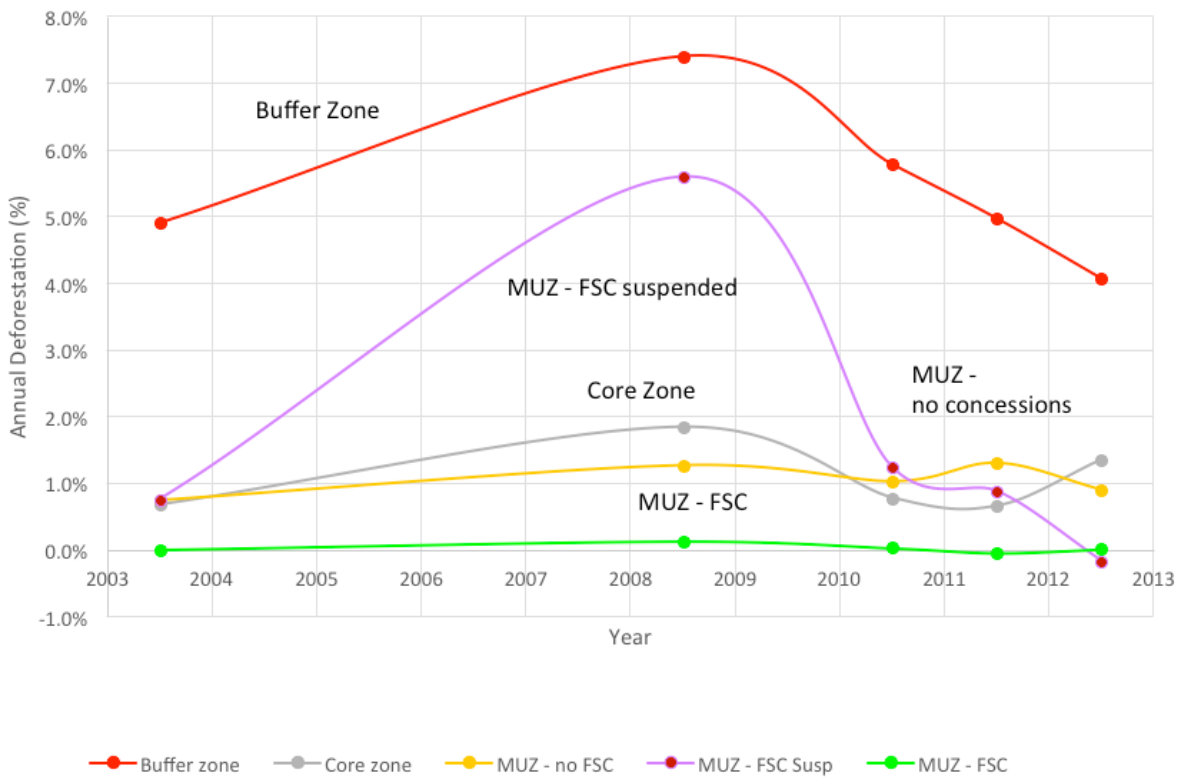


Figure 2
Deforestation rates in certified and non-certified areas

Taken as a whole, Core Zone protected areas experienced an overall deforestation rate of one percent. There was considerable differentiation in deforestation among the 12 management units that make up the Core Zone. The vast bulk of deforestation was concentrated in the western parks, specifically Laguna del Tigre and Sierra de Lacandón national parks. Meanwhile, in parks that are very remote and have no resident populations, deforestation rates were close to zero. At the same time, several parks that are situated on the front lines of the deforestation frontier have seen very low deforestation rates.

Overall, the MBR administrative zone that has experienced the least deforestation is the MUZ. As in the Core Zone, the MUZ features significant heterogeneity. In some parts of the MUZ—in areas that have never been concessioned or were concessioned to recent migrants—deforestation rates have been relatively high. In other areas—such as concessions with no resident populations or whose communities have been in the MBR for more than 50 years—deforestation rates are next to nil. The same is the case for the MUZ's two industrial concessions, both of which lack residents, where deforestation has been near zero.

As noted in Figure 1, deforestation rates in the MBR spiked during the period from 2008 to 2009, a trend expressed by a peak in nearly all management zones in 2010 (since only data from 2007 and 2010 were analyzed). During this period, considerable areas of forest were cleared for livestock operations, most notably in western Core Zone protected areas and cancelled concessions along the road to Carmelita (“Ruta Carmelita”) within the MUZ. After 2010, there was a dramatic drop in deforestation rates, particularly among cancelled concessions. This was largely due to protection measures taken by the state with support from external agencies. The future of these cancelled concessions is a topic that deserves increased attention.

Even though changing deforestation rates in certain parts of the MBR constitute an important story, it is equally notable that deforestation rates in other areas of the reserve remain at or close to zero—including areas that are under considerable conversion pressure. A comparison of those areas in the MUZ that are under timber and NTFP management with areas that are not certified bear out trends similar to those noted for the MUZ as a whole (see Figure 2). Areas that have retained FSC certification, as well as areas with no resident population, have had the lowest rates of deforestation rates in the reserve.

Discussion

Significant diversity in each management zone and among specific units complicates simple comparisons. Spanning 19 percent of Guatemala’s terrestrial surface area, the reserve is so large that there is tremendous variation in threat levels, among other factors. Heterogeneity is the rule.

As noted above, the western parks—Sierra de Lacandón and Laguna del Tigre—have faced the greatest threat levels in the whole reserve. Specific threats have included petroleum exploration and associated road building, as well as organized illegal colonization. Laguna del Tigre’s extensive wetlands (i.e., surface water) have also made it an ideal target for the expansion of cattle ranching. The presence of savannah ecosystems and the proximity to Mexico, moreover, have led to the proliferation of narco-trafficking landing strips, as well as ranching operations controlled by organized crime rings (“narcofincas”). Such operations also lead to high levels of timber and wildlife poaching, not to mention social conflict and violence.



Communities in the MBR manage forests for a range of products, including xate palm

Photo by Charlie Watson

By contrast, Mirador-Río Azul National Park is probably the least threatened section of the whole tri-national Selva Maya complex. The park is extremely remote, with vehicular access largely restricted to the dry season. Surface water is mostly absent, which means the park is not attractive to cattle ranchers and farmers. Although it is also adjacent to Mexico, most of the park is bordered by the extensive Calakmul Biosphere Reserve, in the state of Campeche, which does not contain Mexican settlements.

Finally, the Yaxha-Nakum-Naranjo National Park, at the southeastern flank of the MBR, faces considerable threats due to its relatively easy access. This has resulted in significant pressure from illegal colonization and poaching, though the park has effectively controlled such pressure to date.

MUZ units, including forest concessions, are characterized by a similar divergence of context. Within this management zone, the highest threat levels have been found along the “Ruta Carmelita,” due to year-round vehicular access to the area, which has facilitated timber poaching and extensive colonization by cattle ranchers. As noted, these concessions were settled by new migrants, who brought with them agricultural and pastoral livelihood modes. Despite remaining free of colonists, the AFISAP and Paxban forest concessions have also faced high threat levels from eastwardly expanding

Sustainable forestry is driving enterprise development and building social capital in community concessions

Photo by Rainforest Alliance



land colonization originating in Laguna del Tigre National Park, as well as from the eastern side of AFISAP, within La Colorada's cancelled forest concession.

By contrast, the seven central and easternmost concessions—including La Gloria, Uaxactún, Las Ventanas and the four concessions that are on the Belize border—have faced comparatively low levels of threat since their establishment. With the exception of Uaxactún, which is a traditional forest community, none of these concessions have resident populations. To a notable degree, the southeastern block of Core Zone units—consisting of the El Zotz Biotope, Tikal National Park and Yaxha-Nakum-Naranjo National Park—seem to have provided an effective buffer for certified forest concession management units.

Conclusions and Recommendations

Notwithstanding the diversity among management units, the following general points appear to be supported by forest cover trends in the MBR since 2000.

The first is that production forestry, when certified to international standards, can be a highly effective approach to maintaining forest cover. This holds true for both industrial and community concessions. While some have recently claimed that the successes of community management have been exaggerated (Blackman 2014), the fact remains that community forests have been at least as effective as parks in maintaining forest cover in the MBR. In

a global policy environment that is still largely hostile to the idea of community-managed production forestry in high-value natural forests, the MBR case is revelatory.

Community forestry in the MBR has had greater success where (a) resident communities have a long history of forest-based activity or (b) the forest concession itself is not populated and is located in a remote area, managed from afar by a local organization. Those concessions that were granted to resident communities of recent migrants to the Petén have, in general, not performed well. Two have been cancelled altogether (La Colorada and San Miguel), and one has been suspended indefinitely (Pasadita), with a cancellation notification pending. The exception is Cruce a la Colorada. Although it remains FSC-certified, this concession has faced strong conversion pressure from external forces and significant internal conflict, but thanks to sustained external technical and financial support, it is reestablishing control over its forest.

Meanwhile, the diversity of both context and outcomes in the Core Zone complicates an assessment of the performance of parks and reserves as a whole. While deforestation rates have been very low in most Core Zone units that are located far from human settlements, roads and conversion pressures, the presence of such factors has been correlated with high deforestation rates in some units—most notably, the western parks. In other units that are close to roads and significant conversion pressure—for example, Tikal National Park—very low deforestation rates have been observed.

Here, heavy investment in controlling access, plus a strong government presence and a high-profile tourism industry have helped to keep the deforestation threat at bay.

In summary, this analysis underscores the point that any generalizations attributing success or failure entirely to prescribed management approaches should be viewed with caution and placed in their proper context. The characteristics specific to a given site or management unit are more important. Such caveats notwithstanding, the findings support the growing evidence that community production forestry can be an effective tool for forest conservation. It is clear that FSC-certified forest concessions continue to play a vital role in conserving the forests of the MBR. It is also clear that increased investment in the governance of Core Zone protected areas and MUZ concessions will be needed if the MBR's remaining forest landscapes are to be maintained, particularly those facing heavy conversion pressure.

Based on the results of this analysis, the following recommendations are advanced:

- FSC-certified concessions should be extended beyond the end of current contract periods, and the option of granting longer-term rights should be explored.
- Other areas of the MUZ that could support community-based forestry should be identified and proposed as new concessions and/or as extensions to existing concessions.
- Cancelled or suspended concessions that have brought deforestation pressure under control should be re-concessioned.
- Increased investment in the governance of concessions, non-concession MUZ units and Core Zone protected areas must be made to control the mounting pressure for conversion throughout the MBR.

In planning future investments in the MBR, government, donors and technical assistance agencies should reference the results presented in this paper to support models that have proven their effectiveness in forest conservation, as well as in producing significant benefits for local communities.

References

Blackman, A. 2014. Strict versus mixed use protected areas: Guatemala's Maya Biosphere Reserve. Resources for the Future discussion paper, Washington, D.C.

FAO. 2011. State of the World's Forests. FAO, Rome, Italy.

Gómez, I. and V.E. Méndez. 2004. *Association of Forest Communities of Petén, Guatemala: Context, Accomplishments and Challenges*. CIFOR, Bogor, Indonesia.

Gretzinger, S. 1998. Community forest concessions: an economic alternative for the Maya Biosphere Reserve in the Petén, Guatemala. In: *Timber, Tourists and Temples: Conservation and Development in the Maya Forest of Belize, Guatemala and Mexico*. Primack, R., Bray, D.B., Galletti, H. and Ponciano, I. (Eds.) Island Press, Washington, D.C.

McSweeney, K., Nielsen, E.A., Taylor, M.J., Wrathall, D.J., Pearson, Z., Wang, O., and S.T. Plumb. 2014. Drug policy as conservation policy: Narco-deforestation. *Science* 343(6170): 489-490.

Nittler, J. and Tschinkel, H. 2005. *Community forest management in the Maya Biosphere Reserve of Guatemala: Protection through profits*. Unpublished report submitted to USAID.

Puyravaud, J.-P. 2003. Standardizing the calculation of the annual rate of deforestation. *Forest Ecology and Management*, 177, 593-596.

Radachowsky, J., Ramos, V.H., McNab, R., Baur, E.H., and N. Kazakov. 2012. Forest concessions in the Maya Biosphere Reserve, Guatemala: a decade later. *Forest Ecology and Management*, 268, 18-28.

The production of this document was made possible by the support of the American People through the United States Agency for International Development (USAID). The contents of this publication are the sole responsibility of the Rainforest Alliance, WCS and CONAP and do not necessarily reflect the views of USAID or the United States Government