Reducing Carbon Emissions from Deforestation: the Role of ARPA's Protected Areas in the Brazilian Amazon

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Reducing Carbon Emissions from Deforestation: the Role of ARPA's Protected Areas in the Brazilian Amazon

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Abstract

Protected areas in the Brazilian Amazon biome play a decisive role in conserving biodiversity. Over a 10-year period (2003-2012), the Amazon Protected Areas Program (ARPA) aims to establish 375,000 km^2 in new protected areas and consolidate a total of 600,000 km^2 in both new and existing protected areas, making it by far the most ambitious protected areas program in the world. This paper evaluates the effects of protected areas in general, and of and of those supported by ARPA in particular, on carbon emission from deforestation in the Brazilian Amazon.

Based on analyses of historical deforestation rates from 2002-07 within the region´s 520 protected areas, and in surrounding zones at 0-10 km, 10-20 km and >20 km distance, we found that the probability of deforestation was 7-11 times less within protected areas than outside these areas, increasing progressively in zones increasingly distant.

We used the SimAmazonia-2 model under a business-as-usual scenario to examine the effects of protected areas on future deforestation and emissions, with protected areas established by 2002 as a baseline. The model showed that by 2050, expansion of protected areas during 2003-07 reduced 272,000 km^2 in deforestation, thereby avoiding 3.3±1.1 gigatons of carbon (GT C) emissions, of which 0.4 GT C was attributable to 13 protected areas established with ARPA's support. Including an additional 127,000 km^2 of new ARPA protected areas throughout 2008, the ARPA program would reduce a total of 1.4 GT C (or 5.1 GT CO_2) in emissions by 2050. For purposes of comparison, the latter figure represents ~14% of global CO_2e emissions per year, or ~70% of estimated emissions targeted for reduction under the first commitment period of the Kyoto Protocol.

This study shows that, in addition to their critical role in conserving biodiversity, protected areas in the Brazilian Amazon biome, and in particular those supported by the ARPA program, effectively reduce deforestation and associated carbon emissions. In the scope of the United Nations Framework Convention on Climate Change (UNFCC), ARPA is therefore ready to be integrated in future formal and/or voluntary mechanisms of positive incentives for reducing emissions from deforestation.

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Introduction

With approximately 1.8 million km^2 of the region´s remaining forests, protected areas in the Brazilian Amazon biome play a decisive role in conserving biodiversity and its ecosystems. In this context, the Amazon Protected Areas Program (ARPA), launched by the Brazilian government in 2002, is highly relevant. With a projected investment of US$ 400 million over a 10-year period (2003-12), ARPA aims to establish 375,000 km^2 in new protected areas and consolidate a total of 600,000 km^2 in both new and existing protected areas, making it by far the most ambitious protected areas program in the world. Of the 334,000 km^2 in protected areas that are currently supported by the program, 208,000km^2 are designated for strict protection and 126,000 km^2 for sustainable use[5] (Figure 1; see categories in Table 1[6]).

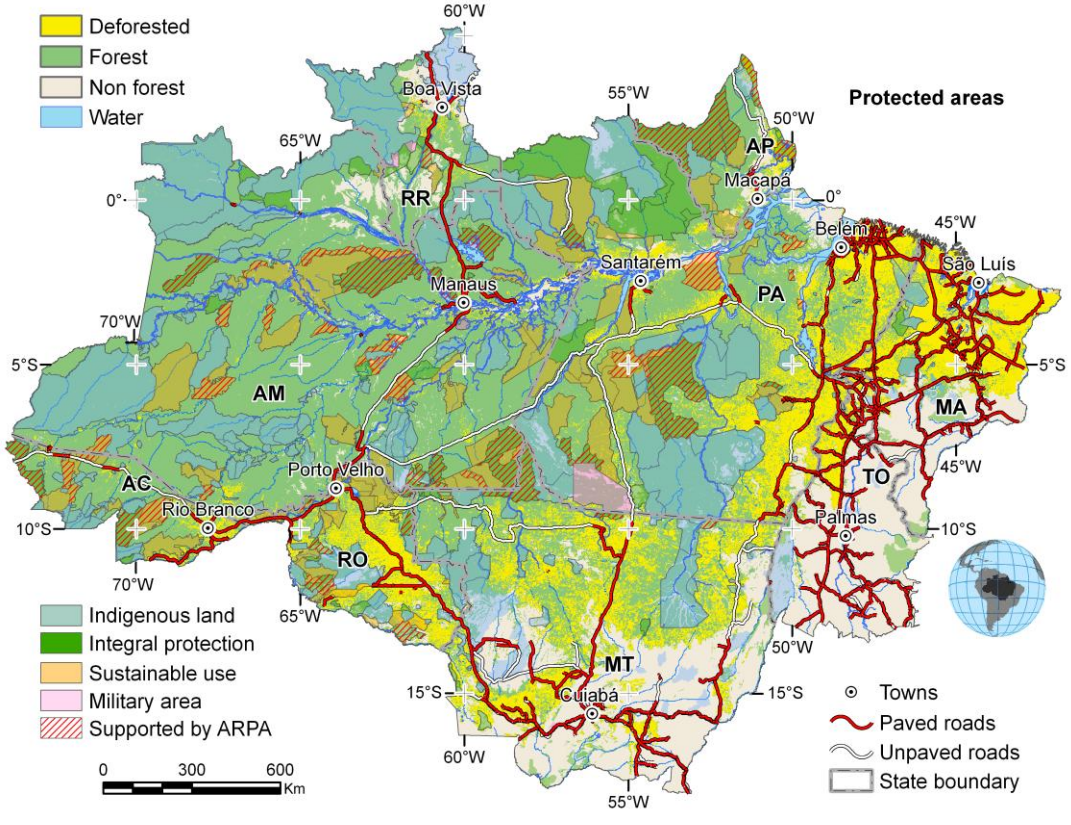

Figure 1. Protected areas in the Brazilian Amazon biome, with areas supported by the ARPA program highlighted.

[5] The first group, strict protection, aims mostly at preserving biological diversity, and the second group, at conciliating conservation with the sustainable use of natural resources. In both cases, there is an association with the remaining interests and benefits resulting from nature conservation such as ecological processes, environmental services and others.

[6] The Environmental Protection Areas ("APA", in Portuguese) were not included in this analysis as they are not of public domain and are not effective in terms of resistance to the current deforestation patterns in the Brazilian Amazon.

Protected Area Category		No.	Area (km²)	Proportion of biome (%)	Proportion of area supported by ARPA (%)
Military area		6	26,235	0.6	-
Indigenous land		281	987,219	23.4	-
Strict protection	state	44	137,385	3.3	22.5
	federal	37	231,072	5.5	80.6
Sustainable use	state	72	201,918	4.8	13.2
	federal	80	233,523	5.5	26.2
Total		520	1,817,355	43.0	16.8

Table 1 – Categories, numbers and size of protected areas in the Brazilian Amazon biome, with their corresponding proportions of the biome and those supported by ARPA.

Despite ARPA being recognized as having an important global role in conserving biodiversity since 2004 (CBD-WGPA, 2008), the program´s potential role in reducing deforestation and associated greenhouse gas emissions has not yet been investigated. This paper proposes to fill this gap by evaluating the effects of protected areas in general, and of those supported by ARPA in particular, on deforestation and carbon emissions in the Brazilian Amazon biome.

Field in preparation for soya plantation

Results

Effects on Past Deforestation

Based on analyses of historical deforestation rates from 2002-07, the probability of deforestation was calculated within the region's 520 protected areas, and in surrounding zones at 0-10 km, 10-20 km and >20 km distance (Figure 2).

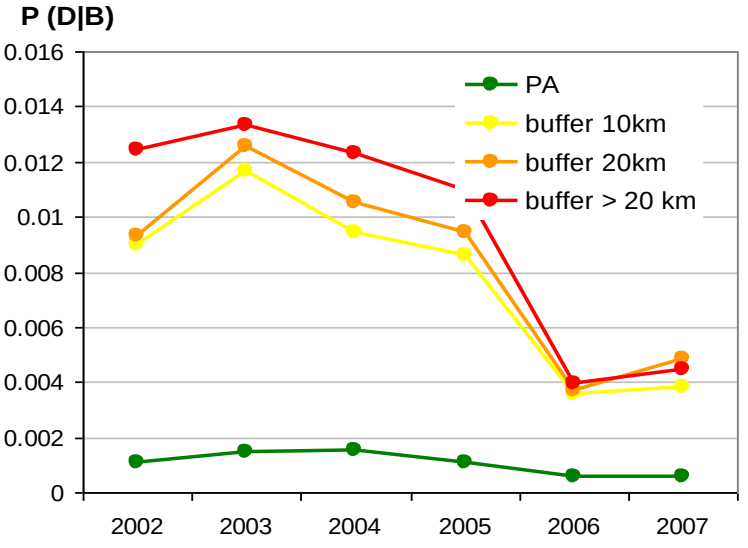

Figure 2. Probability of occurrence of deforestation in protected areas and in buffer zones at 0-10 km, 10-20 km and >20 km distance during 2002-07. On the y axis, P(D/B) represents the probability (P) of deforestation occurring (D) given a spatial pattern including protected areas and the illustrated buffer zones (B).

The results show that protected areas effectively reduce deforestation: the probability of deforestation was 7-11 times less within protected areas than outside these areas, and it increased progressively in zones increasingly distant. This finding corroborates results reported in the Amazon region and elsewhere in the tropics (Bruner *et al.,* 2001; Naughton-Treves *et al.,* 2005; Ferreira *et al.,* 2005; Soares-Filho *et al.,* 2006; Nepstad *et al.,* 2006).

Although protected areas cover 43% of the Brazilian Amazon biome (Table 1), accumulated deforestation to date represents less than 5% of the biome's total deforestation. Distributed by the protected area category, deforestation totaled 3,800 km² in areas under strict protection (1% of the total area under this category), 13,100 km² in areas under sustainable use (3%) and 10,700 km² in indigenous lands (1.1%).

Future Deforestation and Carbon Emissions

The SimAmazonia-2 model of deforestation scenarios in the Amazon basin (Soares-Filho *et al*., 2008), a more advanced iteration of a model developed by Soares-Filho *et al.* (2006), showed the effects of protected areas in general, and those established under the ARPA program specifically, on future deforestation and carbon emissions.

To understand the relationship between forest carbon stocks in ARPA-supported protected areas and their potential for future emissions, we used the model to generate a map of deforestation risks by 2050 for the region, upon which we superimposed a map of forest carbon stocks (Saatchi *et al*., 2007). Assuming that 85% of forest carbon is liberated to the atmosphere during and after deforestation (Houghton et al., 2005), we calculated the carbon stocks in each protected area supported by ARPA and the potential for emissions by 2050 if those areas did not exist (Figure 3).

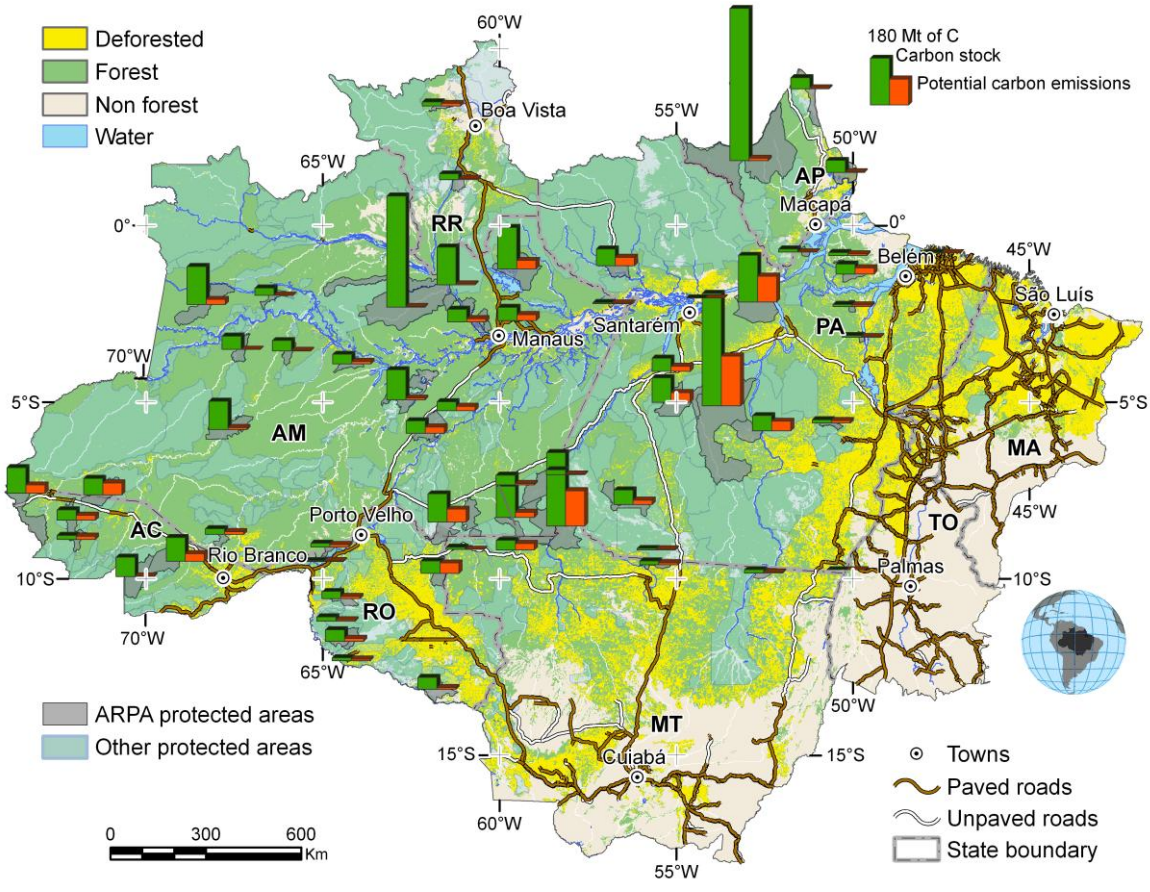

Figure 3. Carbon stocks and potential carbon emissions by 2050 in 61 protected areas currently supported by the ARPA program.

These results show that in protected areas adjacent to active deforestation zones, potential carbon emissions were high compared to total carbon stocks, due to the high risk of deforestation in those areas. Based on this finding, it is clear that the establishment and effective implementation of protected areas in these zones offers high payoffs for reducing carbon emissions, and therefore should be essential components of a regional conservation strategy.

Finally, we examined the effects of protected areas on future deforestation and emissions under a business-as-usual scenario (Figure 4). Since 2002 was adopted as baseline, in the case of ARPA we only considered protected areas established under the program (that officially started in 2003) and not the larger number of areas that only receive support for implementation--thereby underestimating the program´s overall impacts. The model showed that by 2050, expansion of protected areas during 2003-07 would reduce deforestation by 272,000 km^2, thus reducing emissions by 3.3±1.1 gigatons of carbon (GT C), of which 0.4 GT C can be attributable to 13 protected areas established with ARPA support. Including an additional 127,000 km^2 of new ARPA protected areas in process of establishment during 2008, the program would reduce a total of 1.4 GT C (or 5.1 GT CO_2) in emissions by 2050. For purposes of comparison, the latter figure represents ~16% of global CO_2e emissions per year, or ~70% of emissions targeted for reduction under the first commitment period of the Kyoto Protocol.

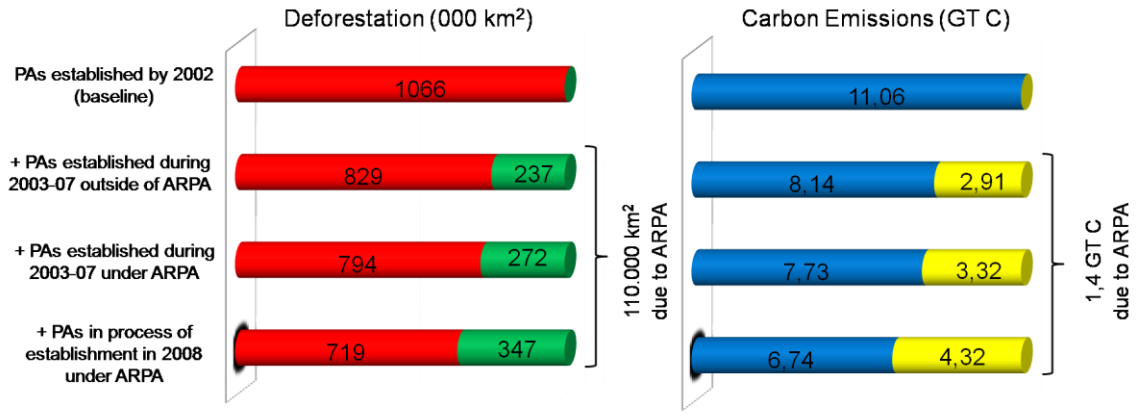

Figure 4. Deforestation and resulting carbon in the Brazilian Amazon biome under a business-as-usual scenario, with simulations showing progressively increasing establishment of protected areas (PAs).

Conclusions

This study shows that, in addition to their critical role in conserving biodiversity, protected areas in the Brazilian Amazon biome, and specifically those established by the ARPA program, effectively reduce deforestation and associated carbon emissions. These effects complement other roles of protected areas in maintaining essential environmental services such as maintenance of hydrological regimes and prevention of forest fires, which play important roles in regulating regional climate.

It also reveals that the establishment and effective implementation of protected areas in zones under high current or future anthropogenic threat offers high payoffs for reducing carbon emissions, and as a result these zones should receive special attention in the planning of investment priorities for regional conservation. On the other hand, this strategy presents greater risks than the approach of prioritizing areas with high biodiversity and under a low degree of threat. Such areas also increase the probability of long-term conservation of biodiversity in a scenario of increasing climate change. As a result, an optimal conservation strategy for the biome should encompass areas under current or future anthropogenic threat and also less threatened areas, thereby assuring reduced carbon emissions and the long-term protection of representative samples of biodiversity.

In the scope of the United Nations Framework Convention on Climate Change (UNFCC), this study contributes to the decisions made by the Conference of Parties (COP 13), held in December 2007 in Bali. The Bali Action Plan[7] refers to the development of policy approaches and positive incentives to reducing emissions from deforestation in developing countries. In a specific decision concerning deforestation[8], it is acknowledged that reducing emissions from deforestation in developing countries requires stable and predictable resources. As demonstrated in this study, the ARPA program is ready to be integrated in future formal and/or voluntary mechanisms of positive incentives for reducing emissions from deforestation.

[7] Report of Conference of Parties on its thirteenth session, held in Bali from 3 to 15 December 2007 – FCCC/CP/2007/6/Add.1 in http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=8

[8] Decision UNFCC 2/CP 13.

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