André Monteiro, Dalton Cardoso, Denis Conrado, Adalberto Veríssimo & Carlos Souza Jr. (Imazon)

Abstract

In this bulletin *Transparency in Forest Management in Pará* we assess the logging situation in the State. To do this, we first verified the regularity or consistency of the information on management plans in the Timber Harvesting Authorizations (*Autorizações de Exploração Florestal* - Autef) and authorized credits from logging issued by the State Secretariat for the Environment in Pará (Sema), from August, 2009 to July, 2010. We found that in 2010 the great majority (90%) of Autef plans were legally compliant, while 10% had inconsistencies, such as: i) area authorized larger than area for management; ii) area authorized in already degraded or deforested area; iii) area authorized in already logged area iv) timber credit commercialized greater than authorized.

Our assessment also involved estimating the areas logged both legally (authorized) and illegally (not authorized) from August, 2009 to July, 2010, using NDFI images derived from Landsat images. The results reveal that of the 120,512 hectares of forests logged in the period, the majority (65% or 78,941 hectares) were authorized by Sema as opposed to 35% or 41,571 hectares authorized. In terms of illegal logging, the great majority (84%) occurred in areas that were private, vacant or disputed; another 13% in land reform settlements; and only 3% in Protected Areas. For the two periods we observed a 16% reduction in illegal logging (15,444 hectares) and a positive increase of 33% (10,400 hectares) in legal logging.

Finally, we evaluated the quality of forest management performance in the State from August, 2008 to July, 2009 and August, 2009 to July, 2010 using NDFI images. We observed that timber harvesting with forest management increased between the period; while there we verified 24,730 hectares with good quality, 16,915 hectares with intermediate quality and 12,021 with low quality logging.

For a general assessment of timber harvesting status in the State, we utilized information from Sema control systems: Simlam (Integrated System for Licensing and Environmental Monitoring - *Sistema Integrado de Licenciamento e Monitoramento Ambiental*) and Sisflora (System for Marketing and Transportation of Forest Products - *Sistema de Comercialização e Transporte de Produtos Florestais*)-, which were overlapped with information generated by Simex (System for Monitoring Timber Harvesting - *Sistema de Monitoramento da Exploração Madeireira*), developed by Imazon (Box 1).

Forest Control System

According to Simlam at Sema/PA, in 2009 approximately 170 Autefs were issued out of a total of 165 forest management plans that covered an area of 157.2 thousand hectares of forest. That represented 3.7 million cubic meters of logwood and 2.3 million cubic meters of forest residues. In 2010 there were approximately 435 Autefs of a total of 433 forest management plans that covered an area of slightly more than 298 thousand hectares of forest, representing a volume of 8.8 million cubic meters of logwood and 4.4 million cubic meters of forest residues. The volumes of logwood and forest residues allowed in Simlam for 2010 represent significant increases of 138% and 91% respectively in relation to 2009. In both years the great majority (89%) of this wood came from native forest and the remaining 11% from planted forest.

For its part, at Sisflora there was the registration[1] and clearing[2] in 2009 of approximately 3.7 million cubic meters of logwood and 2.2 million cubic meters of forest residues. In 2010 7.9 million tons of logwood and 4.2 million tons of forest residues were cleared, representing a significant increase of 113% and 45% respectively in relation to 2009 (Table 1).

Geography of Timber Harvesting in Pará

To identify non-authorized (illegal and predatory) and authorized (legal, forest management) logging in the State from August, 2009 to July, 2010 we overlaid the boundaries of forest management plans on NDFI images derived from Landsat images (Figure 1 and Box 1).

Non-authorized logging was detected in almost all of the regions and mesoregions of the State, with the majority in the southeast (51%), followed by northeast (18%), southwest (15%), Lower Amazon (8%) and Marajó (7%) (Figure 1).

There were 120,512 hectares of logged forests detected, of which 78,941 hectares (65%) lacked authorization and 41,571 hectares (35%) were authorized for forest management. However, when we compare the areas logged between the previous period (August 2008 to July 2009) and the current period (August 2009 to July 2010), we observe a positively a reduction of 16% in non-authorized harvesting and a 38% increase in authorized harvesting (Figure 1 and 2).

Table 1. Volumes of timber authorized through Simlam and through Sisflora in 2009 and 2010

Year	Autef (Qt)	PMF (Qt)	Area authorized (ha)	Volume Simlam (m^3)		Volume Sisflora (m^3)		Difference in volume between Simlam and Sisflora (m3)	
				Log.	Resid.	Log.	Resid.	Log.	Resid.
2009	170	165	157,200	3,769,973	2,338,688	3,727,844	2,248,458	-42,129	-90,229
2010	435	433	298,274	8,859,579	4,482,041	7,985,443	4,246,922	-874,135	-235,119

[1] The timber credits are only cleared by Sisflora after approval in Simlam and Ceprof. Ceprof is an electronic registration system containing information on the owner, company, property, licensed activity, and person technically and legally responsible.
[2] The volumes of logwood and forest residues cleared by Sisflora in 2009 were updated in relation to those described in the previous bulletin (2008-2009).

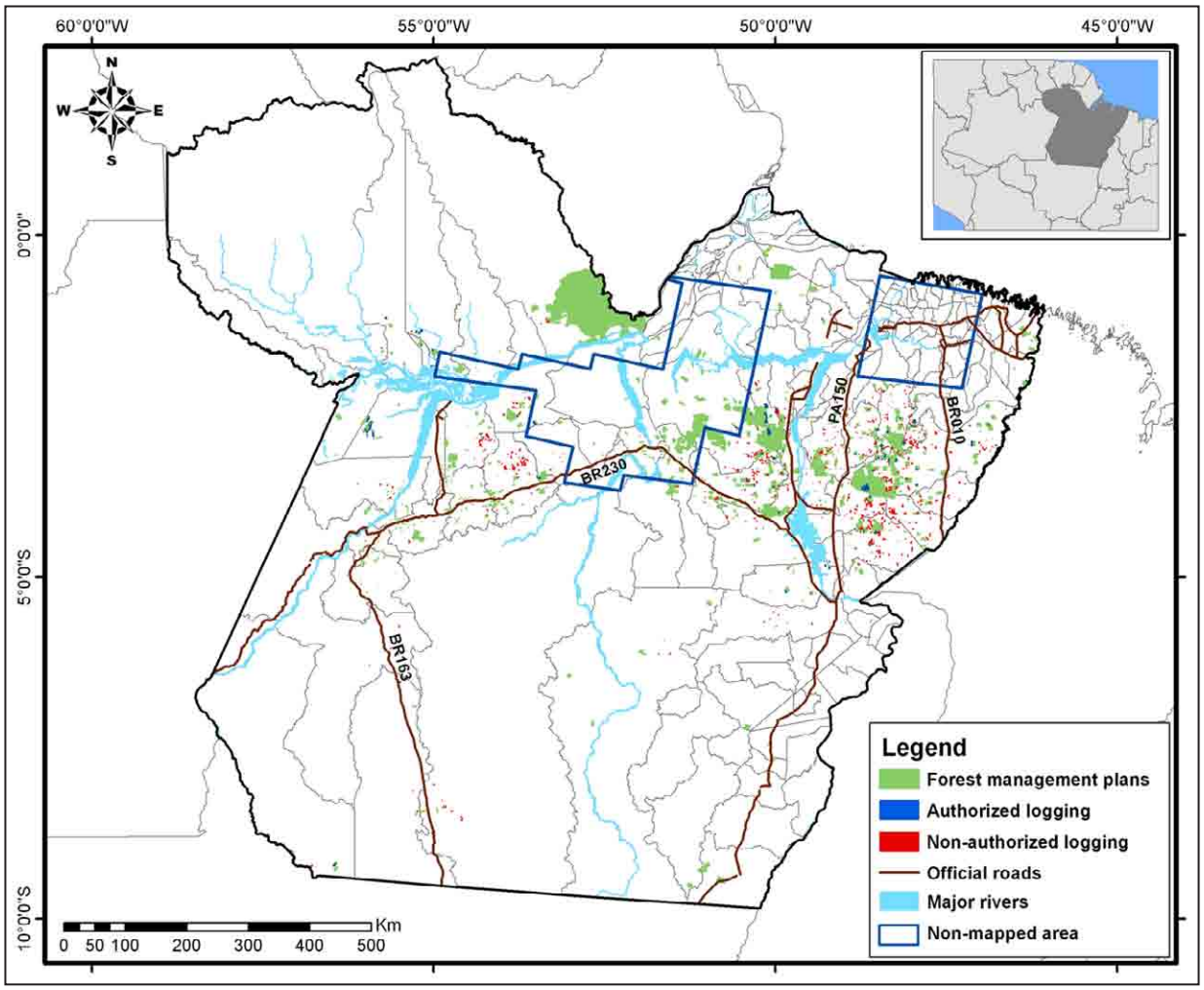

Figure 1. Authorized harvesting (authorized management) and non-authorized harvesting (predatory) in the State of Pará from August/2009 to July/2010 (Source: Imazon/Simex).

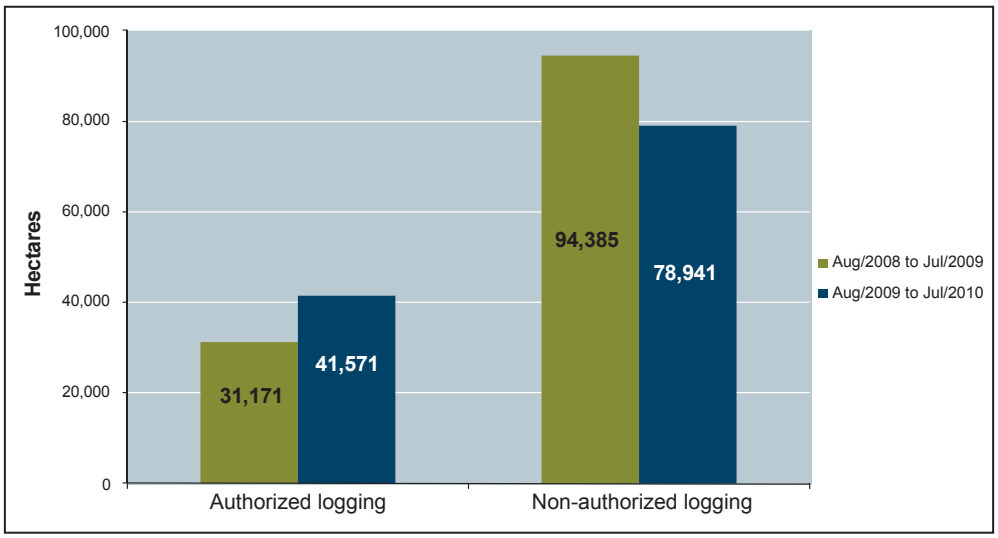

Figure 2: Areas harvested with and without authorization in the State of Pará from August/2008 to July/2009 and August/2009 to July/2010.

Critical Municipalities

Of the 78,941 hectares of forest logged without authorization in Pará from August 2009 to July 2010 the majority (74%) occurred in 10 municipalities (Figures 3 and 4). The remaining 26% were distributed in a sparser manner among 41 other municipalities.

The five municipalities with the largest areas logged without authorization were, in decreasing order: Rondon do Pará (BR-222), Paragominas (BR-010), Goianésia do Pará (PA- 150), Dom Eliseu (BR-010) and Uruará (BR-230) (Figures 3 and 4).

When we compared the current period analyzed (August, 2009 to July 2010) with the previous (August, 2008 to July 2009) we found a significant reduction in non-authorized logging in Paragominas (6,203 hectares), Tailândia (4,031 hectares), Tomé-açu (3,829 hectares), Mojú (2,354 hectares), Goianésia do Pará (230 hectares) and Portel (130 hectares), while there was an increase in that logging in the municipalities of Uruará (1,583 hectares), Rondon do Pará (940 hectares), Pacajá (868 hectares), Ulianópolis (712 hectares), Dom Eliseu (530 hectares) and Ipixuna do Pará (382 hectares) (Figure 5).

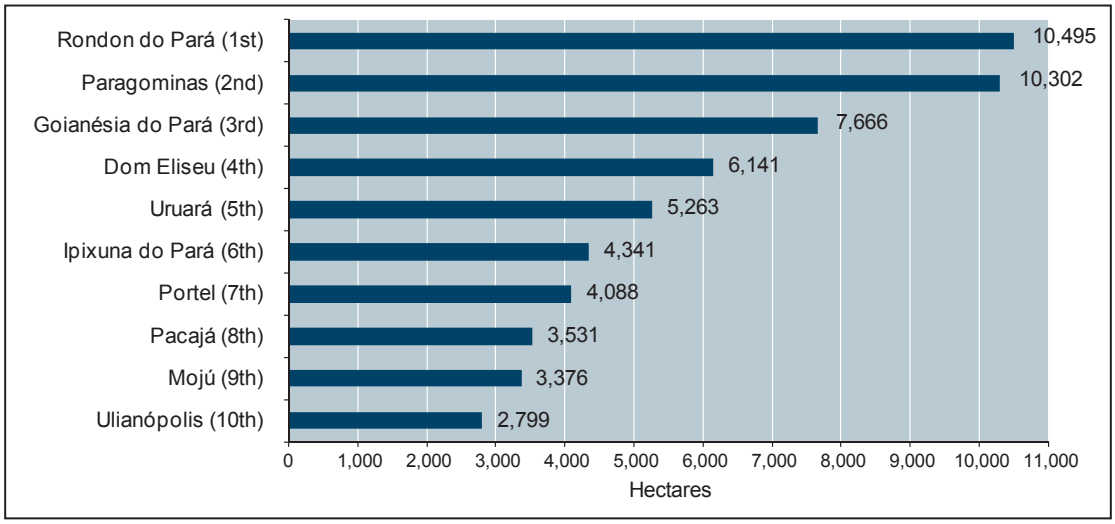

Figure 3. Municipalities with the largest areas logged without authorization in the State of Pará from August/2009 and July/2010 (Source: Imazon/Simex).

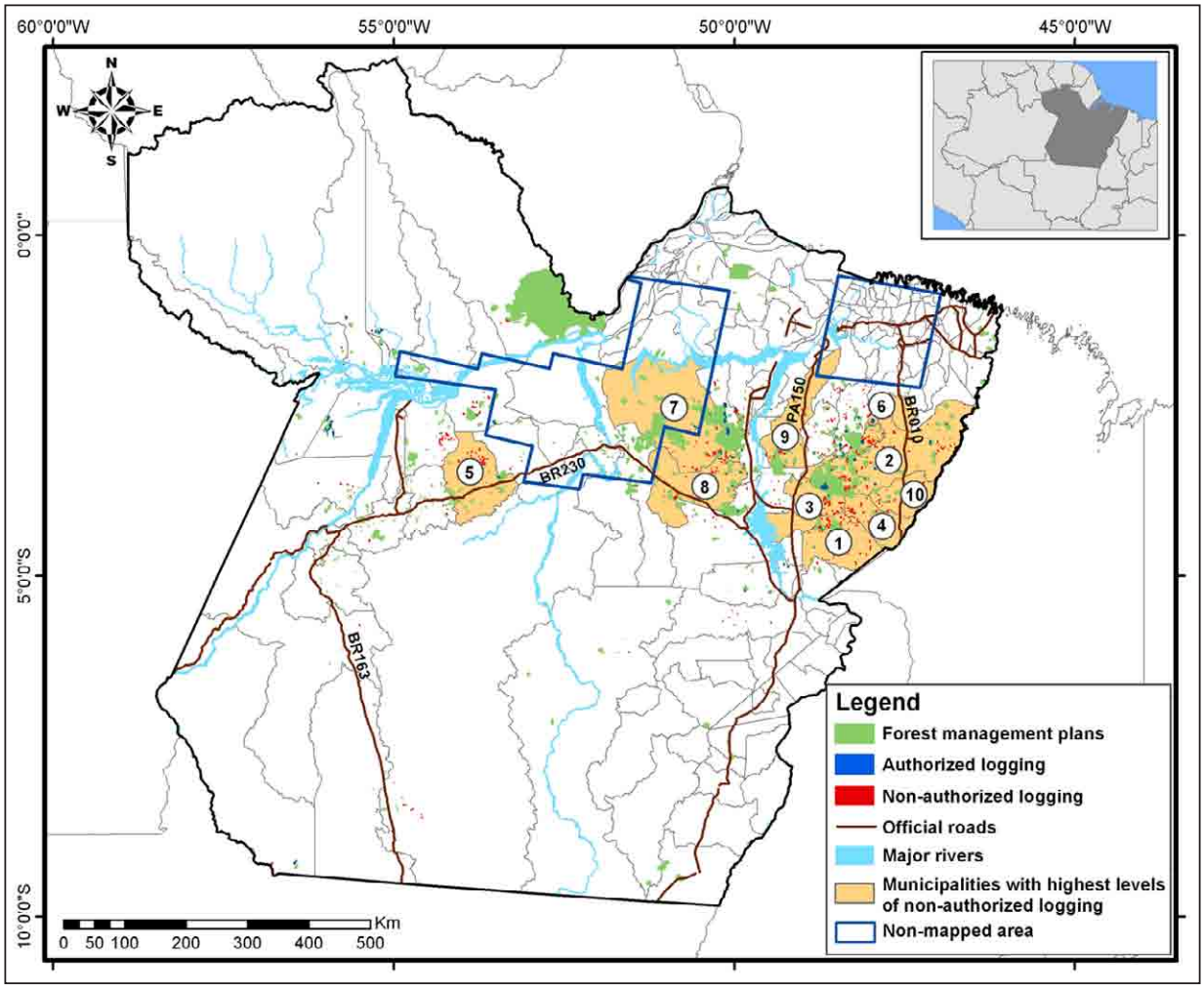

Figure 4. Location of the most municipalities with the largest areas logged without authorization in the State of Pará from August/2009 to July/2010 (Source: Imazon/Simex).

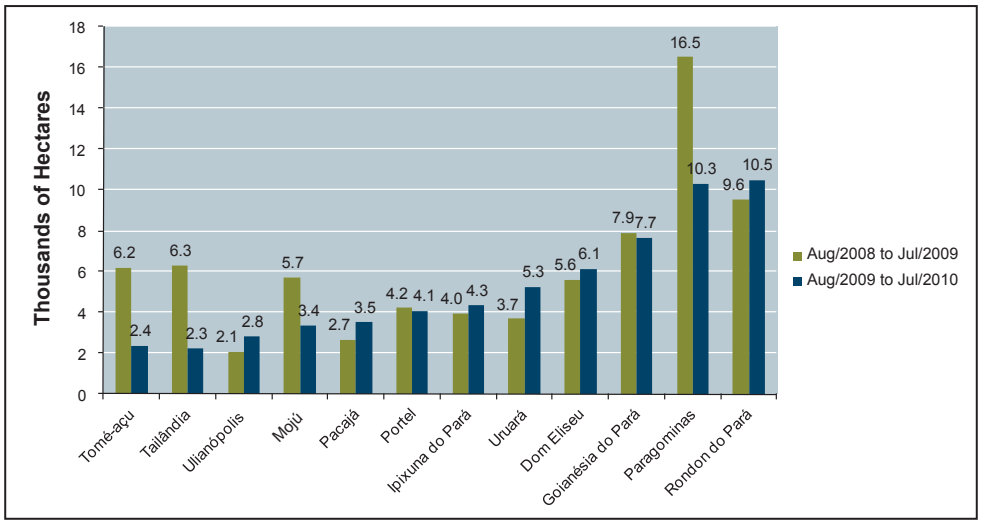

Figure 5. Municipalities with the largest area logged without authorization by the State of Pará between August/2009 and July/2010 (Source: Imazon/Simex).

Protected Areas

Illegal timber harvesting affected 1,084 hectares in TIs (Indigenous Lands) between August 2009 and July 2010. The Sarauá TI, situated in the municipality of Ipixuna do Pará, presented the largest area illegally logged (45%). Next come TI Anambé (Moju) with 33%, TI Nhamundá-Mapuera (Oriximina and Faro) with 10% and TI Cachoeira Seca do Iriri (Placas, Uruará and Altamira) and TI Alto Rio Guamá (Garrafão do Norte, Nova Esperança do Piriá, Paragominas and Santa Luzia do Pará with 6% each (Figure 6).

Illegal timber harvesting in the TIs in Pará increased considerably in the most recent period when compared with the previous period. That increase was most notable in TI Anambé (362 hectares), TI Sarauá (128 hectares) and TI Nhamundá-Mapuera (105 hectares) (Figure 7).

In the UCs (Conservation Units) in Pará 1,211 hectares of illegally logged forest were detected from August 2009 to July 2010. The majority (60%) occurred in the Renascer Resex (Extractive Reserve), followed by the Jamanxim Parna (National Park) with 20% (239 hectares) and Lago do Tucuruí APA (Environmental Protection Area) with 16% (194 hectares) (Figure 8).

Compared to the previous period (August 2008 to July 2009), illegal logging increased considerably in the Resex Renascer (742 hectares), Parna Jamanxim (200 hectares) and APA Lago de Tucuruí (142). On the other hand, considerable reductions in such logging were observed in the Flona Trairão (535 hectares), Flora Itaituba II (72 hectares) and Flona Saracá-Taquera (48 hectares) (Figure 9).

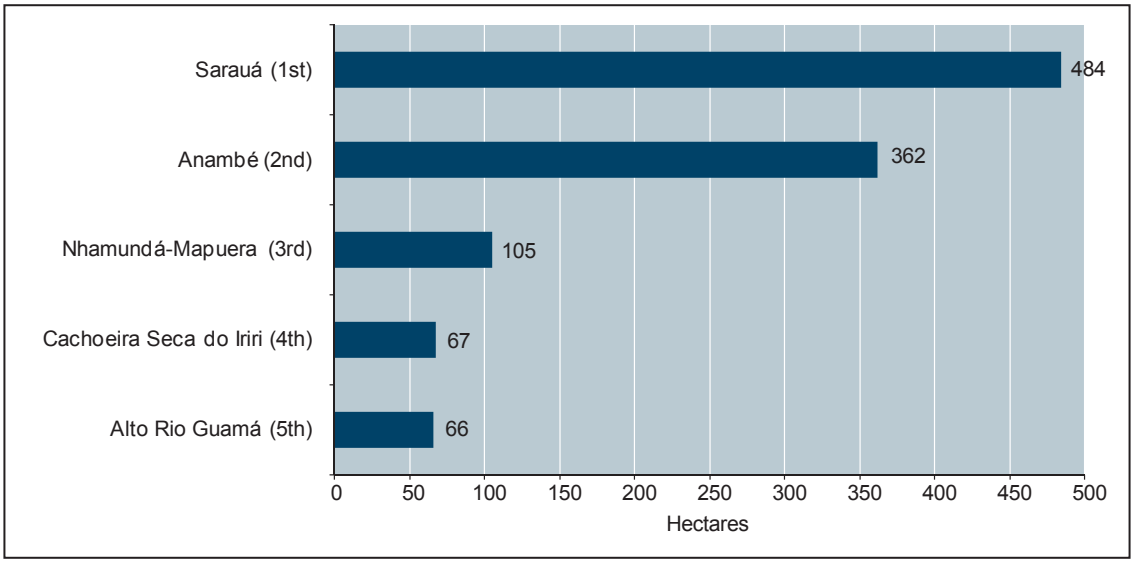

Figure 6. Indigenous lands with the largest areas logged without authorization in the State of Pará from August/2009 to July/2010 (Source: Imazon/Simex).

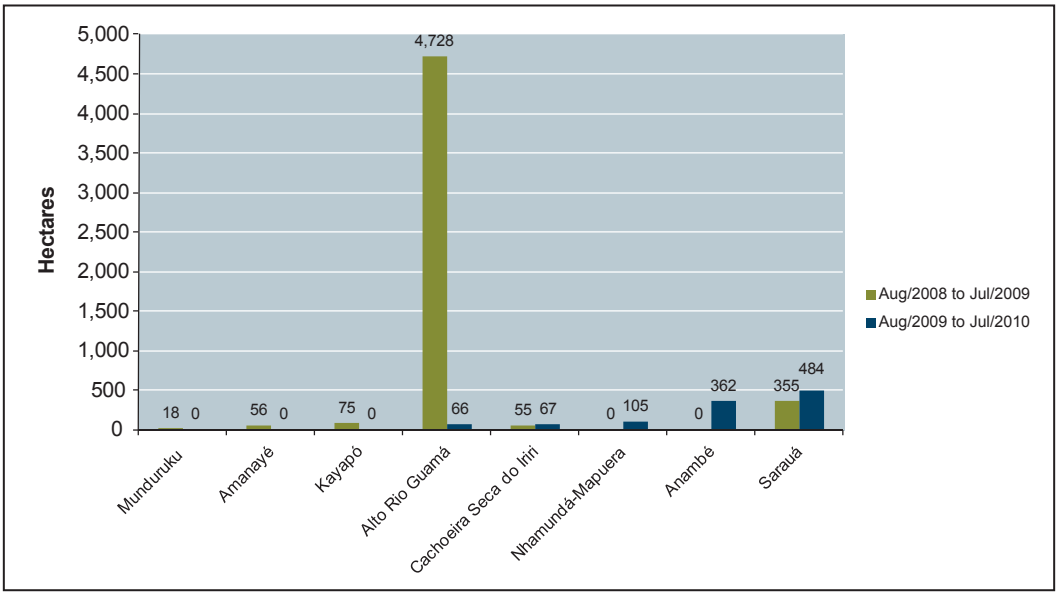

Figure 7. Comparion of Indigenous Lands with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 and August/2009 to July/2010 (Source: Imazon/Simex).

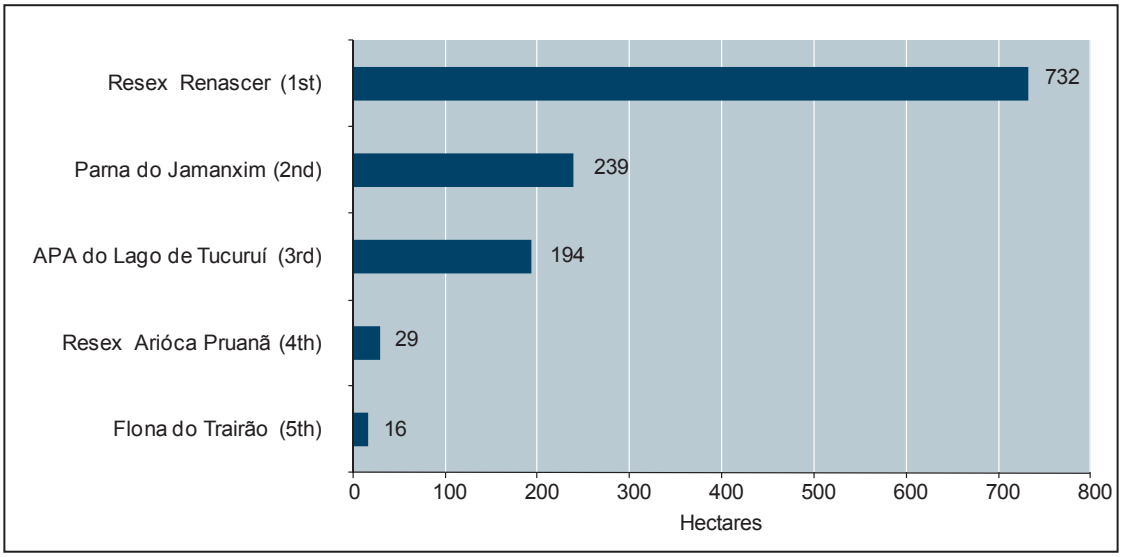

Figure 8. Conservation Units with the largest areas logged without authorization in the State of Pará from August/2009 to July/2010 (Source: Imazon/Simex).

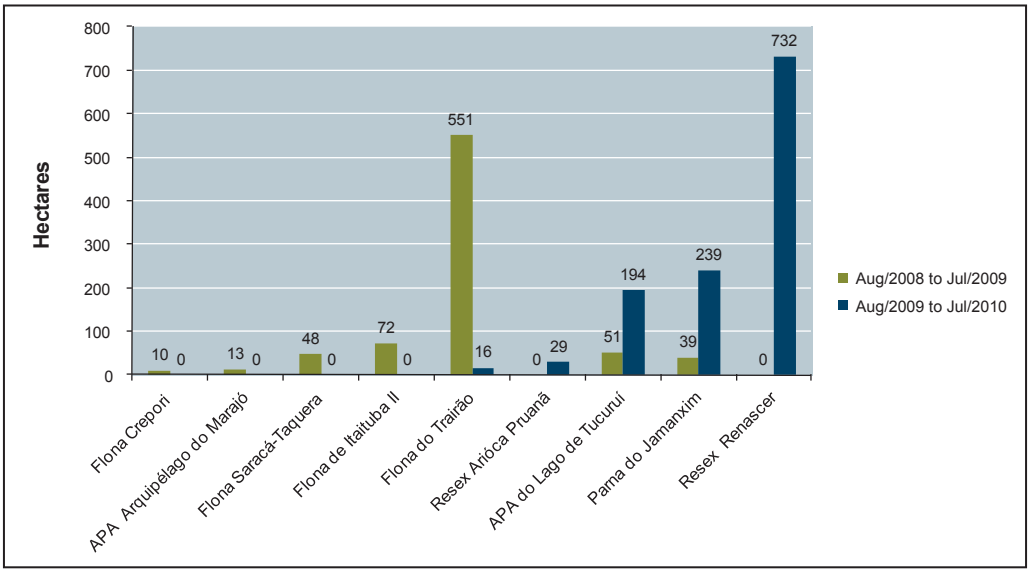

Figure 9. Comparison of Conservation Units with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 and August/2009 to July/2010 (Source: Imazon/Simex).

Settlements

In the land reform settlements in Pará timber harvesting occurred from August 2009 to July 2010 encompassing an area of 10,436 hectares of forest. The most critical situation was in the PDS (Sustainable Development Project) Liberdade (19% of the total logged), PDS Ouro Branco (17%), PAC (Collective Settlement Project) Ouro Branco I (14%) and PA (Settlement Project) Corta Corda (11%) Figure 10.

We verified a significant increase in logging without authorization in the majority of the settlements in the current period compared to the period or August, 2008 to July, 2009. The most critical situation was observed in PDS Ouro Branco (1,387 hectares), PDS Liberdade (751 hectares), PA Corta Corda (768 hectares), PDS Renascer (560 hectares) and PA Cururui (460 hectares) (Figure 11).

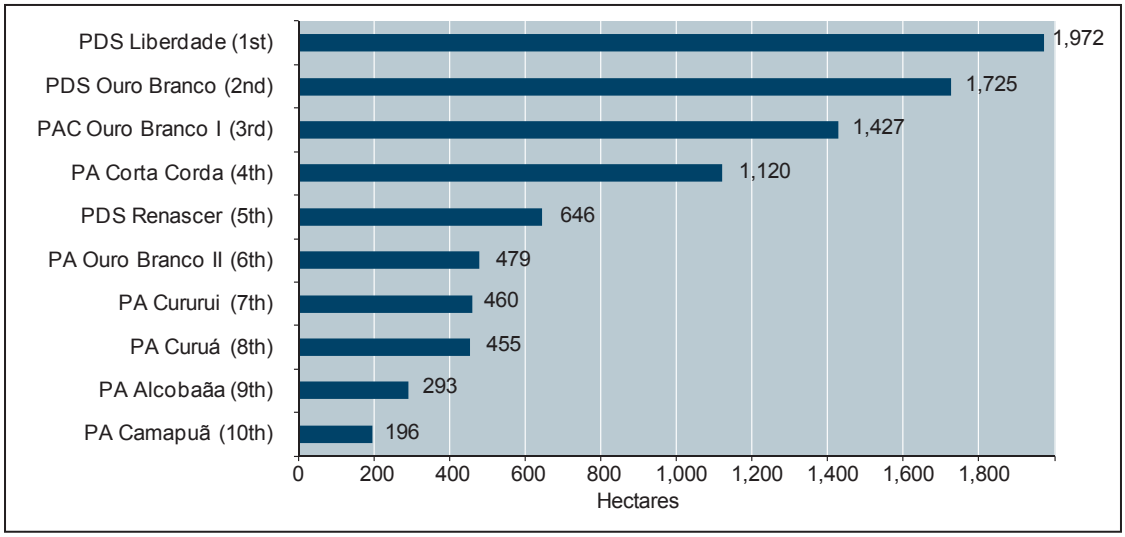

Figure 10. Land reform settlements with the largest areas logged without authorization in the State of Pará from August/2009 to July/2010 (Source: Imazon/Simex).

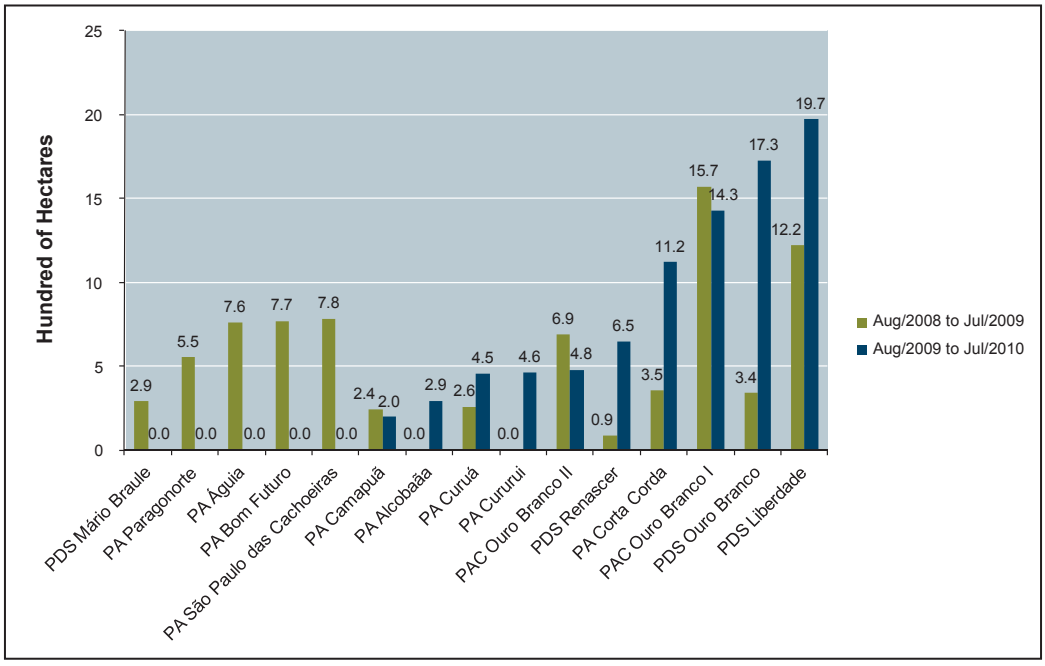

Figure 11. Comparison of land reform settlements with the largest areas logged without authorization in the State of Pará from August/2008 to July/2009 and August/2009 to July/2010 (Source: Imazon/Simex).

Legal Regularity for Authorized Areas

We assessed the consistency of information contained in the Autefs from Simlam and respective timber credits issued in Sisflora in 2010 so as to verify the regularity of the management areas authorized by Sema/PA.

In 2010, 435 Autef were approved of a total of 433 forest management plans covering 282,046 hectares. Of that total, the great majority (90%) were consistent (with no problems), while 10% revealed inconsistencies (notably those displayed in Figures 2 and 3):

i. Area authorized greater than the forest management area. Area authorized for management greater that the total area for forest management. We observed 29 cases of this irregularity of a total of 13,671 hectares of authorized area;

ii. Area authorized in degraded or deforested area. Authorization for forest management in area totally or partially degraded or without forest cover. We observed 19 cases for a total of 9,686 hectares of area authorized.

iii. Area authorized in already logged area. Forest management authorization issued for an area already harvested with timber removal. We observed one case, which totaled 994 hectares of area authorized;

iv. Timber credit commercialized greater than authorized. The timber credit commercialized described in Sisflora does not correspond to the credit authorized at Simlam. We identified five cases, which totalled 5,093 hectares of area authorized.

When we compared the number of inconsistent Autefs from 2009 to 2010 we observed increments in such cases between the years. The most frequent case was that of area authorized greater than the forest management area (going from five to 29 cases), followed by area authorized in deforested area (going from five to 19 cases) and timber credit commercialized greater than authorized (from no occurrence to five cases) (Figure 14).

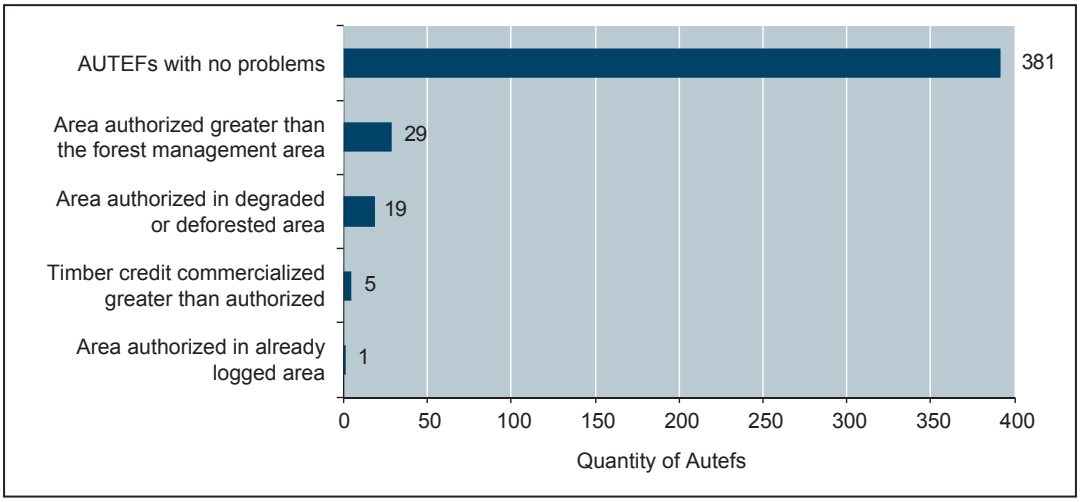

Figure 12. Evaluation of consistencies for Autef and timber credits in 2010 (number of cases) in the forest control systems at Sema/PA (Source: Imazon/Simex).

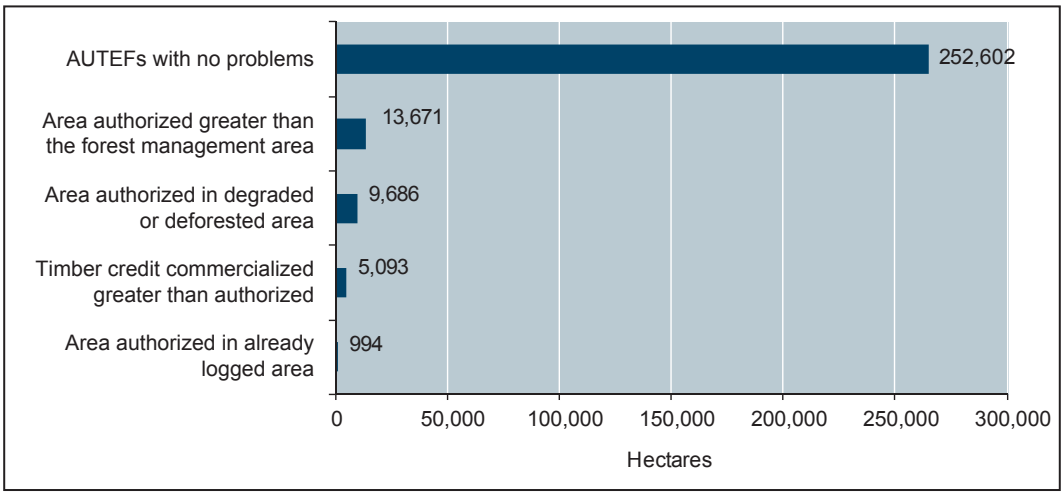

Figure 13. Evaluation of consistencies for Autef and timber credits in 2010 (in hectares) in the forest control systems at Sema/PA (Source: Imazon/Simex).

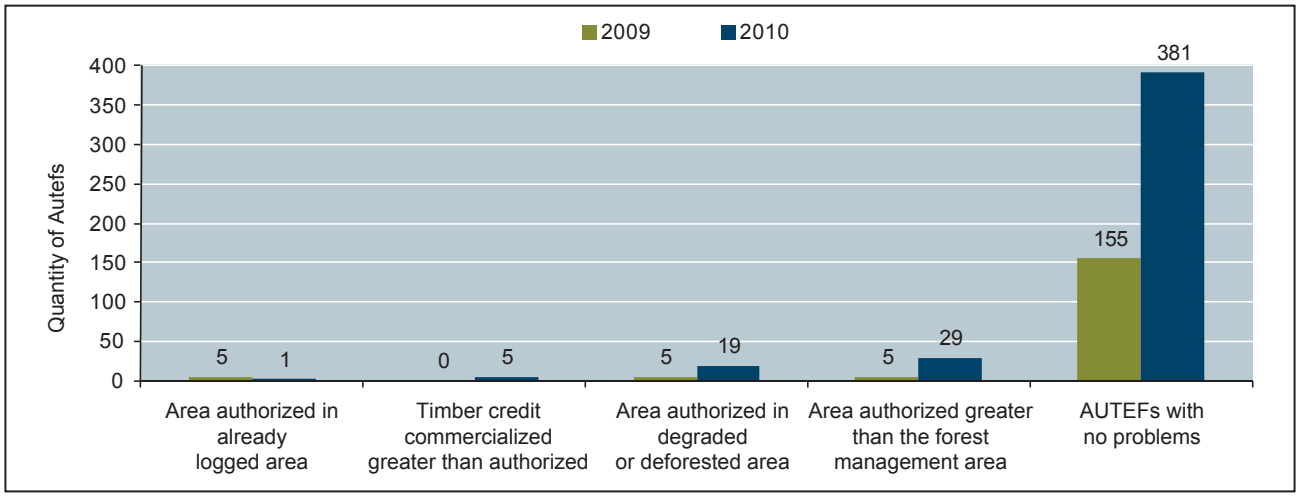

Figure 14. Comparison of situation with Autefs and timber credits in 2009 and 2010 (number of cases) in the forest control systems at Sema/PA (Source: Imazon/Simex).

To assess the regularity of the management areas, we also compared satellite images from 2010 for those areas with their respective Autefs, for a total of 270 Autefs. Of the total of images, 49% (13,675 hectares) could not be analyzed because they presented cloud cover; 42% (94,166 hectares) did not present any irregularity in the comparison; and 9% (21,036 hectares) revealed inconsistencies (Figure 15 and 16), of which the principal ones were:

i. *Forest management executed before authorization.* In ten cases logging was done before issuance of the Autef. Those plans totaled 9,565 hectares of authorized area;

ii. *Area with no signs of logging activity.* No logging scars were identified in the images for the period in which the Autef was valid. However, timber being sold related to that authorization. We identified two cases with this problem, covering an area of 121 hectares;

iii. *Area deforested before authorization.* In two cases the area licensed for forest management was deforested before receiving authorization for management. These plans totaled 1,379 hectares of authorized area.

iv. *Plan overlapping Protected Area.* In one case the licensed area for forest management overlapped a Protected Area. The authorized area for this plan totaled 9,971 hectares.

When we compare the current forest management situation with that of the previous period analyzed we found an increase in the regular cases and a reduction of the cases without signs of harvesting. On the other hand, we observed an increase in the number of cases with management carried out before authorization and area overlapping a Protected Area (Figure 17).

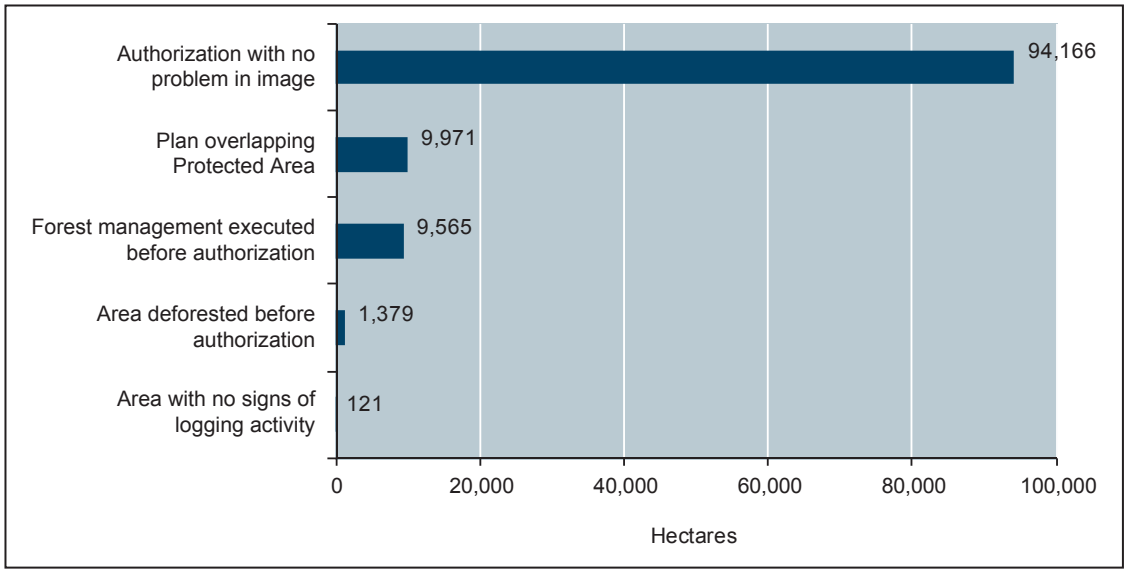

Figure 15. Forest management situation in the State of Pará in 2010 (in hectares), obtained through integrating of information from the control systems at Sema/PA with satellite images (Source: Imazon/Simex).

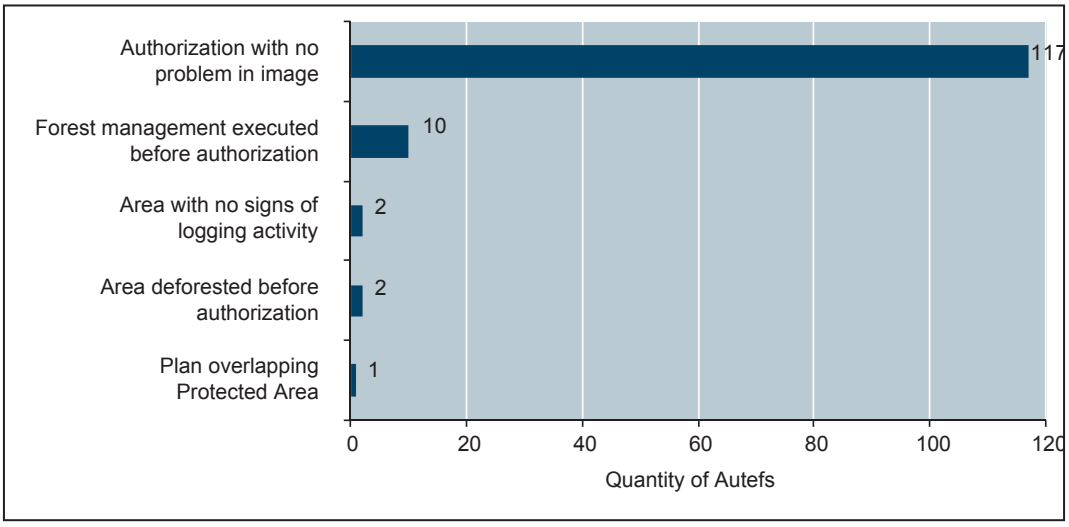

Figure 16. Forest management situation in the State of Pará in 2010 (number of cases), obtained through integrating of information from the control systems at Sema/PA with satellite images (Source: Imazon/Simex).

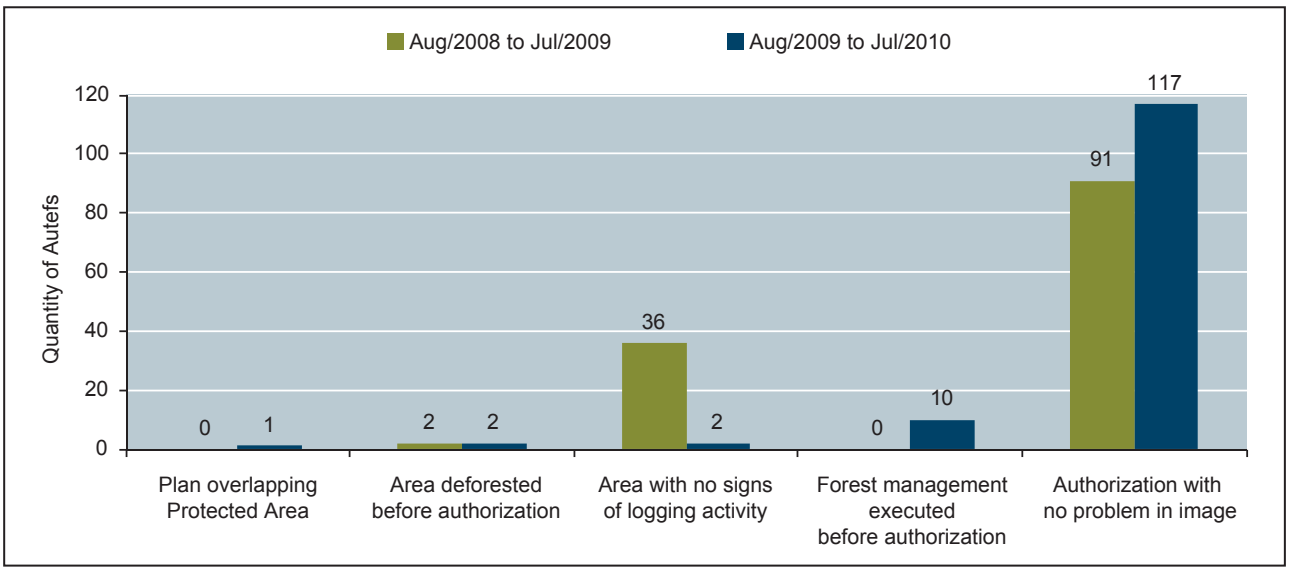

Figure 17. Comparison of the forest management situation in the State of Pará from August/2008 to July/2009 and August/2009 to July/2010, obtained through integrating information from the control systems at Sema/PA with satellite images (Source: Imazon/Simex).

Quality of Timber Harvesting

We assessed the quality of timber harvesting in the NDFI images (Box 1) for which we determined thresholds[3], so that: NDFI ≤ 0.84 represents low quality logging (predatory logging); NDFI = 0.85-0.89, intermediate logging quality (there was an attempt at adopting management, but the layout of roads, log landings and clearings reveals serious problems with execution); and NDFI ≥ 0.90, good quality logging, meaning that the layout of roads, log landings and clearings is in conformity with accepted forest management techniques.

We selected 93 (108,996 hectares) forest management plans in whose 2010 images it was possible to visualize logging scars and assess their quality. Of the logging detected in those images, only 28% was of good quality, 49% presented intermediate quality, and 23% was classified as low quality (predatory logging). In terms of area harvested, 31,151 hectares were classified as good quality; while 53,071 hectares were medium quality; and 24,774 hectares were low quality.

Comparing the quality of timber harvesting between the two periods analyzed in this study, we observed a positive increase in the area with good quality and intermediate quality logging and a negative increase in the area with low quality logging (Figure 19). The most significant increase was observed in good quality logging (24 thousand hectares) (Figure 19).

[3] Monteiro, A; Brandão Jr., A; Souza Jr., C; Ribeiro, J; Balieiro, C; Veríssimo, A. 2008. Identificação de áreas para a produção florestal sustentável no noroeste de Mato Grosso. Imazon: Belém. ISBN: 978-85-86212-24-6. 68p.

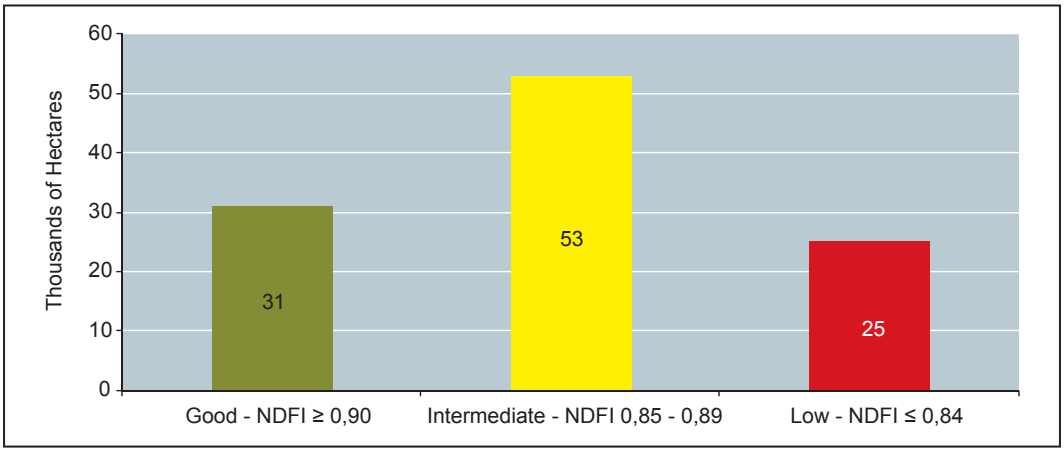

Figure 18. Quality of logging, in area, for 93 forest management plans in the State of Pará from August/2009 to July/2010 (Source: Imazon/Simex).

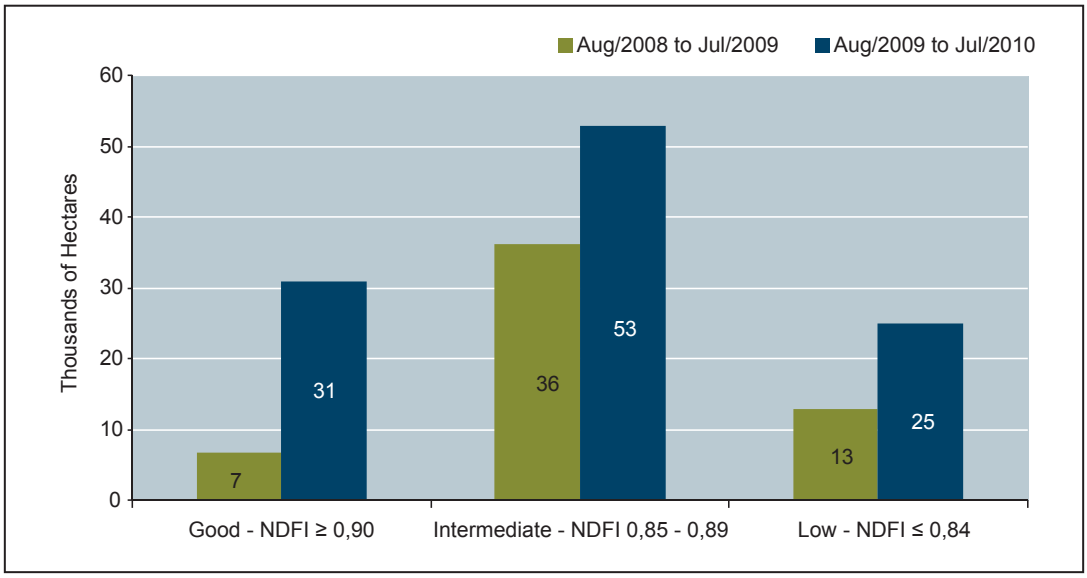

Figure 19. Comparison of logging quality, in area, of timber harvesting carried out from August/2008 to July/2009 and August/2009 to July/2010 in the State of Pará (Source: Imazon/Simex).

Maintenance of Forest Management Areas

We analyzed the satellite images from 2010 to see if the forest management plans in operation between 2007 and 2009 are being maintained for the next cutting cycle. Of the 415 timber harvesting authorizations evaluated for those periods (363,409 hectares), in 94% (347,743 hectares) the areas remain conserved and in 6% (15,666 hectares) there was deforestation (clear cutting) (Figure 19).

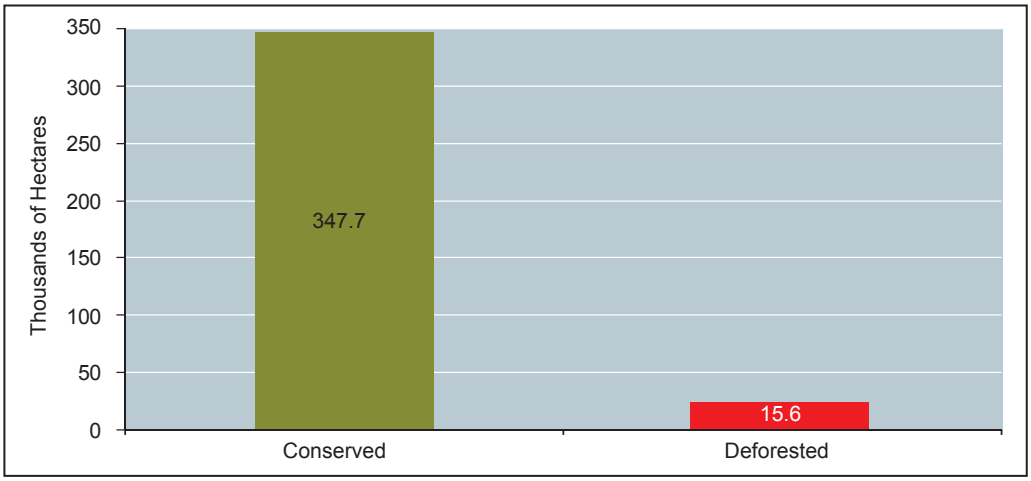

Figure 20. Situation of forest management areas from August/2007 to July/ 2009 evaluated in images from 2010.

Box 1. System for Monitoring Timber Harvesting (*Sistema de Monitoramento da Exploração Madeireira* – Simex)

Simex was developed by Imazon to monitor forest management and non-authorized timber harvesting. The system utilizes Landsat 5 images (with 30 meters of spatial resolution) to detect selective timber harvesting; however, it can be applied to other optical sensors (SPOT, ASTER and ALOS-VNIR).

The Landsat images are processed to generate the spectral mixture model (abundance of vegetation, soils, shadow and NPV - Non-Photosynthetic Vegetation*)* and later for calculating the NDFI (Normalized Difference Fraction Index), defined as:

$$NDFI = \frac{(VEGnorm-(NPV+Soils)}{(VEGnorm-(NPV+Soils)}$$

Where VEGnorm is the vegetation component normalized for shadow, determined by:

$$VEGnorm = VEG / (1-Shadow)$$

The information extracted from the satellite images is crossed with information from Simlam and Sisflora to assess the situation of licensed management plans. First, one analyzes the documentation available in the control systems in order to identify possible inconsistencies. Next, the forest management plans are assessed by overlaying their boundaries with the satellite images. Later on, that information is associated with forest control systems. Simex enables one to assess the occurrence of: i) management authorized in deforested area; ii) management authorized in area already logged; iii) area authorized larger than management area; iv) credit commercialized greater that what was authorized; v) without signs of logging; vi) area harvested above the authorized limit; vii) area deforested before authorization; viii) management carried out before authorization; and ix) plan overlapping Protected Area. Simex also makes it possible to identify evidence of irregularity in forest management licensing and execution, meaning the inconsistency between licensing and the degree of adopting management. For example, plans with few inconsistencies and errors in licensing, but with evidence of low implementation of management practices need to be verified in the field in order to identify the problems with execution.

Project Team:
General Coordination: André Monteiro, Dalton Cardoso, Denis Conrado, Adalberto Veríssimo and Carlos Souza Jr.

Data Source:
Statistics for timber harvesting statistics are generated from Imazon data
Data from Sema/PA (Simlam and Sisflora)
http://monitoramento.sema.pa.gov.br/simlam/
http://monitoramento.sema.pa.gov.br/sisflora/

Acknowledgment
Glaucia Barreto (Editorial revision)

Support:
Gordon & Betty Moore Foundation
United States Agency for International Development (USAID)
United States Forest Service (USFS)
Fundo Vale

Partnership
State Secretariat for the Environment of Pará (Sema)