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## Summary

In this first bulletin *Transparency in Forest Management in Mato Grosso* 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* - Autex) and authorized credits from logging issued by the State Secretariat for the Environment in Mato Grosso (Sema), from 2006 to 2009. We found that in 2009 the great majority (82%) of Autex plans were legally compliant, while 18% had inconsistencies, such as: i) area authorized in already deforested area; ii) area authorized in already logged area; iii) area authorized greater than the total managed area; iv) timber credit commercialized greater than authorized; and v) timber credit authorized without management plan. Of the years assessed, 2008 was the one presenting the greatest proportion of Autex plans with irregularities.

Our assessment also involved estimating the areas logged both legally (authorized) and illegally (not authorized) from August, 2007 to July, 2008 and August, 2008 to July, 2009, using NDFI images derived from Landsat images. The results reveal that of the 460,134 hectares of forests logged in the two periods together, 61% (280,979 hectares) were authorized by Sema as opposed to 39% (179,155 hectares) that were not authorized. In terms of illegal logging, the great majority (93%) occurred in areas that were private, vacant or disputed; another 6%

occurred in Protected Areas; and 1% occurred in land reform settlements. For the two periods we observed a 57% reduction in illegal logging (70,922 hectares) and a positive increase of 76% (77,405 hectares) in legal logging.

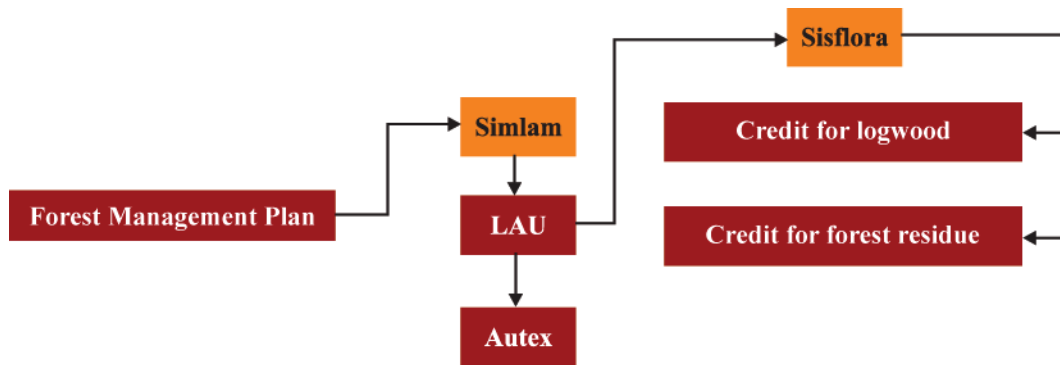
Finally, we evaluated the quality of forest management performance in the State from August, 2007 to July, 2008 and August, 2008 to July, 2009 using NDFI images. We observed that good quality timber harvesting increased only 8% (one thousand hectares) between the two periods, while there were significant increases of 35% and 59% in intermediate (32,000 hectares) and low (44,000 hectares) quality logging, respectively. When we analyzed the satellite images for 2009, we found that in 99% of the forest management areas evaluated in the study periods the forest was maintained, while in only 1% of those areas did deforestation occur (clear cutting).

For a general assessment of timber harvesting in the State, we utilized information from forest control systems at Sema: Simlam (Integrated System for Environmental Licensing and 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*), 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

To control logging activities, the Sema/MT employs two systems. Simlam is used for controlling the entire environmental permitting system, includ-

ing issuance of the LAU (Single Environmental License - *Licença Ambiental Única*) and the Autex. Sisflora controls the flow of entry and issuance of credits for logwood and forest products (Figure 1).



**Figure 1.** Flow for analyzing and granting environmental licenses and timber credits in the Sema/MT forest control systems.

According to Simlam, from 2006 to 2009 there were 12,658,285 cubic meters of logwood<sup>1</sup>, all derived from native forests, while at Sisflora 14,957,684 cubic meters were recorded and cleared. This greater volume registered with Sisflora occurred in all of the years evaluated (Table 1). The greatest difference, however, was detected

in 2007, when the volume authorized by Sisflora was approximately 1.1 million cubic meters larger than that authorized by Simlam. In 2008, that difference was almost 904 thousand cubic meters; in 2006, around 213 thousand cubic meters; and in 2009, it dropped to slightly less than 67 thousand cubic meters (Table 1).

**Table 1.** Volume of timber authorized through Simlam and through Sisflora, 2006 to 2009 in the State of Mato Grosso.

Year	Autex (Qt)	PMF (Qt)	Area authorized (ha)	Volume Simlam (m <sup>3</sup> )	Volume Sisflora (m <sup>3</sup> )	Difference in volume between Simlam and Sisflora (m <sup>3</sup> )
2006	65	60	38,781	881,263	1,094,368	213,105
2007	120	117	91,369	1,177,678	2,293,401	1,115,723
2008	322	312	247,796	6,270,760	7,174,384	903,624
2009	202	202	158,203	4,328,584	4,395,531	66,947

<sup>1</sup> Timber credits are only cleared by Sisflora after approval in Simlam and the Registry for Forest Product Consumers (*Cadastro de Consumidores de Produtos Florestais - CC-Sema*). CC-Sema is an electronic registration system containing information on the owner, company, property, licensed activity, and person technically and legally responsible.

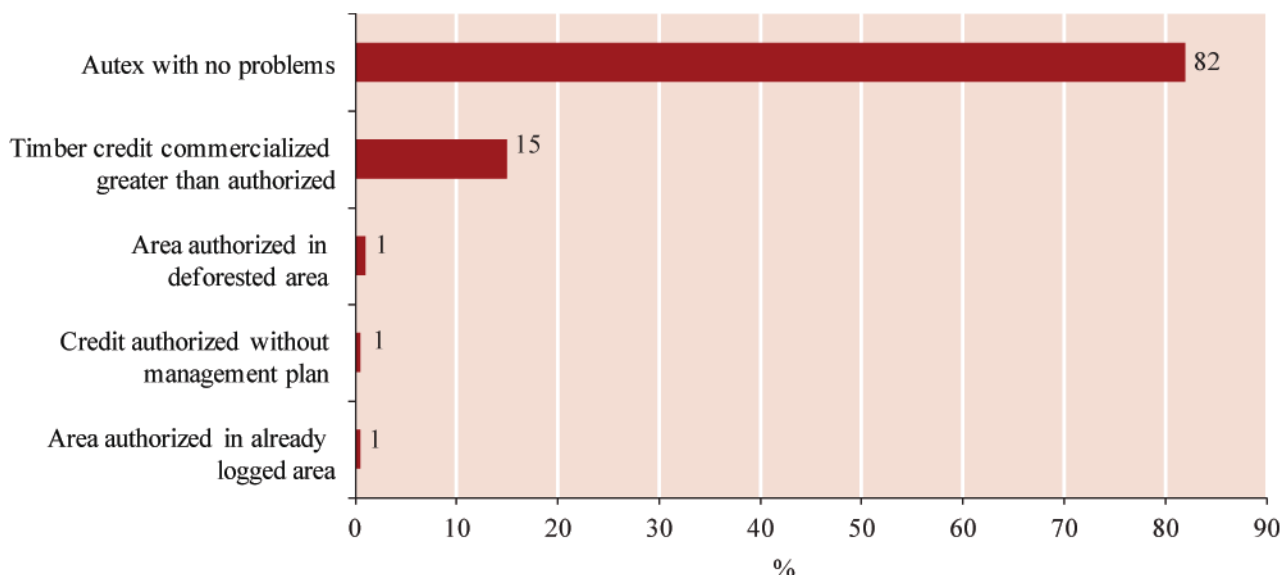


### Legal Regularity for Authorized Areas

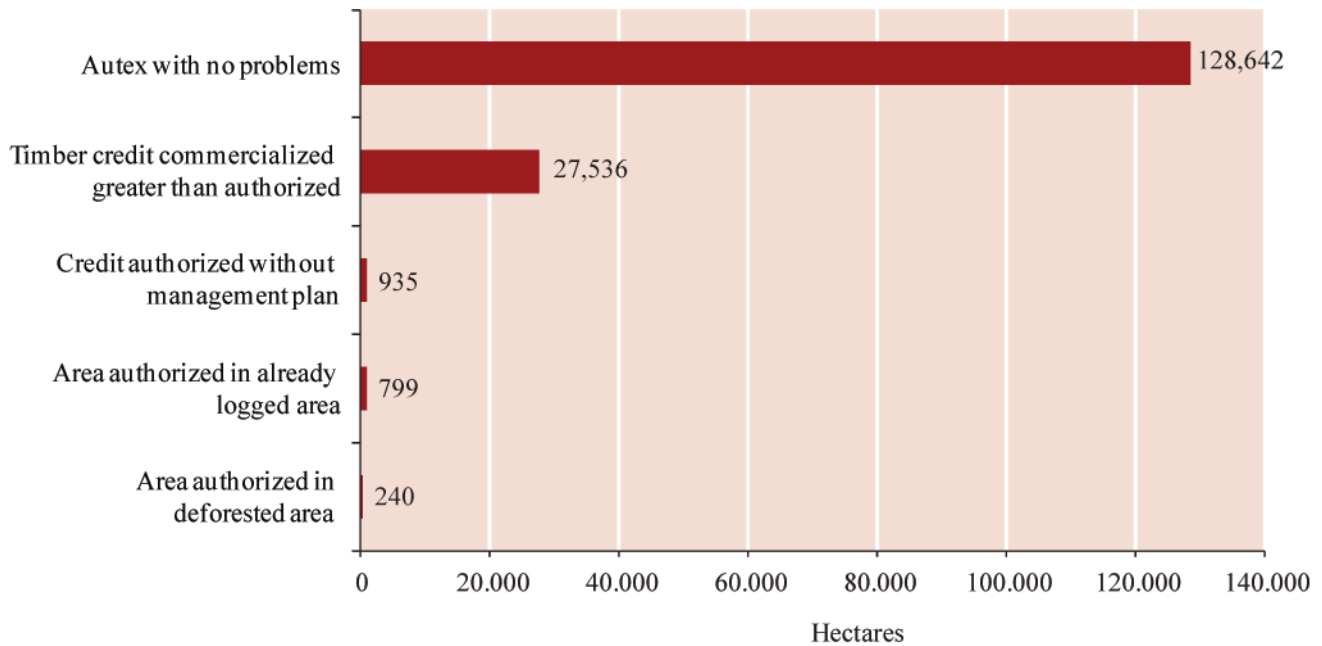
We assessed the consistency of timber harvesting authorizations- Autex from Simlam with the prospective timber credits issued from Sisflora annually from 2006 to 2009 so as to verify the regularity of the management areas authorized. Of the 691 forest management plans operational for those years, we analyzed 684, while 7 plans were not analyzed because no Autex had been issued for them.

In 2009, the most recent year analyzed, 202 Autex were approved of a total of 202 forest management plans covering 158,203 hectares. Of that total, the great majority (82%) present no problems, while 18% revealed inconsistencies, notably (Figures 2 and 3):

- i) Area authorized in deforested area.* Authorization for forest management in area total or partially lacking forest cover. Represented 1% of the cases evaluated, for a total of 240 hectares;
- ii) Area authorized in already logged area.* Authorization for forest management in area already harvested for timber. Observed in 1% of cases, totaling 799 hectares of area authorized.
- iii) Timber credit commercialized greater than authorized.* The timber credit commercialized described in Sisflora does not correspond to the timber credit authorized with Simlam. Identified in 15% of the cases, corresponding to 27,536 hectares of area authorized;
- iv) Credit authorized without management plan.* The credit (Proof of Issuance of Forest Credit - *Comprovante de Liberação de Crédito Florestal - CLCF*) was issued without release of an Autex. This irregularity occurred in 1% of the cases analyzed, totaling 935 hectares of area authorized.



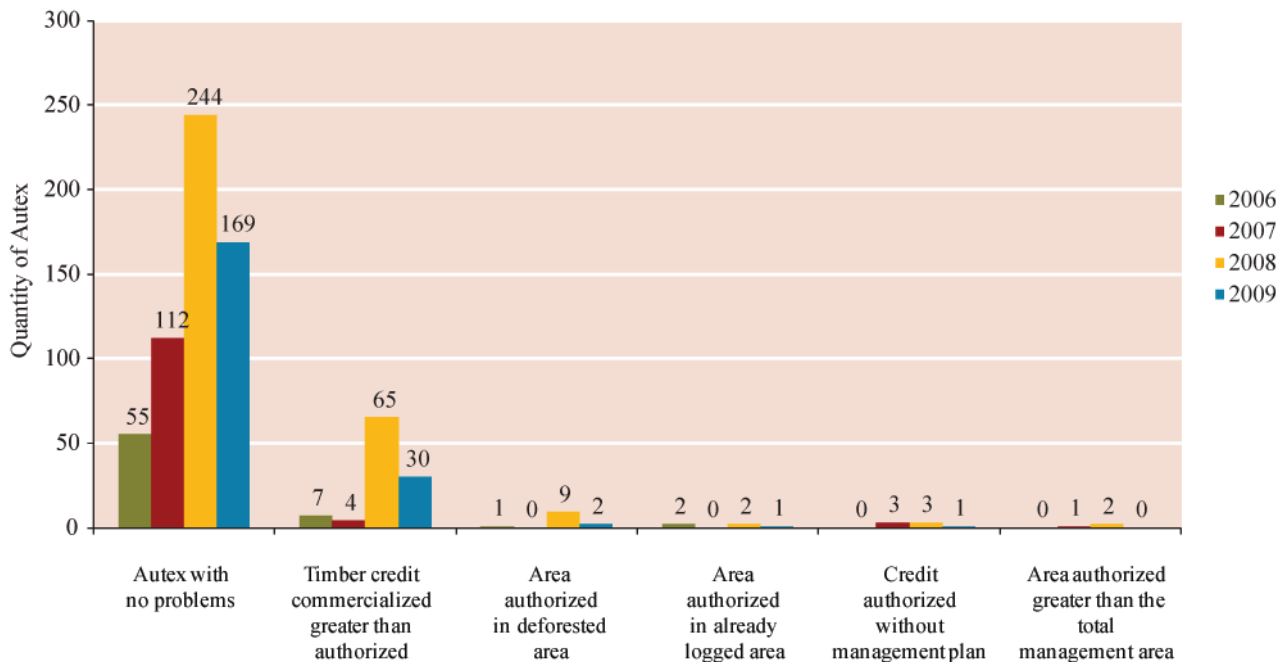
**Figure 2.** Evaluation of consistencies for Autex and timber credits in 2009 (%) in the forest control systems at Sema/MT (Source: Imazon/Simex based on data from Sema/MT).



**Figure 3.** Evaluation of consistencies for AUTEX and timber credits by area (hectares) in 2009 in the forest control systems at Sema/MT (Source: Imazon/Simex based on data from Sema/MT).

The proportion of cases with inconsistencies varied among the four years analyzed. From 2007 to 2008, for example, we observed increments in the cases of timber credit commercialized larger

than that authorized (61% cases), area authorized in deforested area (9%), area authorized in already logged area (2%) and area authorized greater than the total managed area<sup>2</sup> (1%) (Figure 4).



**Figure 4.** Comparison of situation with AUTEX in 2006, 2007, 2008 and 2009 (in units) in the forest control systems at Sema/MT (Source: Imazon/Simex based on data from Sema/MT).

<sup>2</sup> Area authorized for management superior to the total forest management area.

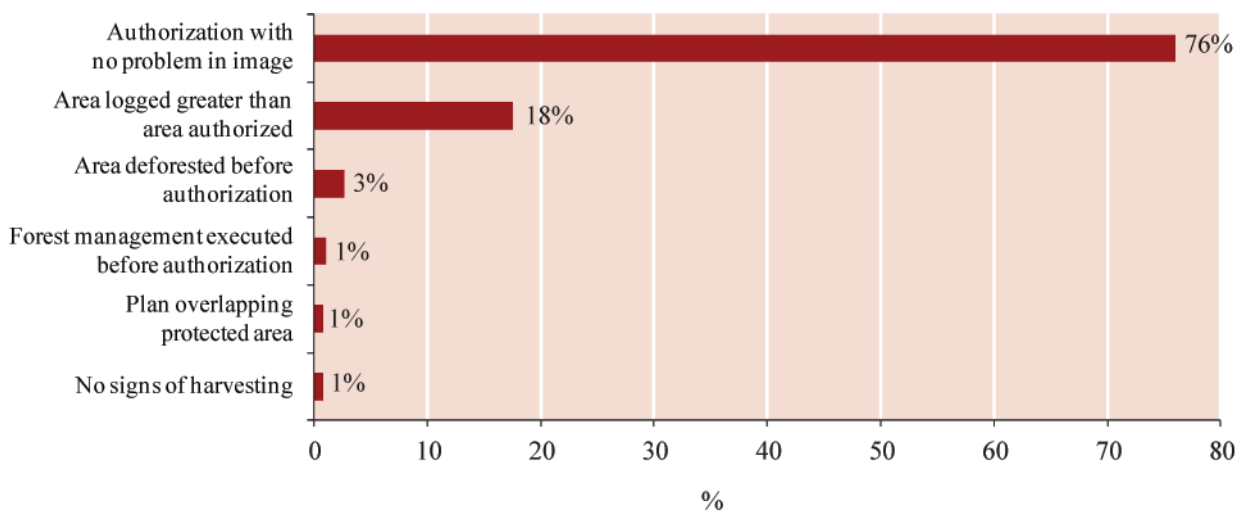
We also analyzed the consistency between the 202 forest management plans, 2009 and their respective satellite images<sup>3</sup>. Of that total, the majority (76%) (233,482 hectares) presented consistency and 24% (70,027 hectares) revealed inconsistencies (Figure 5 and 6). The main ones were:

- i) Area with no signs of logging activity.** No logging scars were identified in the images for the period in which the logging authorization was valid. However, timber being sold related to that authorization was identified 1% of cases, covering an area of 1,438 hectares;
- ii) Area logged greater than area authorized.** In 18% of cases the area was logged above the limit authorized. These cases covered 52,990 hectares;
- iii) Forest management executed before authorization.** In 1% of logging has done before issu-

ance of the forest authorization. Those plans totaled 1,464 hectares of authorized area;

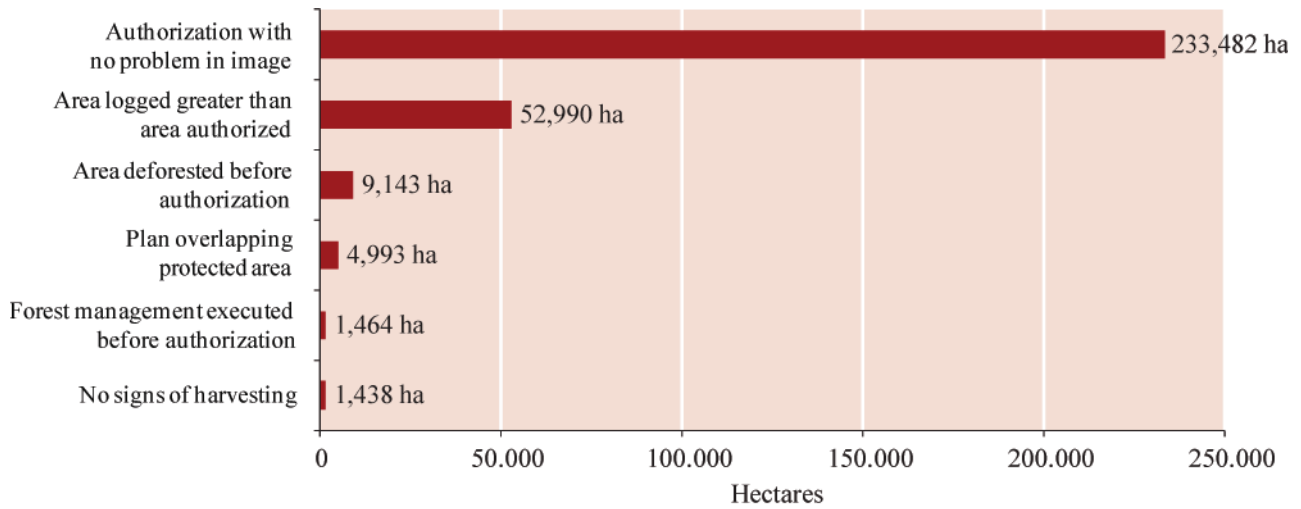
- iv) Plan overlapping Protected Area.** In 1% of cases the licensed area for forest management overlapped an Indigenous Land. The authorized area for those totaled 4,993 hectares;
- v) Area deforested before authorization for management.** In 3% of cases the area licensed for forest management was deforested before receiving authorization. These plans totaled 9,143 hectares of authorized area.

We found an increase in the cases with inconsistency among the periods analyzed, although we did observe a positive increase in regular situations. There were 24 more cases of area logged greater than area authorized, 9 more cases of area deforested before authorization and 1 more case of forest management executed before authorization. The only exception was in areas with no signs of timber harvesting, where there was a reduction, with 24 fewer cases (Figure 7).

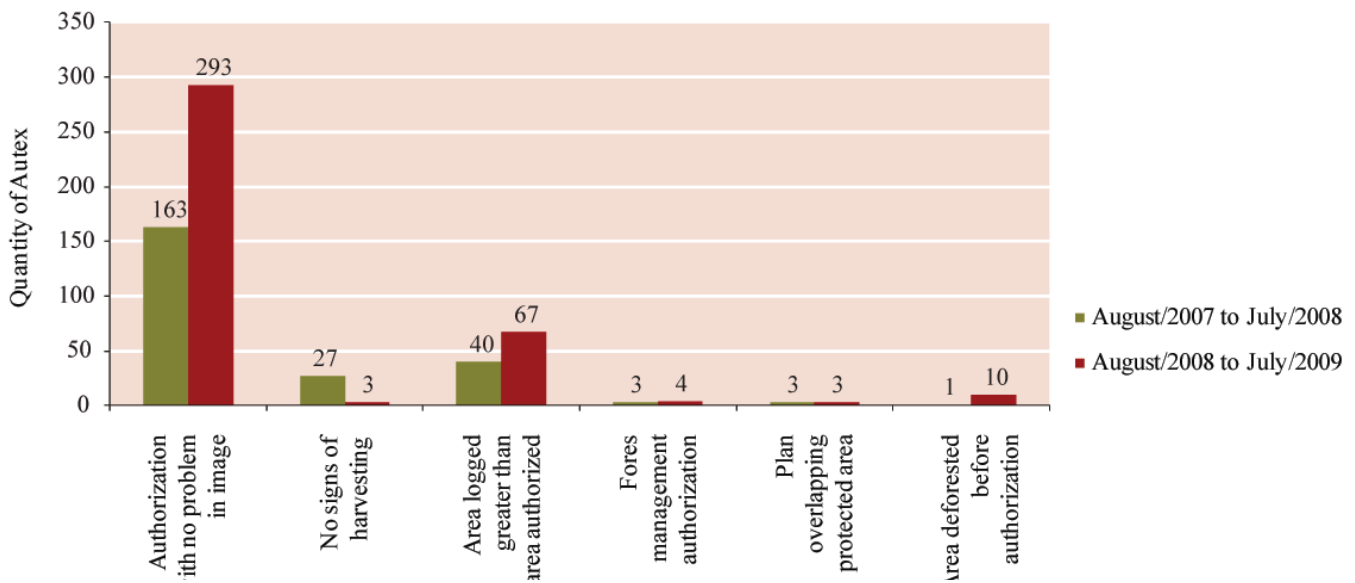


**Figure 5.** Forest management situation in the State of Mato Grosso in 2009 (%), obtained through interaction of information from the forest control systems at Sema/MT with satellite images (Source: Imazon/Simex based on data from Sema/MT).

<sup>3</sup> The images used were collected by satellite during the period of June to August of each year.



**Figure 6.** Forest management situation in the State of Mato Grosso in 2009 (in hectares), obtained by integrating information from the forest control systems at Sema/MT with satellite images (Source: Imazon/Simex based on data from Sema/MT).



**Figure 7.** Comparison of the forest management situation in the State of Mato Grosso from August/2007 to July/2008 and August/2008 to July/2009, obtained by integrating information from the forest control systems at Sema/MT with satellite images (Source: Imazon/Simex based on data from Sema/MT).

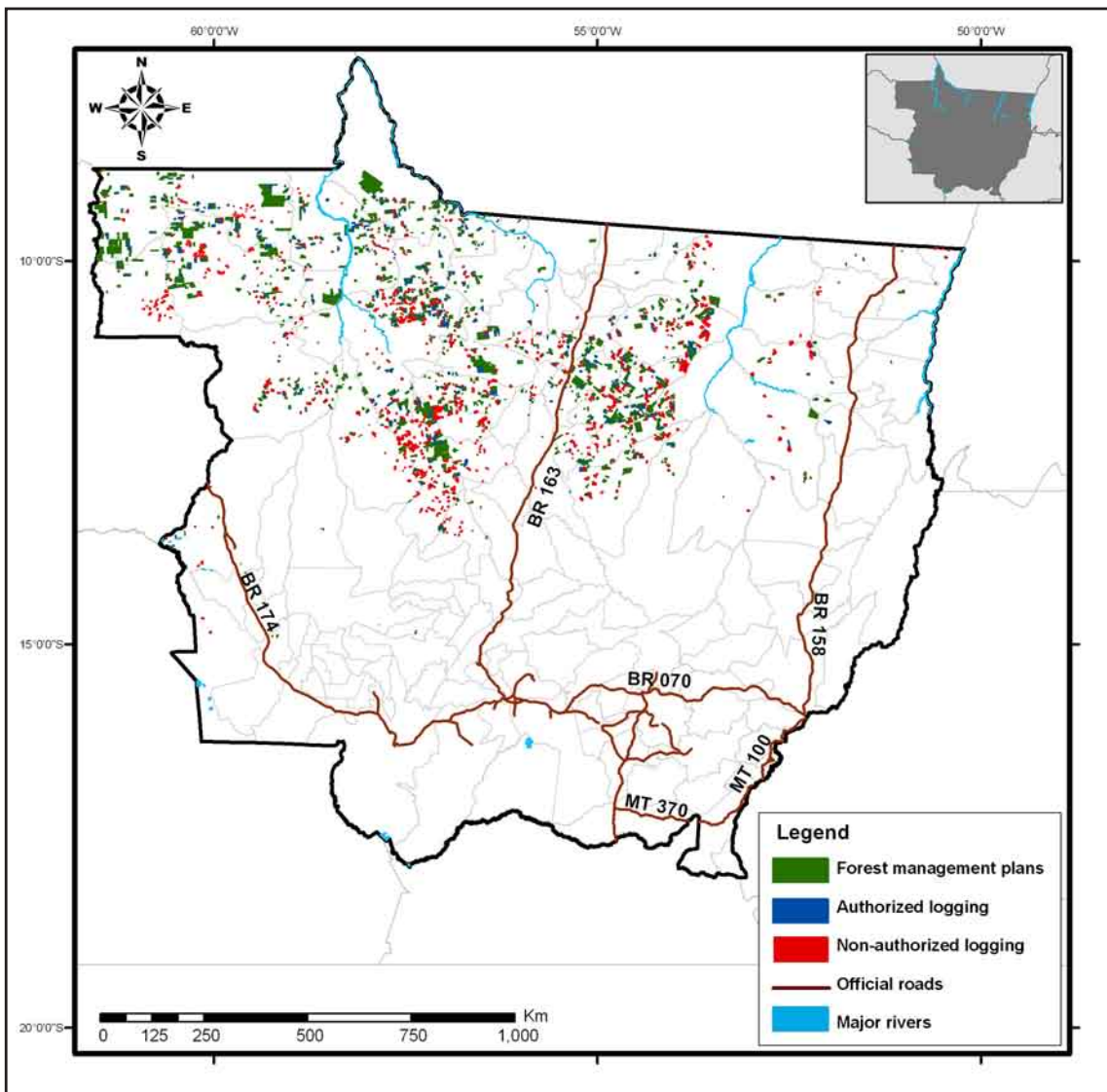
### Geography of Timber Harvesting in Mato Grosso

To identify non-authorized (illegal and predatory) and authorized (forest management) logging in the State from August, 2007 to July, 2008 and August, 2008 to July, 2009 we overlaid the boundaries of forest management plans on NDFI images derived from Landsat images (Figure 8 and Box 1).

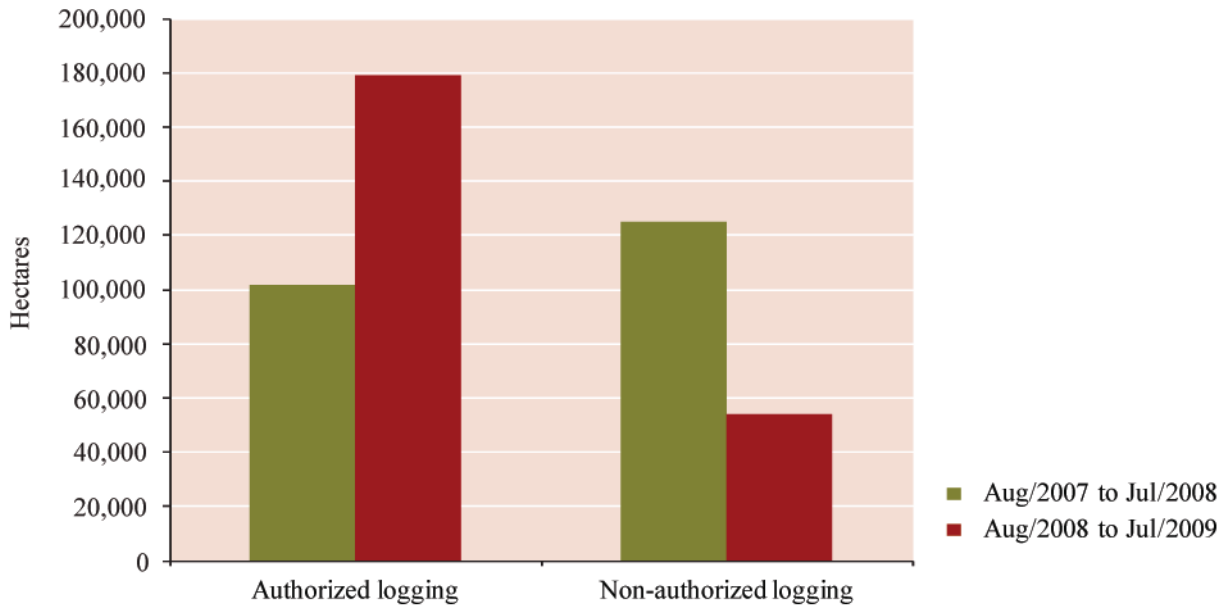
Non-authorized logging was detected in almost all regions of Mato Grosso, with the majority

in the middle-north (72%), followed by northwest (15%), far north (5%), northeast (5%), southeast (2%) and southwest (1%) (Figure 8).

There were 460,134 hectares of logged forests detected, of which 179,155 hectares (39%) lacked authorization and 280,979 hectares (61%) were authorized for forest management. However, when we compare the areas authorized for the two periods, we observe a 76% increase in authorized harvesting and a 57% reduction in non-authorized harvesting (Figure 8 and 9).



**Figure 8.** Spatial distribution of authorized (forest management) and non-authorized (predatory) timber harvesting in the State of Mato Grosso from August/2007 to July/ 2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

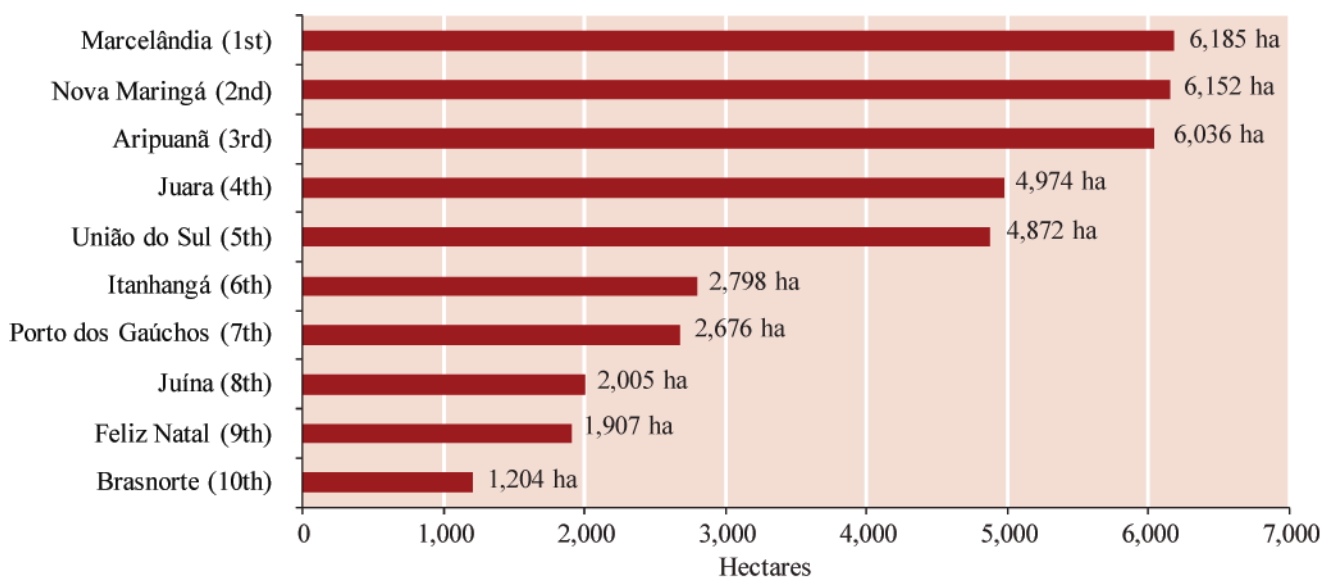


**Figure 9.** Comparison between the areas logged with authorization and without authorization in the State of Mato Grosso from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT)

## Critical Municipalities

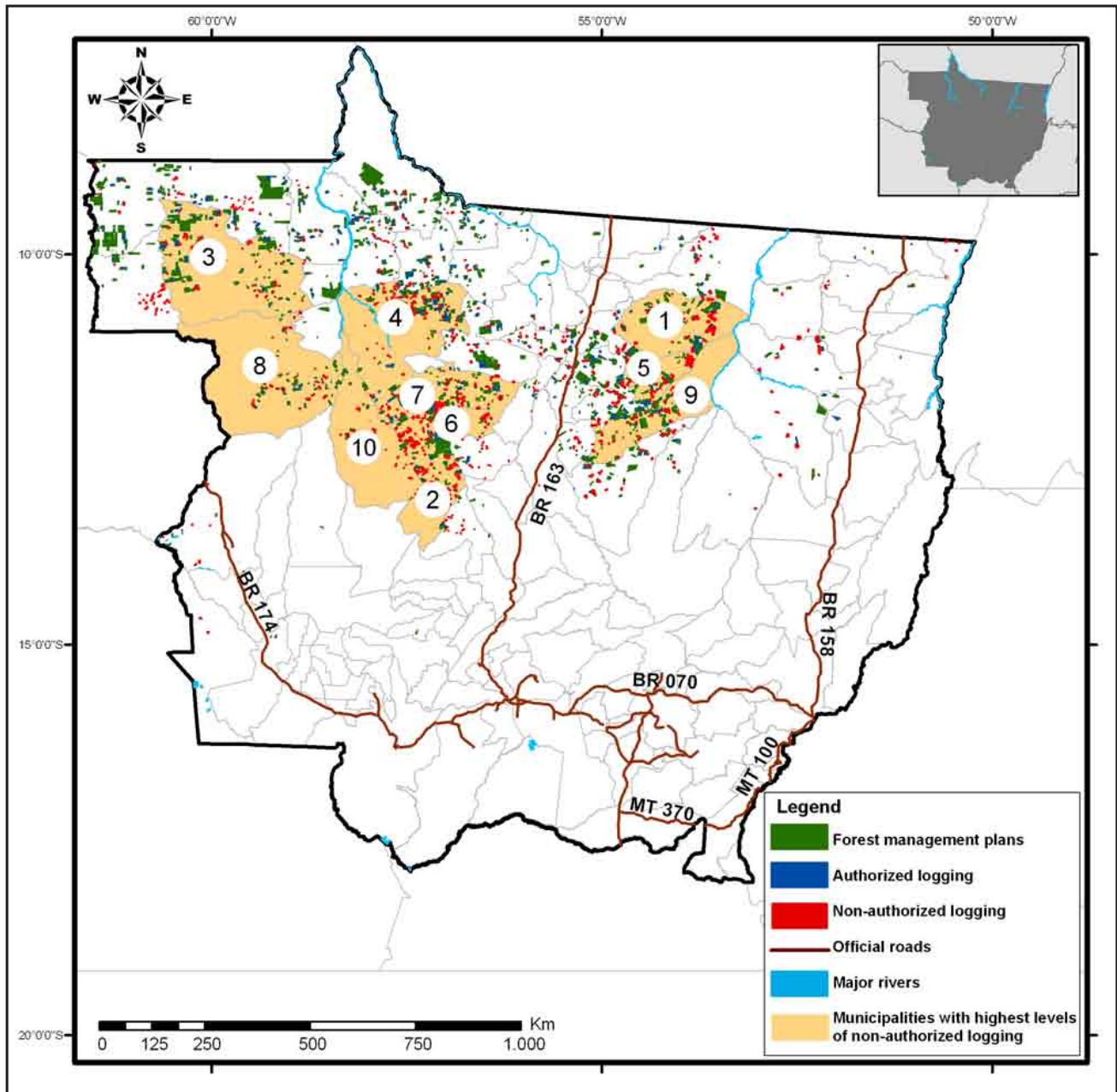
A total of 179,155 hectares of forests in Mato Grosso were logged without authorization from August, 2007 to July, 2008 and August, 2008 to July, 2009. Of those, 54,116 hectares logged in the most recent period, with the majority (72%) occurring in 10 municipalities

(Figure 10 and 11). The remaining 28% was distributed more sparsely among another 32 municipalities. Marcelândia was the municipality with the largest area of non-authorized logging, followed by Nova Maringá and Aripuanã (Figure 10 and 11).



**Figure 10.** Municipalities with the largest areas logged without authorization in the State of Mato Grosso from August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

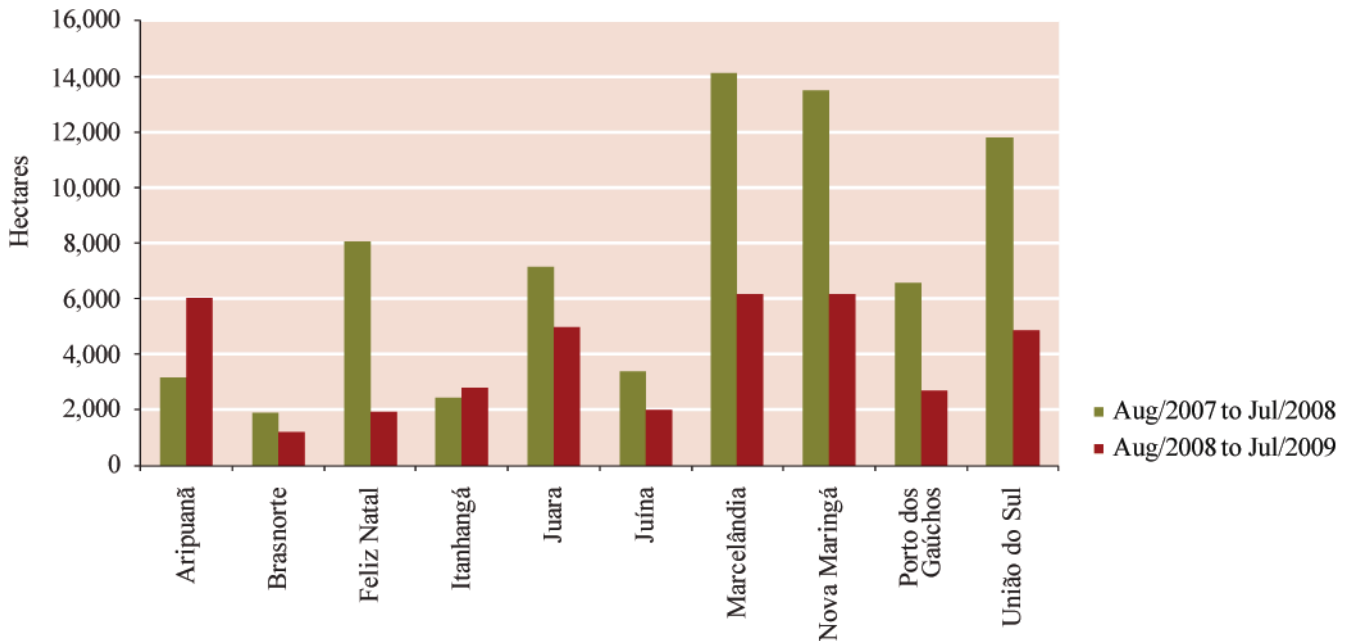




**Figure 11.** Location of the most municipalities with the largest areas logged without authorization in the State of Mato Grosso from August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

When we observe the two periods analyzed, we find a significant reduction in non-authorized logging in (7,939 hectares reduction), Nova Maringá (7,349 hectares reduction), União do Sul (6,912 hectares reduction), Feliz Natal (6,133 hectares reduction), Porto dos Gaúchos (3,903 hectares reduc-

tion), Juara (2,165 hectare reduction), Juína (1,373 hectare reduction) and Brasnorte (678 hectares reduction), while there was an increase of logging of this type in the municipalities of Aripuanã (2,877 hectares increase) and Itanhangá (359 hectares increase) (Figure 12).

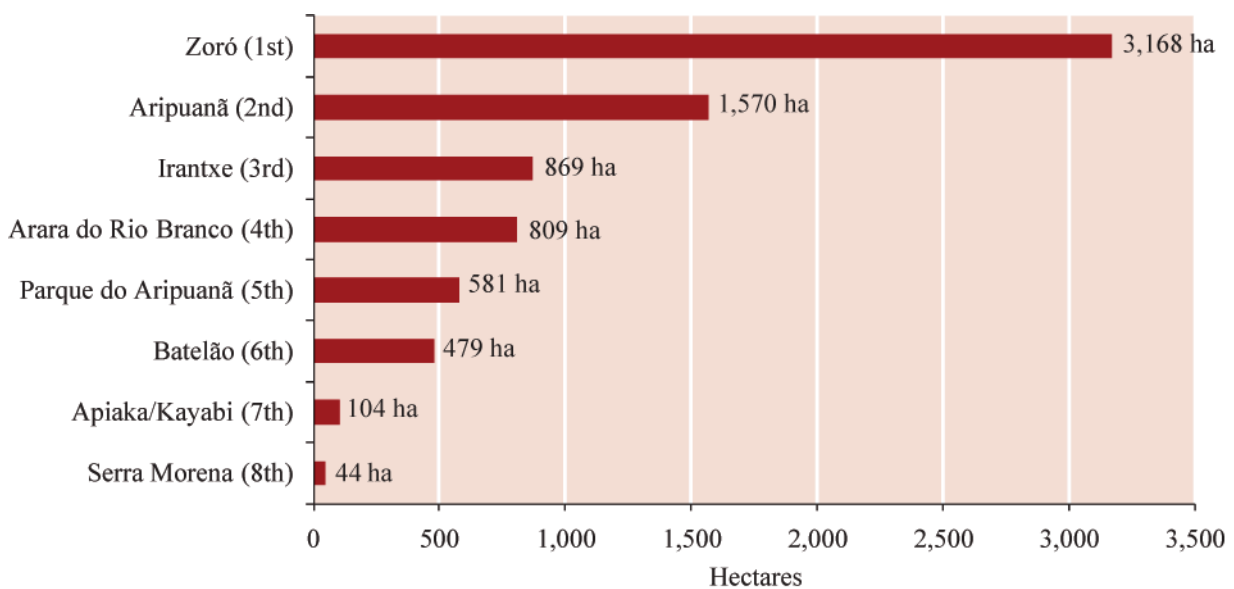


**Figure 12.** Comparison of municipalities with the largest areas logged without authorization in the State of Mato Grosso from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

## Protected Areas

Illegal timber harvesting affected 7,624 hectares of forest in TIs (Indigenous Lands) from August, 2008 to July, 2009. The Zoró TI, located in the municipality of Rondolândia, presented the largest area illegally logged (41% of total). Following

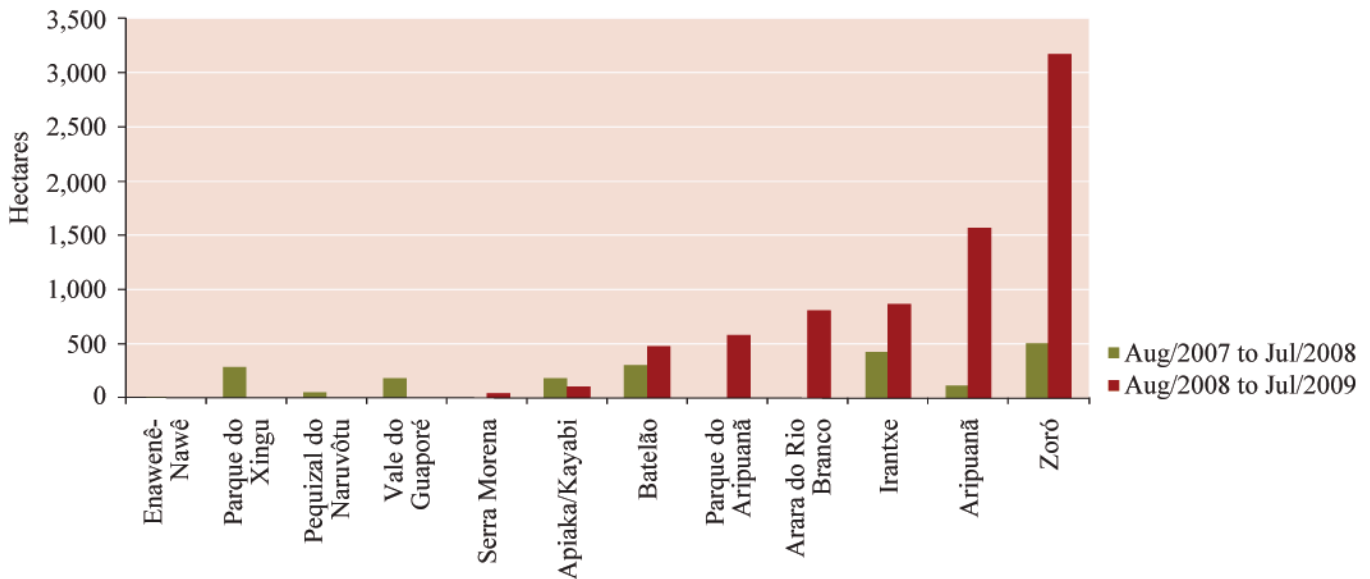
it are TI Aripuanã, with 21% (Aripuanã and Juína); TI Irantxe, with 11% (Brasnorte); TI Arara do Rio Branco, with 11% (Colniza and Aripuanã); TI Parque do Aripuanã, with 8% (Juína); TI Batelão, with 6% (Juara, Nova Canaã do Norte and Tabaporã); TI Apiaka/Kayabi, with 1% (Juara); and TI Serra Morena, with less than 1% (Juína) (Figure 13).



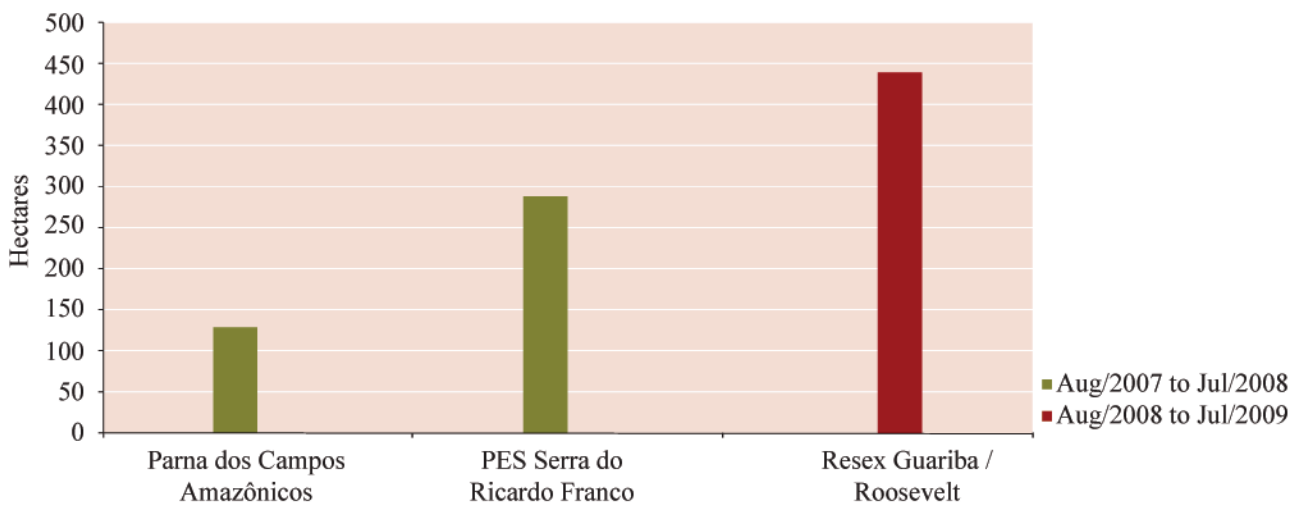
**Figure 13.** Indigenous Lands with the largest areas logged without authorization in the State of Mato Grosso from August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

When we compare the periods from August, 2007 to July, 2008 and August, 2008 to July, 2009, we observe a considerable increase of 373% in illegal logging in the TIs during the more recent period. That increase was most notable in the TI Zoró (2,666 hectares), followed by TI Aripuanã (1,458 hectares), TI Arara do Rio Branco (809 hectares), TI Parque Aripuanã (580 hectares), TI Irantxe (444 hectares) and TI Batelão (172 hectares) (Figure 14).

In terms of the UC (Conservation Units)<sup>4</sup>, a total of 856 hectares of forests illegally logged was detected for the periods studied, distributed among three UC. The greatest incidence was in the Guariba/Roosevelt Resex (Extractive Reserve), with 51% (439 hectares); followed by Serra do Ricardo Franco PES (State Park), with 34% (288 hectares); and Campos Amazônicos Parna (National Park), with 15% (129 hectares) (Figure 15).



**Figure 14.** Indigenous Lands with the largest areas logged without authorization in the State of Mato Grosso from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).



**Figure 15.** Conservation Units with the largest areas logged without authorization in the State of Mato Grosso from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

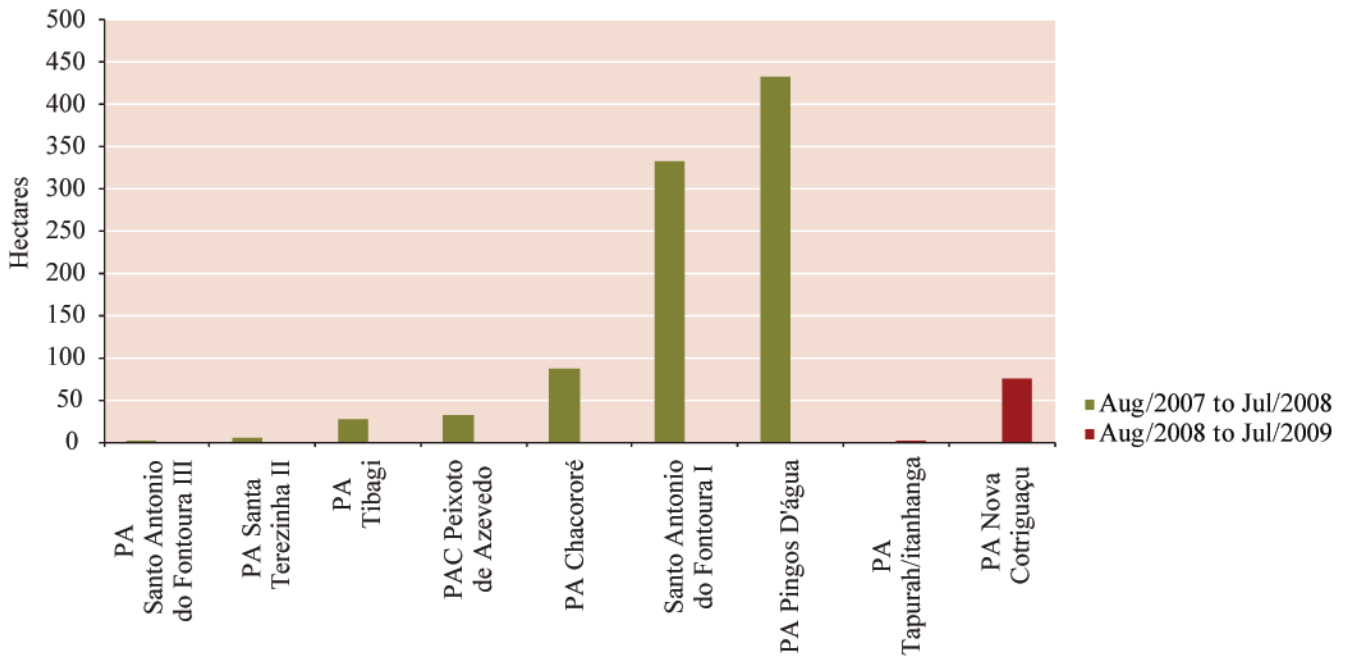
<sup>4</sup> Illegal logging was not observed in the same UC for the two periods.

## Settlements

In land reform settlements in Mato Grosso, timber harvesting involved an area of 994 hectares of forest from August, 2007 to July, 2008 and August, 2008 to July, 2009. The most critical situation was in the PA (Settlement Project) of Pingos

D'Água (44% of the total logged) and PA Santo Antônio Fontoura I (33%).

We identified a significant reduction in non-authorized logging in the majority of settlements during the two periods. However, we detected increases in logging in PA Nova Cotriguaçu (75 hectares) and PA Tapurah/Itanhanga (2 hectares) (Figure 16).



**Figure 16.** Land reform settlements with the largest areas logged without authorization in the State of Mato Grosso from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

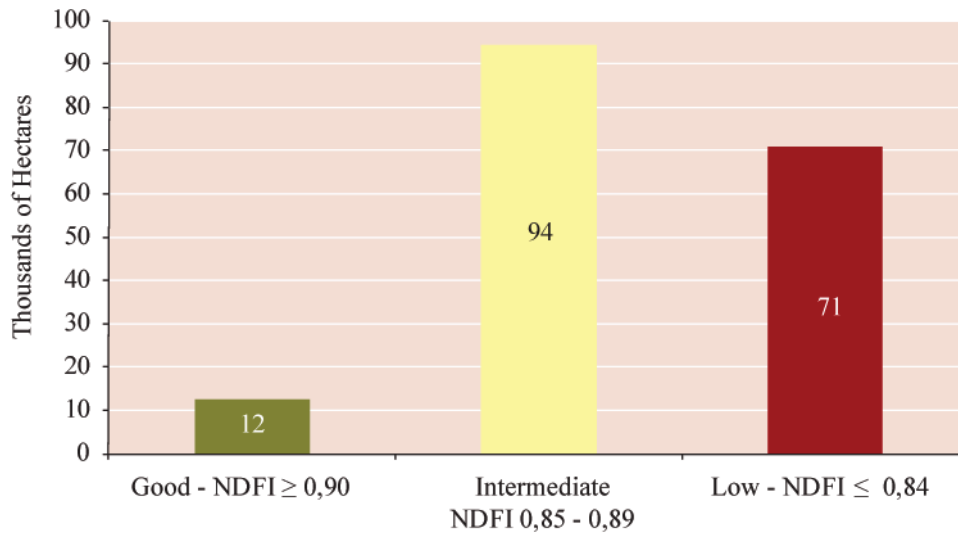
## Quality of Timber Harvesting

To assess the quality of timber harvesting authorized in the State of Mato Grosso, we initially analyzed the management plans in operation from August, 2008 to July, 2009. Of those, we selected those (299 plans involving 177,625 hectares) in whose NDFI images (Box 1) it was possible to visualize scars from timber harvesting and evaluate the logging quality from the images. Next, we for those images we determined logging quality thresholds<sup>5</sup>, such that:  $NDFI \leq 0.84$  represents low quality logging (predatory logging);

$NDFI = 0.85-0.89$ , intermediate logging quality (there was an attempt at adopting management, but the configurations of roads, log landings and clearings reveals serious problems with execution); and  $NDFI \geq 0.90$ , good quality logging, meaning that the configuration of roads, log landings and clearings shows a pattern of managed logging.

We found that, of the logging detected in the image, for 2009, only 9% (12,543 hectares) was of good quality, 55% (94,315 hectares) was of intermediate quality, and 36% (70,767 hectares) was of low quality (Figure 17).

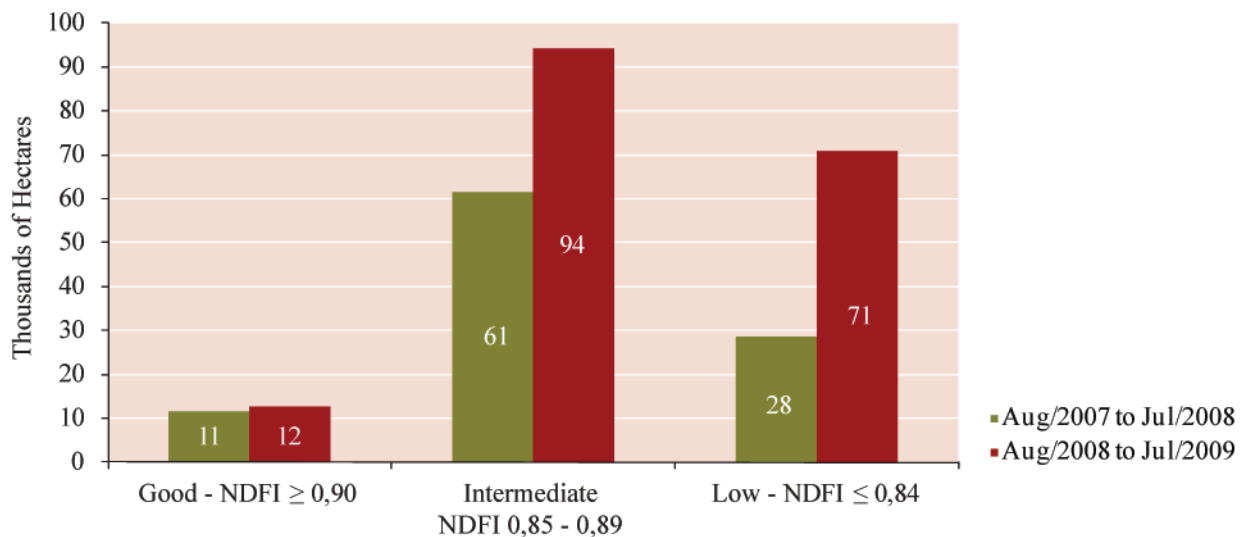
<sup>5</sup> Monteiro, A; Brandão Jr., A; Souza Jr., C; Ribeiro, J; Balieiro, C; Verissimo, A. 2008. Identificação de áreas para a produção florestal sustentável no noroeste de Mato Grosso. Imazon: Belém. ISBN: 978-85-86212-24-6. 68p.



**Figure 17.** Quality (in hectares) of timber harvesting detected in 299 management plans in the State of Mato Grosso from August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

When comparing the quality of timber harvesting carried out from August, 2008 to July, 2009 with that from the previous period (August, 2007 to July, 2008), we observed that the area with good quality harvesting increased little (from 11 thousand

to 12 thousand hectares), but that there was a considerable increase in the areas with intermediate (from 61 thousand to 94 thousand hectares) and low quality logging (from 28 thousand to 71 thousand hectares) (Figure 18).

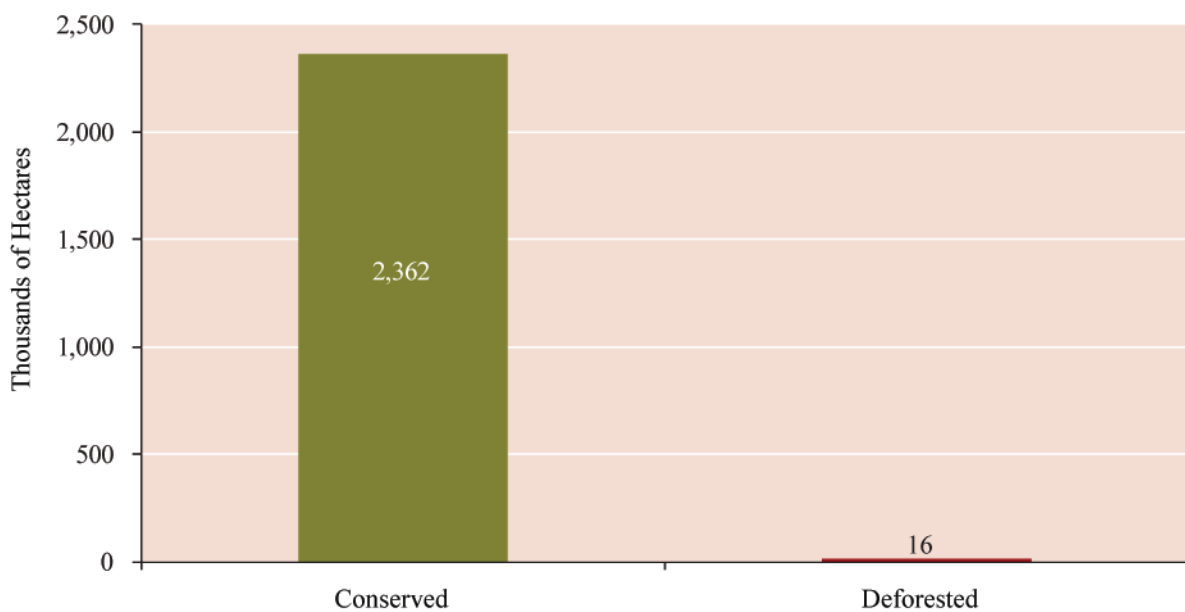


**Figure 18.** Quality (in hectares) of timber harvesting carried out from August/2007 to July/2008 and August/2008 to July/2009 (Source: Imazon/Simex based on data from Sema/MT).

## Maintenance of Forest Management Areas

We analyzed the satellite images from 2009 to see if the forest management plans in operation for the two periods are being maintained for the next cutting cycle<sup>6</sup>. Of the 612 forest management plans

evaluated for those two periods (2,377,366 hectares), in 99% (2,361,739 hectares) the areas remain conserved and in 1% (15,927 hectares) there was deforestation (clear cutting) (Figure 19).



**Figure 19.** Situation of the forest management areas from August/2007 to July, 2008 and August/2008 to July/2009 evaluated in images from 2009.

<sup>6</sup> Cutting cycle is the minimum time for returning to the same area to harvest timber. This time is estimated at 30 years (Amaral, P., Veríssimo, A., Barreto, P., Vidal, E. Floresta para Sempre. Manual de Produção de Madeira na Amazônia. Imazon: Belém, 2008, 137p).

### 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 sectors (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<sup>7</sup> (Normalized Difference Fraction Index), defined as:

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

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

$$\text{VEGnorm} = \text{VEG} / (1 - \text{Shadow})$$

The information extracted from the satellite images is crossed with information from Simlam and Sisflora to evaluate the situation of licensed

management plans<sup>8</sup>. 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 than 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.

<sup>7</sup> Souza Jr, C., Roberts, D. A., Cochrane, M. A. Combining spectral and spatial information to map canopy damage from selective logging and forest fires. *Remote Sensing of Environment* 98, 2005, 329-343.

<sup>8</sup> Monteiro, A. & Souza Jr, C. *Imagens de satélite para avaliar planos de manejo florestal. O Estado da Amazônia* n.9. Imazon: Belém. 4p.

## **Project Team:**

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

## **Data Sources:**

Statistics for timber harvesting are generated from Imazon data

Data from Sema/MT (Simlam and Sisflora)

<http://monitoramento.sema.mt.gov.br/simlam/>

<http://monitoramento.sema.mt.gov.br/sisflora/>

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