

## SCARS OF MINING IN INDIGENOUS LANDS OF THE BRAZILIAN AMAZON

Martha Fellows<sup>1</sup>, Ane Alencar<sup>1</sup>, Rafaella Silvestrini<sup>1</sup>, Cesar Diniz<sup>2</sup>,  
Luiz Cortinhas<sup>2</sup>, Nathalia Carvalho<sup>1</sup>, Julia Shimbo<sup>1</sup>

<sup>1</sup> IPAM (Amazon Environmental Research Institute)

<sup>2</sup> Solved - Soluções em Geoinformação

### 1. Introduction

Indigenous Lands are territories inhabited by multiple indigenous societies that express their worldviews (Little, 2002). These areas, demarcated across the entire national territory, are intended to safeguard the fundamental rights of Indigenous Peoples (Eloy Amado, 2015). However, the law enforcement has proven not to safeguard the integrity of these territories, as their population is constantly affected by economic activities, often illegal, such as mining, especially in alluvial gold mining, which generates direct ecological and sociocultural impacts wherever it occurs. In recent years, the newspapers' headlines have showcased the mining sites due to their negative impacts on health, way of living, and territorial, cultural, and ancestral sovereignty (Senra et al., 2023).

The exploitation of Brazilian soil since the colonial period has gained new layers with the renovation of the mining codes written over the years. Since the 1930s, Brazilian mining legislation has been updated in line with the evolution of the activity. Initially, the figure of artisanal mining was regulated by Decree No. 24,193/1934, which over time evolved to the current Law No. 7,805/1989. It established the PLG (Garimpeira<sup>1</sup> Mining Permit). In 2008, Law No. 11,685 ordered

### Highlights

- The Amazon biome in Brazil has over 80,000 mining sites, covering an area of 241,019 hectares.
- Between 1985 and 2022, the mining area within Amazonian Indigenous Lands grew 16 times, from 1,500 hectares to 25,070 hectares.
- In six years (2016-2022), Indigenous communities saw a 361% increase in mining within their territories.
- 90% of all mining is concentrated in three Indigenous Lands: Kayapó, Munduruku, and Yanomami.
- 122 Indigenous Lands are located in watersheds impacted by mining activity.
- 44% of mining sites outside Indigenous Lands in the Amazon are located within 50 km of the Indigenous territories' boundaries.

1. Garimpeiros are those who work in mining sites artisanally in small-scale.

the Statute of the Garimpeiro, among other legal mechanisms aimed at regulating this activity (MPF, 2020).

With the creation of the ANM (National Mining Agency), the country is endowed with an organization governing such activity that categorically recognizes the prohibition of mining activities in Indigenous territories<sup>2</sup>. In contrast, Law No. 12,844/2013 makes buying and selling gold more flexible, from Brazil to other countries. According to this law, known as the “Good Faith Law”, associations or individuals can easily issue receipts to certify the origin of the gold without any, or very little, inspection of its real origin<sup>3</sup>. In practice, this law allows for the extraction of gold from socio-environmentally sensitive areas, such as Indigenous Lands (ILs).

Legal mechanisms are just one aspect of the imminent risks that mining poses to Indigenous Peoples. The activity itself directly impacts life in the communities. Water, air, soil, vegetation, and local fauna near areas influenced by mining become contaminated (Gerson et al., 2022), leading to serious health consequences for the Indigenous population living in territories invaded by miners (Villen-Perez et al., 2020). The impacts of mining can be felt kilometers away, threatening social and environmental quality (Siqueira-Gay & Sánchez, 2021).

To understand the location and severity of mining scars in the Indigenous Amazonia, this technical note aims to highlight the impact of these activities through a political-legal and geospatial lens. In this regard,

the main regulatory acts guiding the issue were analyzed; subsequently, the size and distribution of areas influenced by mining in Indigenous Lands, their surroundings, and watersheds in the Amazon biome in Brazil over the last three decades were evaluated.

## 2. Methodology

To understand the legal situation, a review of Brazilian mining, environmental, and indigenous legislation was conducted in 1988, when the Federal Constitution was promulgated. Some mining guidelines predate the Constitution, however, this timeframe was chosen to maintain parallelism with the geospatial analyses. Primary sources were used for direct analysis of laws and other legal frameworks related to the central theme of this study. In the second stage, secondary sources were consulted based on analyses from the 4th Chamber of Coordination and Review of the Federal Public Ministry (MPF, 2020), and the Journal of Studies and Research of FUNAI (National Foundation of Indigenous Peoples) launched in 2007 (Curi, 2007). These pieces of information were used to frame a timeline with the main legal milestones of gold extraction and to provide a political context.

Afterward, analyses of the distribution of the historical and spatial reach and impact of mining were conducted. Mining data from Collection 8 of MapBiomass Brazil were utilized for this purpose. The MapBiomass network data are based on the mapping of scars left by mining operations in Landsat satellite images with a spatial

2. To learn more, visit: <https://www.gov.br/anm/pt-br>. Accessed on January 19, 2024.

3. To learn more, visit: <https://www2.camara.leg.br/legin/fed/lei/2013/lei-12844-19-julho-2013-776582-norma-pl.html>. Accessed on January 19, 2024.

resolution of 30 meters for the time series between 1985 and 2022. These data were generated using high-performance machine learning-based classification techniques (MapBiomass, 2023). The mining-affected area data were converted into points based on the centroid of each mining spot, in order to determine the number of mining sites inside and outside Indigenous Lands in the Amazon biome in Brazil. The mined area and number of mining sites were calculated on a 20x20 km grid, which allowed for the calculation of the proportion of mining area and concentration of mining sites in each of these grid cells, facilitating visualization. These data were then combined with the boundaries of Indigenous Lands (FUNAI, 2021) to identify the area and percentage of the affected area, as well as the number of mining sites within and outside these territories.

To assess the impact of mining on water resources inside and outside the ILs, the otto-coded level 4 watershed database (ANA, 2012) was used. For each basin, the area affected by mining and the overlap between the affected basins were calculated, and the ILs were used as an impact indicator even if there was no mining within the boundaries of the territories. In addition, the distance of

each mine outside the ILs from their border was calculated to indicate the degree of proximity of the mines located outside the ILs to their boundary.

## 3. Results

### 3.1. Mining and Indigenous Legislation

The quest for precious metals has driven the economy since the colonial period in countries such as Brazil. In addition to the movement of natural and financial resources, mining has also caused dramatic changes in the socio-environmental dynamics of the country. From the beginning, Indigenous Peoples have been among the main targets of the negative impacts of mineral extraction (MPF, 2020).

The initial legal norms regulating the activity reaffirmed its exploratory nature, without yet incorporating environmental and sociodemographic aspects. The Federal Constitution initiates a new period of regulation of mining activities by determining that mineral resources belong to the Union, which also has to demarcate Indigenous Lands, protect, and ensure that Indigenous Peoples have their cultural, historical, and social integrity respected (Table 1).

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**Table 1.** Timeline with the main milestones regulating mining activities, Indigenous and environmental legislation in Brazil, since the 1988 Federal Constitution. Sources: MPF (2020); Curi (2007), Portal of the Chamber of Deputies and Federal Senate.

Year	Legislation	Highlights
1988	Federal Constitution	<p>Art. 20: The following are assets of the Union: IX - mineral resources, including those on the underground.</p> <p>Art. 225: § Paragraph 2: Anyone who exploits mineral resources is obliged to restore the degraded area.</p> <p>Art. 231: Indigenous Peoples are recognized for their social organization, customs, languages, beliefs, and traditions, and their original rights over the lands they traditionally occupy, and the Union is responsible for demarcating, protecting, and ensuring respect for all their assets.</p>
1989	Law No. 7.805/1989	Extinguishes the registration system and creates the Garimpeiro Mining Permit (PLG) system
1997	Resolution No. 237/1997 (CONAMA)	Determines the activities or undertakings subject to environmental licensing
2008	Law No. 11.685/2008	Garimpeiro Statute
2013	Law No. 12.844/2013	Good Faith Law. Provides for proof of tax compliance by taxpayers; regulates the purchase, sale, and transportation of gold
2018	Decree No. 9.406/2018	Regulates the Mining Code
2020	Bill No. 191/2020	Establishes the conditions for the research and mining of mineral resources and hydrocarbons, and for the generation of electricity by hydroelectric plants on Indigenous Lands
2022	Bill No. 571/2022	It empowers the President of the Republic to release mineral extraction in any area of the country in times of crisis, including in Indigenous Lands and Conservation Units
2023	Bill No. 3.025/23	Reforms the rules for trading and transporting gold in Brazil. Eliminates the presumption of good faith
2023	Decree No. 11.405/2023	Provides for measures to deal with the Public Health Emergency and combat illegal mining in Yanomami territory

The years following the promulgation of the Federal Constitution shaped the rules of mining activity. Subsequently, the old registration system was replaced by the current PLG (Garimpeira Mining Permit) by Law No. 7,805 of 1989. So, individuals or cooperatives of miners became dependent on prior environmental licensing to explore an area of up to 50 hectares, with exceptions

for cooperatives. Years later, Resolution No. 237 issued in 1997 by CONAMA (National Council for the Environment) made it clear that extraction, treatment, and activities related to the mineral products industry are subject to environmental licensing. As a complementary measure, Decree No. 9,406 published in 2018 details the rules regarding the administration of mineral

resources by the Union, indicating that it is the responsibility of the miner to prevent and mitigate the impacts resulting from the activity<sup>4</sup>.

In 2008, Law No. 11,685/2008 was sanctioned, creating the Garimpeiro Statute, differentiating the activity from industrial mining, considering the former as small-scale and able to be practiced individually or collectively through cooperatives. In contrast to the activities described by CONAMA, which require prior authorization for execution, this new law facilitates the exploitation of minerals by garimpeiros, based on the small-scale operation<sup>5</sup>. In 2013, Law No. 12,844/2013 further expanded the precedents of mining deregulation by presuming those legal entities buying and selling gold act in good faith when indicating the origin of this precious metal.

In 2023, Law Project No. 3,025 emerged aiming to reverse the prevailing lack of transparency, which creates an environment conducive to illegality (Manzoli & Rajão, 2022). Among its proposals are: i) establishment of control chains to prevent money laundering; ii) traceability of gold; iii) end of the presumption of good faith; among other mechanisms to reduce illicit activities.

### 3.2. The Evolution of Mining in Indigenous Lands in the Amazon

Currently, an area of 241,019 hectares is directly affected by mining in the Amazon

biome in Brazil, with an estimated 80,180 mining sites. The most affected regions are concentrated in the northwest of Roraima, southwest and southeast of Pará, north of the states of Mato Grosso and Rondônia, and some areas in the states of Amazonas, Amapá, and Maranhão (Figure 1). This scenario illustrates the advancement of mining over the past four decades, accelerated mainly since 2016. According to the MapBiomias Collection 8 survey, the area of mining in the Brazilian Amazon increased 12 times between 1985 and 2022, from 18,619 ha to 241,019 ha.

For Indigenous Peoples, the situation is even more critical. Approximately 25,070 hectares of the area occupied by mining in the region are located within Indigenous territories (Figure 1). Comparatively, this area represents a relatively small percentage of the total biome (10.5%); however, it is highly significant for these territories. Mining within ILs has grown more rapidly than the advancement of the activity across the region. While mining increased 12 times in the Brazilian Amazon, within Indigenous Lands, the increase was 16 times, rising from 1,510 hectares in 1985 to 25,070 hectares in 2022. The recent six years marked the peak of this increase: between 2016 and 2022, Amazonian Indigenous territories became the land category proportionally most affected by mining, with the mining area growing by 361% within ILs and 96% in the rest of the biome.

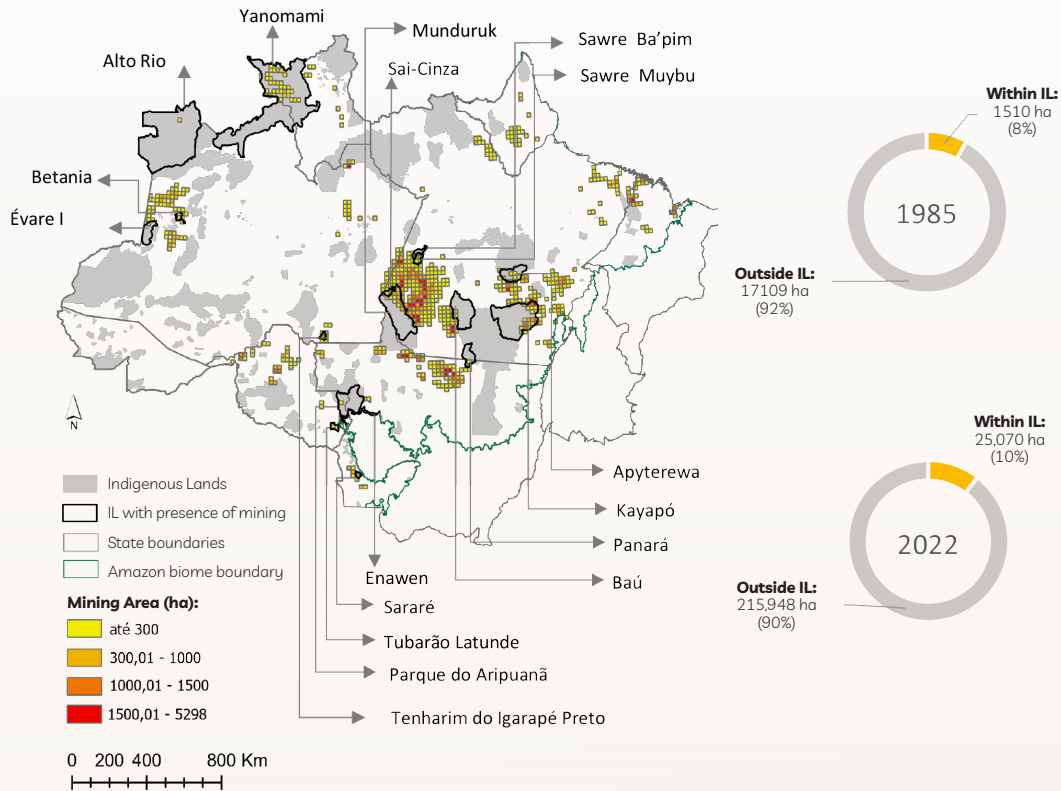
4. To learn more, visit: [https://www.planalto.gov.br/ccivil\\_03/\\_ato2015-2018/2018/decreto/d9406.htm](https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/decreto/d9406.htm). Accessed on January 19, 2024.

5. To learn more, visit: [https://www.planalto.gov.br/ccivil\\_03/\\_ato2007-2010/2008/lei/111685.htm](https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/lei/111685.htm). Accessed on January 19, 2024.



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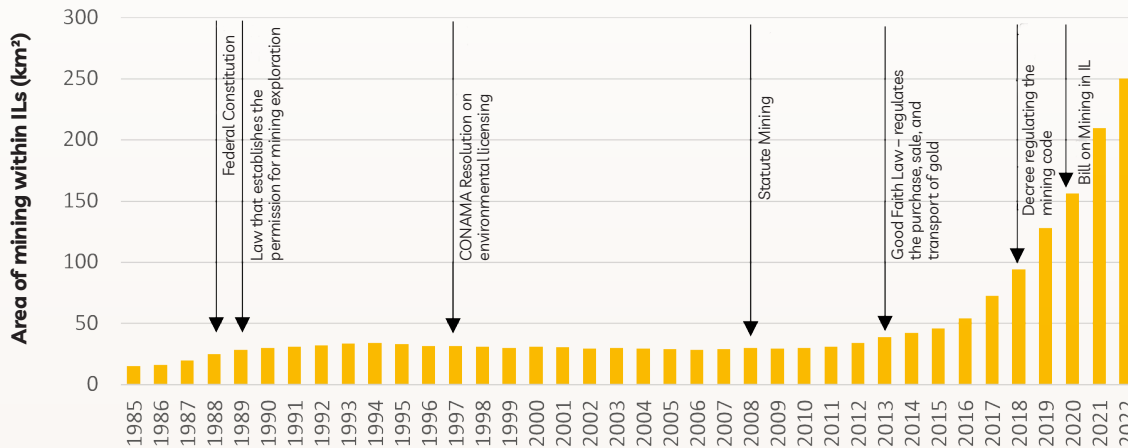
**Figure 1.** (A) Concentration of the area occupied by mining in the Brazilian Amazon in 2021 per 20 km x 12 km grid cell, including all Indigenous Lands (ILs) in gray and ILs with mining occurrences inside them with boundaries in black. (B) Area and proportion of the area occupied by mining inside and outside ILs in the Amazon biome in 1985 and 2022. Source: IPAM Analysis with MapBiomas Collection 8 data (2023).

Over the past four decades, the dynamics of increasing mining areas in Indigenous territories have had two growth periods. The first, more modest one, occurred between 1985 and 1990, which stabilized by 2013, and the second, more accelerated

one, with a steep upward curve of mining in Indigenous Lands, particularly after 2016. The growth of the mining area has been significant in recent years: 78% of the entire area occupied by mining in ILs emerged between 2016 and 2022 (Figure 2).

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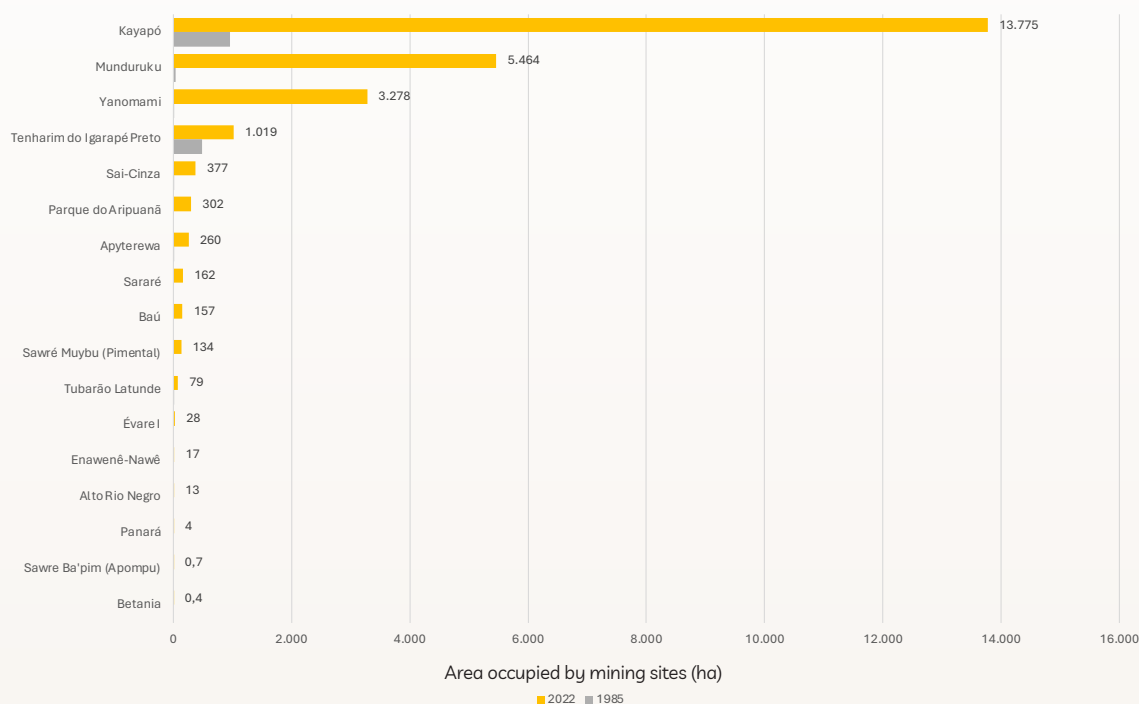


**Figure 2.** The historical mining area in Indigenous Territories of the Amazon biome in Brazil between 1985 and 2022 and legal milestones. Sources: IPAM Analysis with MapBiomias Collection 8 data (2023), MPF (2020), Curi (2007), Chamber of Deputies and Federal Senate Portal.

Out of the 335 Indigenous Lands in the Amazon biome in Brazil, in various stages of demarcation, 17 have the presence of mining. These are, in the state of Pará: Kayapó IL, Munduruku IL, Apyterewa IL, Panará IL, Sai-Cinza IL, Baú IL, Sawré Ba'pim IL, and Sawré Muybu IL; in Rondônia: Sararé IL, Tubarão Latunde IL, and Parque do Aripuan IL; in Amazonas: Alto Rio Negro IL, Évare I IL, Betania IL, and Tenharim IL; in Mato Grosso: Enawenê-Nawê IL; and between Amazonas and Roraima, Yanomami IL (Figure 3).

The Kayapó IL concentrates 55% of the mining area in ILs, followed by Munduruku IL (22%) and Yanomami IL (13%). Together, these three ILs represent a large part of the

area affected by mining activities (90%), indicating a highly concentrated occupation of mining in a few traditional territories. Besides encompassing the majority of mining, they have also seen a surge in mining invasion. For example, mining in Kayapó IL increased by over 1,339%, from 957 hectares to 13,775 hectares between 1985 and 2022. The Munduruku IL, the second most affected by mining, had its mining area expanded by over 129 times in the 38 years of analysis, jumping from 42 hectares to 5,463 hectares (Figure 3). In the same period, the Yanomami IL recorded an expansion of over 20,000 times in the mining area, increasing from 15 hectares to 3,278 hectares.



**Figure 3.** Evolution of mining area by Indigenous Territory from 1985 to 2022.  
Source: IPAM analysis with MapBiomias Collection 8 data (2023).

### 3.3. Impact of Mining on Rivers in Indigenous Territories

Although mining is concentrated in specific geographies in the Amazon biome, its impact extends beyond the area directly occupied by the activity. Since much of the mapped mining activity is alluvial, meaning the extraction is done by opening holes mostly located along riverbanks, mining sites end up impacting the nearby water bodies. Pollutants such as mercury are carried and contaminate the entire river and air chain in the region (Ribeiro, 2016; Hacon et al., 1995). If these rivers are partially blocked, they fail to fulfill their ecosystem

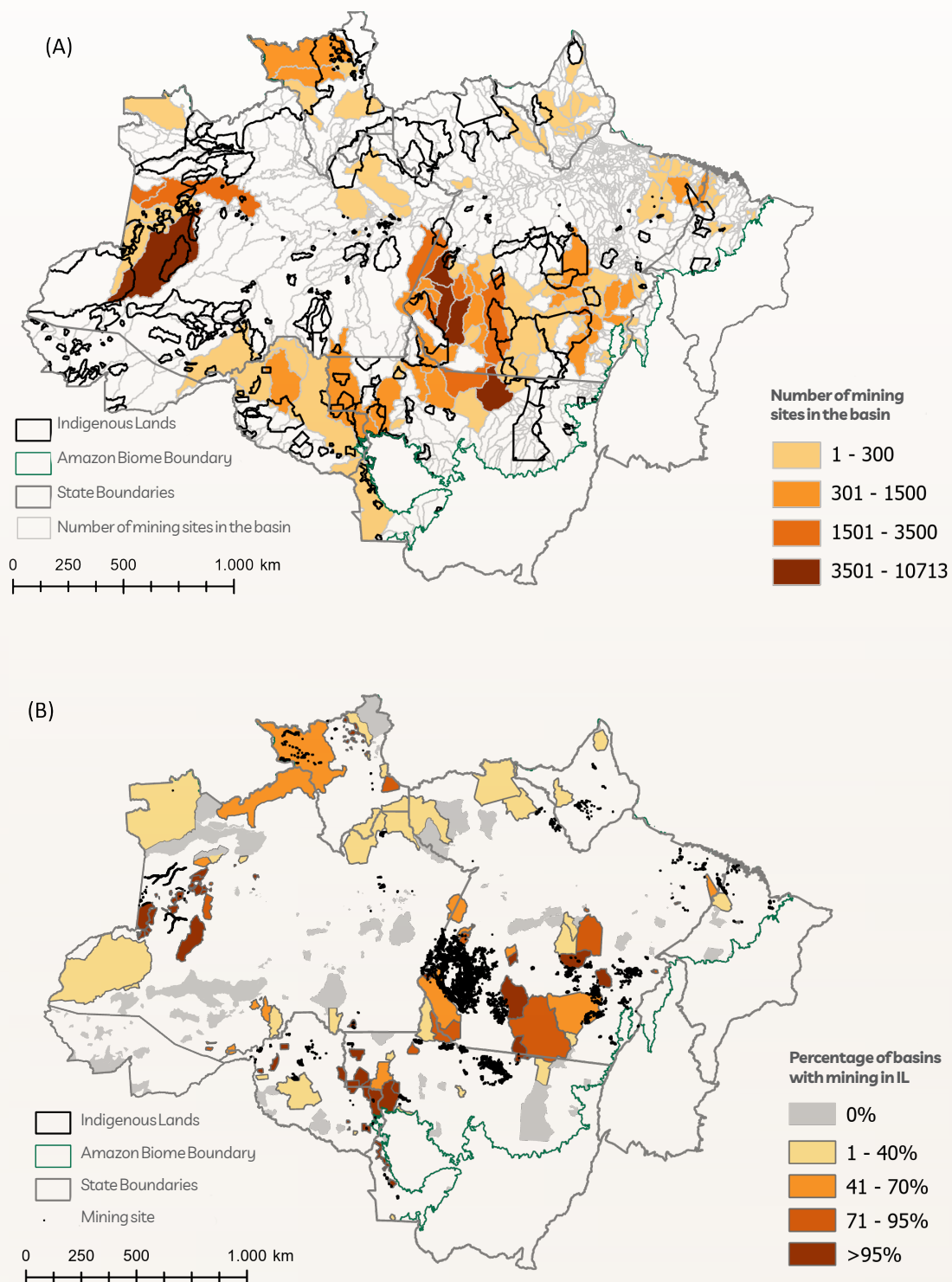
and cultural functions, directly impacting life in the villages (Senra et al., 2023).

In this sense, even though only 17 ILs have direct occurrences of mining within their territory, another 122 ILs are located in hydrographic basins impacted by mining activity. Among these, 77 ILs have 100% of their territory in basins with mining activities, while 45 ILs have parts of their territory in basins with mining activities (Figure 4). Additionally, about 44% of mining sites outside ILs in the Amazon are located within a radius of up to 50 km from the boundaries of Indigenous territories, and of these, approximately 12.5% are within the first 5 km from the edge of ILs.



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**Figure 4.** (A) Watersheds with presence of mining area by number of mining sites; and (B) Indigenous Lands with basins impacted by mining. Source: IPAM analysis with MapBiomas Collection 8 data (2023).

## 4. Discussion

Indigenous territories cover approximately a quarter of the Brazilian Amazon and historically represent the portion with the lowest rates of deforestation and fires in the region (Alencar et al., 2022; Walker et al., 2020). However, the intensification of illicit activities has increased the devastation of these territories in recent years. The Federal Constitution of 1988 is a legal milestone that introduces the principles of regulating mining activities. Subsequent legislation has evolved in two directions. On one hand, it delineates rules to ensure the socio-environmental integrity of areas affected by mining; on the other hand, it has created facilities for the exercise of this activity, compromising the fulfillment of the former. Law No. 12,844/2013, or the Good Faith Law, hampers the traceability of the gold trade (Manzoli & Rajão, 2022; MPF, 2020). The Garimpeiro Statute, established by Law No. 11,685/2008, also opens space for illegal activities by removing the requirement for prior licensing (MPF, 2020). The astonishing increase in the mining area in Indigenous territories follows the path of these legal mechanisms, as illustrated in Figure 2.

The Bill No. 3,025 of 2023 serves as a counterpoint to the aforementioned legal mechanisms, particularly emphasizing the proposal to end the Good Faith Law. In specific situations, such as the health emergency experienced in Yanomami IL, the State resorted to immediate actions, such as Decree 11,405/2023, to curb illegal mining. To reverse the upward trend of mining and gold mining in Indigenous

Lands, it is necessary to build legal and structural barriers to the advancement of the activity, as in the recent six years, the incidence of mining in these areas increased 16 times, while the Amazon region had a 12-fold increase in the same period. The concentration of direct impacts on 17 Indigenous territories and indirect impacts on 122 is noteworthy, as some peoples are more exposed than others to contamination from mining, which necessarily requires greater care for those most affected.

In addition to the increasing threat to Indigenous Peoples due to the growing amount of mining in their territories, the speed at which this phenomenon has occurred is alarming, driven by the observed legal flexibilization in the last legislative cycle. In just six years, the three ILs most affected by mining - Kayapó IL, Munduruku IL, and Yanomami IL - have experienced an unprecedented increase in mined areas. The speed at which miners reach Indigenous communities is inversely proportional to the time it takes for families and their homes to recover. It takes years for mercury, an element commonly used in gold extraction, to leave the environment (Hacon et al., 1995). Furthermore, the health of Indigenous Peoples is compromised when exposed to mercury. Violations of the rights of these communities affected by mining occur at various levels, from the invasion of their sacred spaces to the disruption of food security, ultimately leaving an entire generation disorganized and ill (Greenpeace, 2023).

To ensure that Indigenous territories remain important socio-cultural spaces and

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maintain their integrity, it is essential to curb the invasion of miners in these territories, while also ensuring a legal framework that, to some extent, advanced in 2023 and addresses the risks associated with the activity, regardless of where it is carried out. In this context, it is urgent to follow some recommendations, including:

- Strengthening mining and Indigenous legislation to ensure compliance with the Federal Constitution and respect for the traditional ways of life of Indigenous Peoples;
- Implementing a traceability system for the origin of gold production and commercialization, following the guidelines of Bill No. 3,025/2023;
- Immediate removal of all miners from Indigenous Lands following ADPF 709<sup>6</sup> and Decree No. 11,405/2023, starting with the three most impacted

territories, namely Kayapó, Munduruku, and Yanomami ILS;

- Developing a strategic plan to prevent the recurrence of these miners in already affected areas and new Indigenous Lands;
- Strengthening enforcement agencies to ensure they have sufficient financial and human resources to operate in all regions affected by illegal mining;
- Promoting coordination between command-and-control agencies and Indigenous agencies - Ministry of Indigenous Peoples and FUNAI - so that the actions to be implemented respect the cultural specificities of each group affected by mining activities;
- Ensuring ecosystem, social, and cultural recovery in Indigenous territories affected directly and indirectly by mining.

6. ADP 709, to learn more, visit: <https://portal.stf.jus.br/noticias/verNoticia-Detalhe.asp?idConteudo=488324&ori=1>. Accessed on January 19, 2024.

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