

## COMMENT

## Mining code changes undermine biodiversity conservation in Brazil

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Protected areas (PAs) are vital for the conservation of Brazil's biodiversity (Barber *et al.* 2014). However, they are at risk of a downgrade in legal status due to economic pressures on natural resources (Bernard *et al.* 2014; De Marques & Perez 2014; Pack *et al.* 2016). Mining is one of the most urgent environmental threats in Brazil (Ferreira *et al.* 2014; El Bizri *et al.* 2016), with plans in place for a 10-fold increase in the number of mining projects in *c.* 8 years. If all were developed, the Brazilian territory occupied by mining would increase 23-fold in the near future. Currently, 12 697 projects covering  $98 \times 10^5$  ha are planned within PAs. Licensing and exploitation of 53% of this land will depend on the approval of three bills that intend to authorize mining in areas where it was formerly forbidden. Here, we analyse the potential consequences of the approval of these new policies for conservation.

Brazil has a number of legal categories for land protection, including strict PAs, sustainable-use PAs and indigenous lands. Mining is only permitted in some sustainable-use PAs (named APAs and ARIEs from their initials in Portuguese; see Supplementary Material, available online). Today, 1195 mining projects covering  $1.6 \times 10^5$  ha are established in these areas, while 367 projects covering  $4.2 \times 10^5$  ha are working in PAs where mining is theoretically not allowed (Figs 1 and 2). The large impacted area in lands regulated as mining-free has various explanations. For some PAs, the law allows mining works to continue when they were approved prior to the establishment of the PA (IBAMA 2004). For the others, diverse misinterpretations of current law have led to improper mining concessions and subsequent judicial battles (Ricardo & Rolla 2006). In addition to direct habitat loss and the frequent destruction of caves (Ferreira *et al.* 2014; Sayuri *et al.* 2015), mining causes a range of secondary impacts. The massive migration of workers to low-populated areas, as well as the infrastructure associated with the project, further increases habitat loss and opens up intact wild areas to illegal forest colonization and exploitation (Laurance *et al.* 2009). Mining activity itself also has an impact beyond its frontiers: rivers downstream may be polluted (Castilhos *et al.* 2015) and threatened by environmental accidents, such as the mining dam collapse that devastated the Doce River and the Southeast

Brazilian coast in November 2015 (Escobar 2015). Finally, mining has often resulted in social problems and conflicts with nearby communities (Hilson 2002; Haslam & Tanimoune 2016), such as the confrontation between miners and the Cinta Larga indigenous tribe (Rolla & Ricardo 2013).

### NEW BILLS MEAN 'CARTE BLANCHE' TO MINING IN PROTECTED AREAS

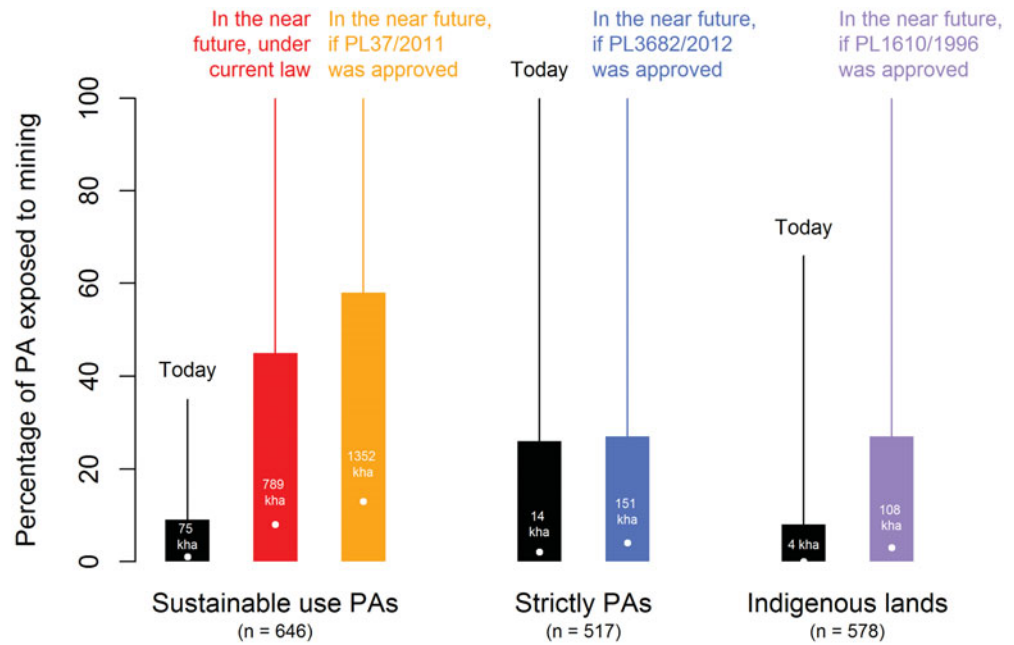
There are three parliamentary bills that consider the establishment of mining in PAs where it is currently forbidden. Each of the bills is directed at one type of PA. Bill PL37/2011 is proposed to allow mining in all types of sustainable-use PAs without restrictions on the percentage of the PA extension to be impacted. PL3682/2012 may allow mining covering up to 10% of each strict PA, and PL1610/1996 would allow the development of mining activities in indigenous lands without extension restrictions. PL1610/1996 is currently under consideration, while PL37/2011 and PL3682/2012 were recently retracted. Nonetheless, they could be brought back up at any time, especially given the scenario of political instability in Brazil. Moreover, mining enterprises appear to be preparing for the approval of the three bills. The government has recently received nearly 2400 applications for mining exploration or licensing within PAs in which mining is currently not permitted.

### WOULD NEW POLICIES MAKE A DIFFERENCE?

In accordance with current jurisprudence, only mining planned at APAs and ARIEs could be licensed. There are more than 11 200 projects planned in these areas to date. Following their establishment, the area affected by mining in these units would expand 30-fold. This would increase the direct impact of mining on sustainable areas (Figs 1 and 2).

However, if the three bills pass, the mining impact in all other PAs could increase 13-fold (5 million ha) within 8 years, resulting in a total impact of 10 million ha by mining in Brazilian PAs (Fig. 2). The approval of PL37/2011 would open the possibility for extraction in sustainable-use PAs where mining is currently forbidden, in which 46 projects are planned. If this bill were approved, the development of these projects would increase the total impact of mining in these lands from the current  $3 \times 10^5$  ha to  $40 \times 10^5$  ha. The approval of PL3682/2012 would imply the official release

**Figure 1** Impact of mining on Brazilian PAs today (black bars) and as planned for the near future under four legal scenarios (red, orange, blue and purple bars). The percentage land that is/could be impacted by mining is represented by means (white points), standard errors (boxes) and maximum values (whiskers); the average absolute impacted areas are shown by white numbers. Impact is defined as the spatial extent occupied by mining. Planned projects are estimated to be developed within 8 years.  $n$  = total number of PAs; PA = protected area.



of strict PAs, where 1851 projects have already been planned. If these projects were developed, even considering the areal restrictions of the bill, the total impact of mining in strict PAs would expand from the current  $0.7 \times 10^5$  ha to  $8 \times 10^5$  ha. Finally, the approval of PL1610/1996 would mean a victory of mining enterprises over indigenous interests after a 20-year legal battle (e.g. Rolla & Ricardo 2013). The 114 million ha of indigenous lands that protect both biodiversity and indigenous rights would be available for mining without extension restrictions. To date, 541 projects have been planned in indigenous lands, meaning that the current impact of mining on these lands ( $0.2 \times 10^5$  ha) could rise to  $6 \times 10^5$  ha.

Supporters of downgrading PAs argue that the total amount of land affected would be quite small compared to the large extents of Brazilian PAs (see Fig. S1). However, the average percentage of land impacted (Fig. 1) suffers from the fallacy of the average. There are many areas in which mining enterprises have not shown any interest yet, either because there are no exploitable resources or because benefits do not outweigh transportation costs due to geographical isolation. When averaging, areas with zero impact may overshadow large impacts on others, where mining already occupies up to 100% of the PA (Figs 1 and 2). However, impacts are relevant at the scale of individual PAs, as each one aims to preserve endemic biotas, landscapes or cultures of special interest (Schulman *et al.* 2007). Therefore, mining development and subsequent environmental damage may compromise species, ecosystems and human populations with restricted distributions. Moreover, our results only refer to direct impacts within project limits, so the real consequences of mining, including secondary effects, may be underestimated. In addition, the impacts shown here are added to those of illegal mining, which in Brazil accounts for

up to 90% of artisanal mines (Barreto 2003). Such changes in the mining legislation may also hinder the compliance of Brazilian international agreements both to preserve 17% of its territory with effective PA networks and to reduce the extinction risk of endangered species by 2020 (Aichi goals; CBD 2010).

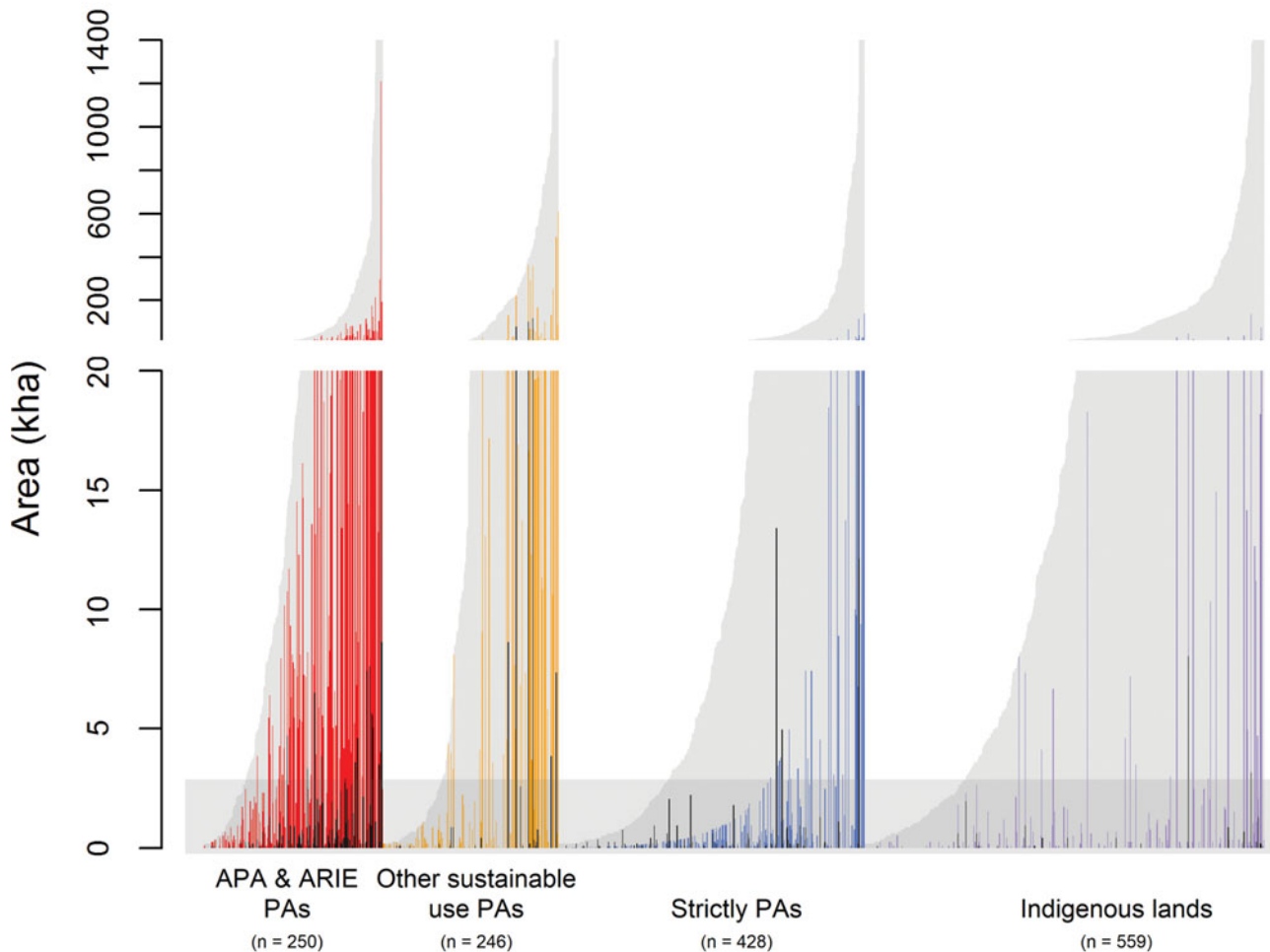
Here we have shown how changes in the Brazilian mining code may affect the PAs of the country in the short-term, considering projects that are in the planning phase. The velocity at which mining will impact Brazilian biodiversity in the mid-term is uncertain, although a change in the mining code may further stimulate the interest of companies in currently unexplored PAs. Mining is an important economic activity in Brazil (ICMM 2013), but extending it across current PAs via any PA downgrading, downsizing and degazettement mechanism (Pack *et al.* 2016) is not compatible with the sustainable development of the country (Meira *et al.* 2016). New bills are neglecting the importance of PAs, as mining jeopardizes water resources and ecological services maintenance, climate change prevention and indigenous well-being and culture preservation. Mining companies are waiting for the open season to exploit new lands, while the parliament now has the opportunity to avoid further degradation of the PAs that may be the last refuge for Brazilian biodiversity.

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**Figure 2** Total extent of Brazilian PAs (grey) and area occupied by mining today (black) and as planned for the near future under four legal scenarios (from left to right): if any new law was approved (red); if PL37/2011 was approved (orange); if PL3682/2012 was approved (blue); and if PL1610/1996 was approved (purple). Each bar represents one single PA. Planned projects are estimated to be developed within 8 years.  $n$  = number of protected areas represented in the figure; protected areas with extents of  $\leq 85$  ha are excluded; PA = protected area. See Fig. S2 for more details corresponding to the grey rectangle in this figure.

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### Supplementary material

To view supplementary material for this article, please visit <https://doi.org/10.1017/S0376892917000376>

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- SARA VILLÉN-PÉREZ<sup>1</sup>, POLIANA MENDES<sup>1</sup>, CAROLINE NÓBREGA<sup>1,2</sup>, LARA GOMES CÓRTEZ<sup>3</sup> AND PAULO DE MARCO JUNIOR<sup>\*1</sup>
- <sup>1</sup>Universidade Federal de Goiás – Ecology, Goiânia, Goiás, Brazil, <sup>2</sup>Instituto de Pesquisa Ambiental da Amazônia, Belém, Pará, Brazil and <sup>3</sup>Instituto Chico Mendes de Conservação da Biodiversidade, Brasília, Distrito Federal, Brazil
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- \*Correspondence: Dr Paulo De Marco Junior email: [pdemarcojr@gmail.com](mailto:pdemarcojr@gmail.com)