MINING CODE CHANGE IMPACTS ON AMAZONIAN THREATENED SPECIES: IDENTIFYING CONSERVATION AND RESTORATION PRIORITIES.

MÁSTER UNIVERSITARIO EN RESTAURACIÓN DE ECOSISTEMAS

Presentado por: Dª LUISA FERNANDA ANAYA VALENZUELA

Director: Dra. Dª SARA VILLÉN PÉREZ

Tutor académico: Dr. D. JUAN ANTONIO DELGADO

En Madrid, a 30 de junio de 2020

TABLE OF CONTENTS

FIGURES AND TABLES

ABSTRACT

The Amazon basin sustains about 10% of the world's known biodiversity, including hundreds of vertebrates threatened by habitat loss and degradation. The basin also contains one of the largest unexplored reserves of minerals in the world. Mining leases have increased rapidly in Brazil for the last decades, and new operations are expected to further affect ca. 7000 kha in years to come. Protected areas represent an important barrier to mining expansion, though a number of bills have been recently proposed to allow mining in different categories of protected areas where it is currently forbidden. I quantified the direct impact of mining on the distribution of 125 threatened Amazonian terrestrial vertebrates to date and in the near future, considering four scenarios of mining restriction in protected areas. Current mining projects impact an average of 0.31% of the distribution of each species. Considering new mining requests, in the near future this value may increase up to 2.3% if the law does not change, up to 3.7% if mining were allowed in all sustainable use protected areas, up to 2,4% if mining were allowed in 10% of strictly protected areas, and up to 2.5% if mining were allowed in indigenous lands. The most impacted species have small distributions, which itself increases their local extinction risk. Even though mining projects occupy a relatively small area, they may have a relevant impact when considering indirect deforestation and pollution. Using the Representation Target to estimate the Protection Status of the species, I proposed priority areas for restoration and conservation in Pará that would have a positive effect on 91 threatened species.

Keywords: Downgrading, Legislative Scenarios, Protected Areas, Representation Target, Species Distribution Models

RESUMEN

El Amazonas sustenta aproximadamente el 10% de toda la biodiversidad conocida en el mundo, incluyendo cientos de vertebrados amenazados por la pérdida y degradación del hábitat. La cuenca Amazónica también posee una de las mayores reservas de minerales sin explorar. Las licencias mineras han aumentado rápidamente en Brasil durante las últimas décadas, y se espera que las nuevas operaciones afecten aún más ca. 7000 kha en los años venideros. Las áreas protegidas representan una barrera importante para tal expansión, pero recientemente se han propuesto una serie de proyectos de ley que permitirían la minería en diferentes categorías de áreas protegidas donde actualmente está prohibido. Mediante este estudio cuantificamos el impacto directo de la minería en la distribución de 125 vertebrados terrestres amazónicos amenazados hasta la fecha y en el futuro cercano, considerando cuatro escenarios de restricción minera en áreas protegidas. Los proyectos mineros actuales impactan un promedio de 0.31% de la distribución de cada vertebrado amenazado. En el futuro cercano esto puede aumentar a 2.3% si la ley no cambia, a 3.7% si se permitiera la minería en todas las áreas protegidas de uso sostenible a 2.4% si se permitiera en el 10% de las áreas estrictamente protegidas, y a un 2.5% si se permitiera en tierras indígenas. Aunque los proyectos mineros ocupan un área relativamente pequeña, el impacto puede multiplicarse al considerar la deforestación indirecta y la contaminación. Además, las especies más afectadas tienen una distribución reducida, lo que a su vez aumenta su riesgo de extinción. Utilizando las Metas de Representación para estimar el Estado de Protección de las especies, propuse áreas prioritarias para la restauración y conservación en Pará, que tendrían un efecto positivo en 91 especies amenazadas.

Palabras Clave: Áreas Protegidas, Degradación, Escenarios legislativos, Metas de Representación, Modelos de distribución de especies.

INTRODUCTION

The Amazon basin contains the largest tropical forest in the world. It sustains about 10% of the world's known biodiversity, including hundreds of mammals, birds, reptiles and amphibians threatened by habitat loss and environmental degradation (MMA, 2014). Brazil has a leading responsibility in the conservation of this biodiversity, given that it hosts more than 60% of the Pan-Amazon (RAISG, 2015). In order to comply with the Convention of Biological Diversity requirements, the Brazilian government established the goal to protect at least 30% of Amazon biome by 2020 (MMA, 2013). This goal is almost reached, as 28% of the Amazon is protected under the National System of Conservation Units (SNUC) or under the category of indigenous lands, which have been shown to be very effective for protecting biodiversity (Nolte et al. 2013; Brunner et al. 2001; Jenkins et al., 2015; Anzolin & Peres, 2019). This relatively high level of protection is the consequence of an historical struggle to protect biodiversity against the persisting interest to exploit the natural resources of the biome. However, protected areas continue to be an insufficient tool for the protection of biodiversity, and this is how more than 300 threatened vertebrate species were catalogued in the Brazilian Amazon.

The natural assets of the Amazon constitute a direct threat for the biome, which has been declared by the Brazilian Government to be essential to ensure the energy sovereignty, mining production and commercialization of commodities of the country (RAISG, 2012). Thus, as in other regions of the world, there is a trade-off between the use and conservation of natural resources (Campos-Silva et al., 2015; Ferreira et al., 2014). Between primary products such as oil, gas, agricultural products, minerals and metals have increased to be amongst the main export products (more than 20%) (CEPAL, 2018a), generating an increase in environmental pressures (CEPAL, 2018b). Brazil has the second largest proportion of Amazonian territory occupied by mining operations, only after Guyana (RAISG, 2012). Mining leases, concessions and exploration have increased rapidly in the country since the early 1990s (Agência Nacional de Mineração, 2019). The impact of mining on Amazon deforestation and biodiversity conservation is often considered small given the relatively restricted extension of mining operations (Sonter et al., 2015). Although, studies have illustrated the physical indirect growth of mining operations in the Amazon (Sonter et al., 2013, 2014a, 2014b). The indirect impact is caused by the construction of new transportation infrastructure, the increased plantation expansion for charcoal production for use in pig iron and steel making, the increase offsite deforestation rates probably driven by competition between mining companies and urban developers, and the expansion of urban areas for the establishment of new economic activities associated (2014a, 2017). Thus, mining activities indirectly drive deforestation that extend on the Amazon forest up to

70 km from mining leases (Sonter et al., 2017). These demographic and infrastructural changes cause habitat loss, pollution and poaching that directly threat biodiversity (Pfaff et al. 2015). Moreover, mining activities are supervised by a very limited number of government technicians supported by a very deficient structure and, as a result, most mining operations lack the necessary control to ensure faithful compliance with mining regulation (Spiegel et al. 2012). Thus, the increase of mining activities, its indirect impacts and the lack of control make mining one of the main activities that put biodiversity at risk even in areas where protection is the main objective (Durán et al, 2013).

Protected Areas (PAs hereafter) in the Brazilian Amazon have eventually suffered area reductions and loss in protection status as a consequence of economic pressures (Bernard et al. 2014). In the last years, all PAs in Brazil have been threatened by a downgrade in protection status related to mining activities, as there is a strong interest to permit mining activities in areas where it is currently forbidden. Under the current legislation, mining activities are only permitted in two categories of PAs designated to the sustainable use of its resources (i.e., APA and ARIE from its initials in Portuguese). Therefore, mining is forbidden in the other types of sustainable use units, in all strictly protected areas and in all indigenous lands, unless specifically allowed in the management plan of a specific PA (see Box 1). Mining regulation in PAs has been repeatedly discussed in parliament, and a number of bills have been evaluated to extend extractive activities in all types of PAs. Specifically, it has been proposed to allow mining with no size restrictions in all sustainable use units (bill PL37 / 2011), to allow mining to cover up to 10% of any strictly protected area (PL3682 / 2012), and to allow mining activities with no area restrictions in indigenous lands (PL1610 / 1996). There are no bills proposing mining in the Quilombola territories, so it will not be taken into account in this study. Bills PL3682 / 2012 and PL1610 / 1996 have been disregarded at the moment, but represent plausible legislative proposals that could come back into discussion at any time. On the other hand, the proposal to allow mining in indigenous lands has been under debate for more than 20 years (Volpato, 2007) and has been recently reformulated into bill PL191/2020 (Agência Brasil, 2020). If these bills were passed, about 10 million ha of Brazilian PAs could suffer a direct impact from mining in the near future (Villén-Pérez et al. 2018). Moreover, forest loss associated to these activities may increase substantially when considering the related indirect deforestation (Sonter et al. 2017). Overall, the extension of mining permissions in PAs of the amazon may result in habitat loss and degradation and thus increase the threatened status of animal species.

Knowing the conservation needs of different species throughout their distribution may help optimize the allocation of conservation and restoration efforts (Jenkins et al. 2013). The degree of attention required by different species may be related to its relative level of protection. One way to determine if individual species are effectively protected is to estimate the representativeness of each species into PAs using the concept of Representation Target proposed by Rodrigues et al. (2004), because although PAs may represent only a partial look at conservation requirements, these must assure, at different levels, the conservation of biodiversity in specific regions (Rodrigues et al. 2004). Representation target assessments, especially those of threatened or keystone species, have been applied to address conservation goals of animal groups or regions (Nori et al., 2015), to identify unprotected areas of the world that have remarkably high conservation value (2004) and to evaluate the effectiveness of PAs (García-Bañuelos et al., 2019). Species with smaller distribution ranges are expected to show a greater variation in their protection and area impacted by mining exposure, as these will be strongly determined by their region of distribution. On the other hand, species with larger ranges of distribution will show levels of protection and impact close to average levels in the biome. Thus, species with smaller ranges are at risk of presenting lower Representation Targets and higher levels of mining impact in the Amazon biome.

This study aims to quantify the direct impact of mining on threatened species of the Amazon, to date and in the near future. I focused on 125 terrestrial vertebrate species that present a relevant part of their distribution in the biome and are classified in any threatened category by the MMA (2014) based on the IUCN classification. I work on their distributions within Conservation Units and indigenous lands, under the assumption that habitat preservation outside these areas is highly uncertain. For the near future, I predict the Potential impact of mining under four potential legislative scenarios that vary in their restrictions to mining activities in different categories of PAs. For each time and scenario, I assess the direct impact of mining activities on the distribution of the species. I also study whether distribution area size is a trait determining the variability of mining impact on the species' area of distribution. Then I evaluate distribution area losses in relation to species Representation Targets. Finally, I apply these results to identify important areas for restoration of the habitat lost from mining activities, and important areas for conservation in order to prevent new mining activities in order to ensure the compliance of Representation Targets for some threatened terrestrial vertebrates of the Amazon.

Box 1. National System of Conservation Units in Brazil

The National Strategic Plan for Protected Areas (PNAP) established the National System of Conservation Units (SNUC) in order to protect the biodiversity and genetic resources in Brazil (Law 9.985 of 18 July 2000). It organizes strategic areas in 12 management categories divided in two groups: strictly PAs (Portuguese: proteção integral), consisting of five categories; and sustainable use units (Portuguese: Uso sustentável), with seven categories.

Since 2006, Indigenous and Quilombola (traditional communities of Afro-Brazilian descendants) territories were included as part of the PNAP and recognizes these communities as part of the Brazilian biodiversity conservation policy. For that, PNAP integrates it into the planning effort of conservation established by the Law.

Categorization of PAs into SNUC indicating the permission of mining activities and its possible Law that would permit it. The corresponding names in Portuguese -following the same order than in the table- are: Estações Ecológicas; Reservas Biológicas; Parques Nacionais, Estaduais, Municipais; Monumentos Naturais; Refúgios de Vida Silvestre; Áreas de Proteção Ambiental; Áreas de Relevante Interesse Ecológico; Florestas Nacionais e Florestas Estaduais; Reservas Extrativistas; Reservas de Fauna; Reservas de Desenvolvimento Sustentável; Reservas Particular do Patrimônio Natural; Terras Indígenas; Terras Quilombola.

Category	Sub-category	Mining currently permitted	Bill that would permit mining
Strictly protected areas	Ecological stations	No	PL3682 / 2012
	Biological reserves	No	
	National parks, State parks and Municipal nature parks	No	
	Natural monuments	No	
	Wildlife refuges	No	
Sustainable use units	Environmental protection areas (APAs from their initials in Portuguese)	Yes	
	Areas of relevant ecological interest (ARIEs from their initials in Portuguese)	Yes	
	National forests and State forests	No	PL37 / 2011
	Extractive reserves	No	
	Wildlife reserves	No	
	Sustainable development reserves	No	
	Private natural heritage reserves	No	
Indigenous lands		No	PL1610 / 1996
Quilombola lands (not included in the analysis)		Yes	

MATERIALS AND METHODS

Study area

The study area are the PAs in the Brazilian Legal Amazon, where PAs include Conservation Units and indigenous lands (see Box 1). The Brazilian Legal Amazon is a region officially delimited by its social, political and economic common challenges (Law 5173, October 27th 1966). The region includes the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima, Tocantins, Mato Grosso and part of Maranhão. The Brazilian Legal Amazon comprises ca. 520 Mill. ha (Almeida et al., 2016), of which 86% is part of the Amazon biome and 14% is part of Cerrado and Pantanal biomes (Figure 1).

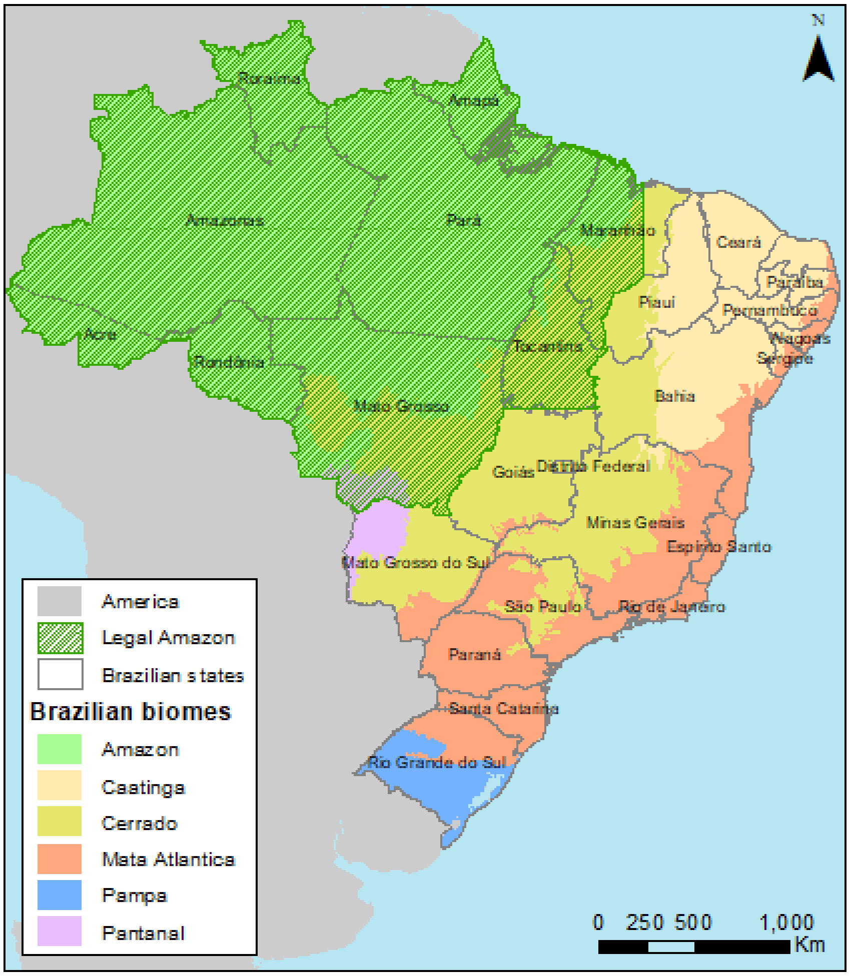


Figure 1. The Brazilian Legal Amazon in the geographical context of Brazil and South America.

Data sources and processing

Biome boundaries were obtained from the Image and Geoprocessing Laboratory– LAPIG (http://maps.lapig.iesa.ufg.br/lapig.html). The Brazilian Legal Amazon boundary was obtained from the Brazilian Ministry of Environment (http://mapas.mma.gov.br/i3geo/datadownload.htm).

A georreferenced database of Conservation Units was obtained from the Brazilian Ministry of Environment (http://mapas.mma.gov.br/i3geo/datadownload.htm), while a georreferenced database of all delimited, declared, homologated and regularized indigenous lands was obtained from the Brazilian National Indian Foundation (FUNAI) (http://www.funai.gov.br/index.php/shape). The spatial overlap that exists between protected areas of different categories was eliminated, always keeping the PA category of higher protective effect. This prioritization was based on the results obtained by Nolte et al. (2013), who found that indigenous lands are the most effective at avoiding deforestation, followed by strictly PAs and sustainable use PAs. In a similar way, federal PAs were prioritized over state PAs and those over municipal PAs. Protected areas were reclassified into four categories: indigenous lands, strictly PAs, sustainable use PAs in which mining is legally not allowed and sustainable use PAs in which mining is legally allowed.

A georreferenced database including all mining projects in the study area was obtained from the Mining Geographic Information System (SIGMINE) of the National Department of Mineral Production (DNPM; http://sigmine.dnpm.gov.br/webmap/). The information was downloaded by state and joined in a single shapefile. Mining projects were reclassified as *Existing, Planned and Potential* according to their licensing phase, following the criteria by Villén-Pérez et al. (2018). *Existing projects* obtained their working license and thus are assumed to be currently running. *Planned projects* have required operation license and are estimated to be running in up to eight years (Villén-Pérez et al. 2018). Finally, *Potential projects* have required research license and may proceed to require operation license depending on exploration results.

A georreferenced database on the distribution of 302 threatened species of mammals, birds and herpetofauna in Brazil was provided by Dr. Paulo De Marco (Universidade Federal de Goiás, Brazil). Species distributions were estimated by De Marco using Species Distribution Models (SDM) as described in Supplementary Material 1 following the same methodology published by De Marco et al. (2018) and based on the existence of validated occurrence points. The predictions were built as an ensemble of the results of seven modelling algorithms applied to the Neotropic region. Of the original species pool, 139 species presented part of their distribution into the Brazilian Legal Amazon. Of those, I excluded from further analysis 2 species with no presence into PAs, and 12 species that showed a marginal distribution in the region; i.e., those that had less than 5% of their distribution within the Brazilian Legal Amazon. Thus, the final species distribution pool included 125 terrestrial vertebrates: 41 mammals, 78 birds and 5 amphibians and 1 reptile.

All georeferenced data were updated in January, 2019 and processes using R-4.0.2 (R Core Team, 2013) and QGIS 3.14.0 (QGIS.org, 2020). Georreferenced data was projected using the Brazil Polyconic projection and the reference system SIRGAS 2000.

Analysis

To know the incidence of the management plans in the permissiveness of mining activities in the sustainable use PAs, databases of the mining and PAs shapefiles were compared in order to know the projects that were approved before and after the creation of the PAs.

For each species it was assessed the extent of its area of distribution affected by Existing, Planned and Potential mining projects in each category of PA. For Planned projects it was estimated the total area of species distribution that would be affected at each of four legislative scenarios: (i) if mining code would not change, (ii) if mining would be allowed in all types of sustainable use protected areas without extent restrictions (i.e., scenario that emulates PL37 / 2011), (iii) if mining would be allowed in indigenous lands without extent restrictions (i.e., PL1610 / 1996), and (iv) if mining would be allowed to occupy up to 10% of each strictly protected areas (i.e., PL3682/2012). For the latter scenario, the following procedure was used for the cases in which Existing and Planned projects summed up an extension larger than 10% of total PA. First, all pixels affected by Existing and Planned projects in each strictly PAs were identified. For each of the PAs, 10% of the affected pixels was sampled with no replacement and the impact on the species was evaluated. The process was repeated 1000 times, and the impact on the species was estimated as the average of the 1000 samples. For each legislative scenario, we identified the most affected species and areas.

The non-parametric Friedman test was used to compare both, the affected area in each of the PAs in the near future and the affected area today and in the near future in each of the legislative scenarios considering statistical significance $p < 0.05$. In both cases, Wilcoxon signed-rank test with Bonferroni’s correction which was applied in the post-hoc analysis.

Species’ Representation Targets were calculated based on the proposal by Rodrigues et al. (2004) showed in the Figure 2 and used to estimate the Protection Status of each of the species in each legislative scenarios. The Representation Target as defined by Rodrigues et al., (2004) is the percentage of the area of distribution of each species that should be covered by PAs in order to effectively protect the species.

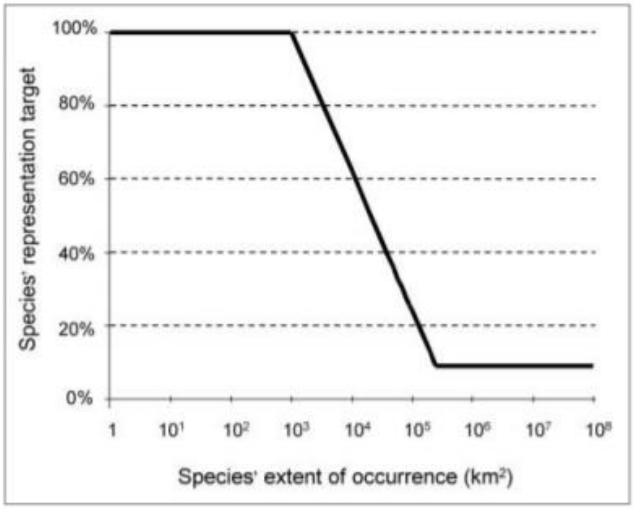


Figure 2. Relationship between each species' extent of occurrence and their Representation Target (percentage of range that must be overlapped by protected areas in order for the species to be considered covered). For very narrowly distributed species (extent of occurrence < 1000 square kilometers [km2]), the representation target is 100% of the range; for very widespread species (< 250,000 km2), the target is 10%. For species with ranges of intermediate size, the target was interpolated between these two extremes (Rodrigues et al, 2004).

Protection Status was calculated with the Formula 1 defining it as the proportion between the species' distribution area effectively protected in any legislative scenario and their Representation Target. With this concept I estimated how mining would modify the distance to the Representation Target of each threatened species. In this study, the area of distribution, the Representation Target and the Protection Status of each species were calculated considering only the PAs inside the Legal Amazon.

$$PS_{sp,si} = \left(\frac{EPA_{sp} - AL_{sp,si}}{DA_{sp} * RT_{sp}}\right)$$ **Formula 1.**

Where:

$PS_{sp,si}$ = Protection Status of species *sp* in relation to its Representation Target, in legislative scenario *si*, where:

$PS_{sp,si}$ <1 means that the Protection Status is below the target, so the Representation Target was not reached;

$PS_{sp,si}$ =1 means that the Protection Status has exactly reached the Representation Target; and

$PS_{sp,si}$ >1 means that the Protection Status is above the target, so the target was surpassed.

EPA_{sp} = Effectively Protected Area of species *sp* (area)

$AL_{sp,si}$ = Area Loss of species *sp* in a near future under scenario *si* (area)

DA_{sp} = Distribution Area of the species sp (area)

RT_{sp} = Representation Target of species sp (% of distribution area)

$DA_{sp} * RT_{sp}$ = Representation Target of species sp (area)

The Protection Status was used to prioritize areas for restoration and conservation. In order to identify priority areas for restoration I selected two type of areas. First, the affected areas by current mining projects with the highest of the five proposed ranges of number of threatened species (1-10, 11-20, 21-30, 31-40, 41-55). Second, areas where there are species distribution that are below but close to reach their Representation Target (i.e., with a Protection Status between 0.9 and 1). The priority areas for conservation were proposed to urge to avoid its downgrading even if any of the legislative proposals were approved. These we defined using two alternative criteria. First, areas with the highest of the five proposed ranges of number of threatened species that are predicted to be affected by mining in the near future under any legislative scenario. Second, species that are above but close to their Representation Target (Protection Status between 1 and 1.1) and are at risk of downgrading its status by any legislative scenario in the near future.

RESULTS

More than one-fourth of the Amazon biome is protected under any protection category, almost reaching the 30%-goal of the Convention of Biological Diversity. Almost one-fourth (23%, ca.120 Mill ha) of the Legal Amazon is-covered by Existing, Planned and Potential mining projects. Existing and Planned projects cover more than 8 Mill ha of the Amazonian PAs, ca. 3% of its area, and reach ca. 42 Mill. ha when accounting for Potential projects where a research interest has been registered, threatening ca. 18% of the PAs. Sustainable use areas are the most affected by Existing and Planned projects, while indigenous lands are the most affected by Potential projects (Table 1).

Table 1. Distribution of Existing, Planned and Potential mining projects in each type of PAs of the Legal Amazon. Both the number of projects and their total extension area (kha) are given. Planned and Potential projects do not include Existing ones.

Mining project	APA & ARIE Pas		Other sustainable use PAs		Strictly PAs		Indigenous lands		Total	
	Num. of projects	*Area*	*Num. of projects*	*Area*	*Num. of projects*	*Area*	*Num. of projects*	*Area*	*Num. of projects*	*Area*
Existing	629	60	124	325	28	9	21	9	802	403
Planned	8,311	2,678	2,395	4,158	579	394	364	453	11,649	7,683
Potential	708	1,283	1,633	5,955	354	1,309	3,671	25,822	6,366	34,369
Total	9,648	4,021	4,152	10,438	961	1,712	4,056	26,284	18,817	42,455

All 125 species distribution have shown Existing or Planned mining projects in PAs, except the bird *Taoniscus nanus*. Depending on the type of protected area in which the mining projects were located, the species were predicted to be impacted by a variable amount of their distribution area in the different legislative scenarios (see example species in Table 2). Thus, the impact of species distributions that registered Planned projects only in PAs where mining is currently allowed would be independent of law changes (e.g., *Cotinga maculata*). On the contrary, law changes would matter when species distribution overlaps with mining projects in all types of PAs (e.g., *Chamaeza nobilis fulvipectus*). Finally, those distributions affected by Planned mining projects in protected areas where mining is not allowed would be only affected if the mining code changes in that direction (e.g., *Synallaxis kollari*, *Lagothrix poeppigii*). The predicted impact of Existing and Planned projects in all legislative scenarios are presented for all species in the Supplementary Material 2.1.

Table 2. Examples of the impact of mining on species affected by mining in different types of protected areas. Values of the near future scenarios include the impact of Existing and Planned mining projects.

Species	% of species distribution exposed to mining in each scenario				
	Current	In the near future, under the current law	In the near future, if PL37/2011 were approved	In the near future, if PL3682/2012 were approved	In the near future, if PL1610/1996 were approved
Cotinga maculata (bird)	2	16	16	16	16
Chamaeza nobilis fulvipectus (bird)	0.65	7.99	15.98	8.45	8.37
Synallaxis kollari (bird)	0	0	0.29	0	0
Lagothrix poeppigii (mammal)	0	0	0	0.15	0
Taoniscus nanus (bird)	0	0	0	0	0

The largest impact of current mining projects on species distribution occurs in sustainable use areas different from APA and ARIE, affecting 325 kha that represents an average of 0.19% of the distribution of species. Existing mining projects affect 60 kha and an average of 0.11% of the distribution of species within APA and ARIE. The impact of mining in indigenous lands and strictly PAs is smaller and similar, representing 8 kha each one, an average of 0.003% and 0.002% of the distribution of species, respectively. The impact of Existing and Planned mining projects over species distribution would reach up to 4480 kha into sustainable use areas different from APA and ARIE (8% of this kind of PAs) if bill PL37 / 2011 were approved. This represents an average of 1.61% of the species distribution. Existing and Planned projects would affect in the near future a total of 2740 kha (an average of 2.08% of the species distribution) within APA and ARIE, if there would not be changes in the legislation. In this same no-changes scenario five species (*Cotinga maculata, Pyrrhura leucotis, Hydrodynastes melanogigas, Columbina cyanopis* and *Dysithamnus plumbeusour*) will lose more than 10% of their distribution area inside the Legal Amazon in the near future. If bill PL1610 / 1996 were to be approved, 455 kha would be affected inside indigenous lands (1.16% of this kind of PA) representing and average of 0.18% of the species distribution (Figure 3). If bill PL3682 / 2012 were to be approved, 395 kha would be affected inside strictly PAs (0.33% of this kind of PA), representing an average of 0.1% of the species distribution.

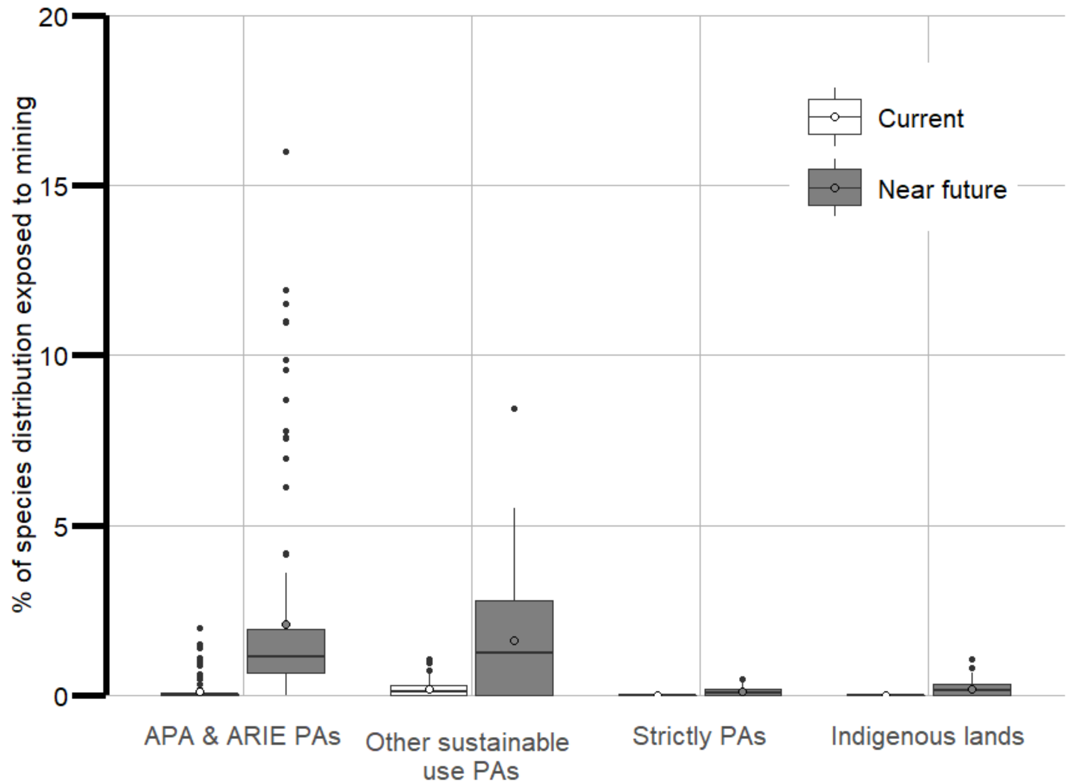


Figure 3. Percentage of species distribution area exposed to mining at each type of PA, in the current time and in the near future. Near future boxes include the current impact of Existing projects and the Planned ones if they were developed considering the four legislative scenarios in the near future: under the current law, if PL37/2011, PL3682/2012 or PL1610/1996 were approved. Boxplots represent the average of the percentage of distribution area that is or could be impacted by mining (white or grey circles), its median (horizontal lines), interquartile ranges (boxes), whiskers (vertical lines) and outliers (black dots). Summary of statistics are presented in the Supplementary Material 2.2.

A non-parametric Friedman test of differences across repeated measures was conducted and rendered a Chi-square value of 211.33 (df = 3, p-value < 2.2e-16). This means that there are significant differences in the percentage of species distribution exposed to mining among PAs in the near future. The post-hoc test showed that there are significant differences among all paired values tested (Table 3).

Table 3. Results of the Wilcoxon's test on the differences between the percentages of species distribution exposed to mining in each type of PA in the near future. All paired comparisons show significant differences ($p < 0.05$).

Type of PA	**APA & ARIE PAs**	**Other sustainable use PAs**	**Strictly PAs**
Other sustainable use PAs	$2.11*10^{-1}$		
Strictly PAs	$1.05*10^{-20}$	$4.33*10^{-16}$	
Indigenous lands	$1.60*10^{-20}$	$1.83*10^{-15}$	$3.89*10^{-15}$

Exposure of species distribution to mining increases from Existing to Planned and Potential projects. Planned projects would increase the affected area 19 times the Existing ones or 85 times if Potential projects are taken into account. In average, birds are the most affected by Existing and Planned projects, and herpetofauna are the most affected group by Potential projects (Figure 4).

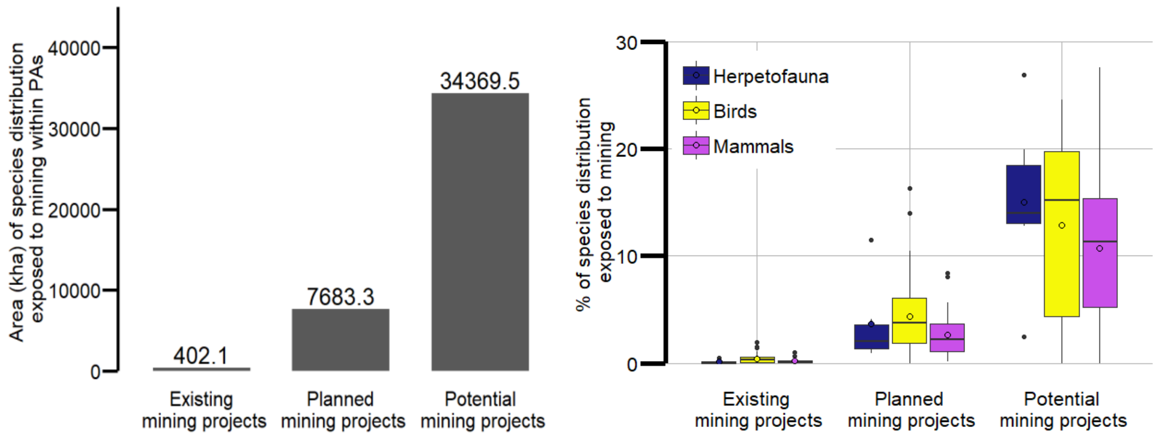


Figure 4. Left: Total area (kha) within PAs of species distribution affected by Existing, Planned and Potential mining projects (value over each bar). Right: percentage of species distribution exposed to Existing, Planned and Potential mining projects within PAs in the Brazilian Legal Amazon, categorized by animal group. The percentage of species distribution that is or could be impacted by mining is represented by averages (open circles), medians (horizontal lines), interquartile ranges (boxes) and outliers (black dots).

Current scenario affects 97 species in a range that varies among 0 and 2% of the distribution area exposed to mining (Figure 5). If there were no changes in the legislation, in the near future the average percentage of species distribution exposed to mining would increase from the current 0.31% to 2.28% (Figure 6) on 119 species due to the increase of the number of mining projects within APA and ARIE. However, as in all future scenarios, the future impact of current legislation will reach up to 16% of the species distribution area exposed to mining and it could be worse if the current trend of mining permits within other sustainable use areas continues. There are 124 Existing projects within sustainable use PAs different from APA and ARIE, 94 were approved before the creation of the protection units and the other 30 were approved after, due to the permitted activities established in its management plans. There are 11 species that are not affected by mining to date but will be affected in the near future, even if no legislative changes occur. Moreover, there are 13 species that are currently affected and the impact will increase even if none of the legislative proposals were approved.

The approval of any legislative proposal in the near future increases the average percentage of the impacted area in the current legislation. The aproval of bill PL37/2011, which would permit mining in all sustainable use PAs, would be the worst legislative scenario for threathened species. Sustainable use PAs cover the distribution area of 123 of the 125 threatened species under study. The average percentage of species distribution that would be exposed to mining in the near future if bill PL37/2011 would be passed (3.7%) is more than 10 times the area exposed to date (0.31%). If PL3682/2012 or PL1610/1996 were approved, the increase in the average percentage of affected species distribution would reach 2.38% or 2.46% respectively, increasing around 2% the impact in both cases (Figure 7). The percentage of species distribution exposed to mining is significantly different among scenarios (Friedman test: Chi-square = 401.22, df = 4, p-value < 2.2e-16). Specifically, there are significant differences among all paired values tested (Wilcoxon post-hoc test, Table 4).

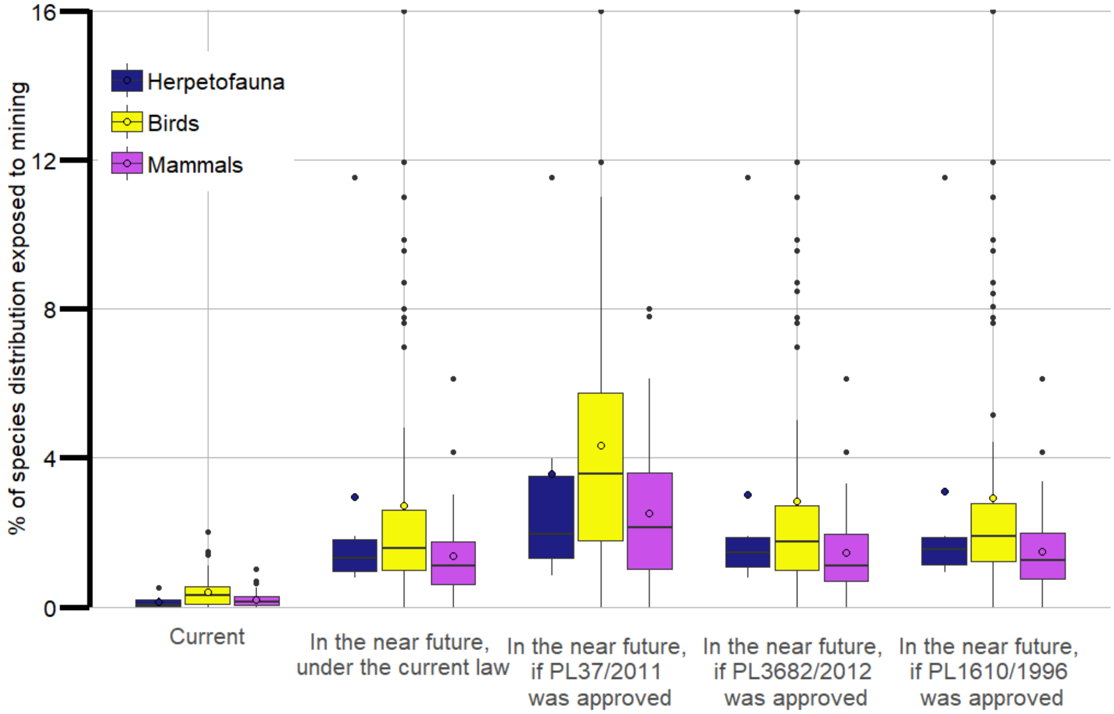


Figure 5. Percentage of the area of species distribution exposed to mining in each legislative scenario, distributed by animal group. The percentage of species distribution that is or could be impacted by mining is represented by averages (open circles), medians (horizontal lines), interquartile ranges (boxes) and outliers (black dots). Summary of statistics are presented in the Supplementary Material 2.3.

Table 4. Results of Wilcoxon´s test for defining differences between the percentages of species distribution exposed to mining in each legislative scenario.

Legislative scenarios	Current	In the near future, under the current law	In the near future, if PL37/2011 were approved	In the near future, if PL3682/2012 were approved
In the near future, under the current law	$2.92*10^{-20}$			
In the near future, if PL37/2011 were approved	$6.40*10^{-21}$	$5.66*10^{-16}$		
In the near future, if PL3682/2012 were approved	$9.36*10^{-21}$	$5.46*10^{-16}$	$9.40*10^{-16}$	
In the near future, if PL1610/1996 were approved	$1.37*10^{-20}$	$1.74*10^{-14}$	$3.82*10^{-15}$	$8.34*10^{-5}$

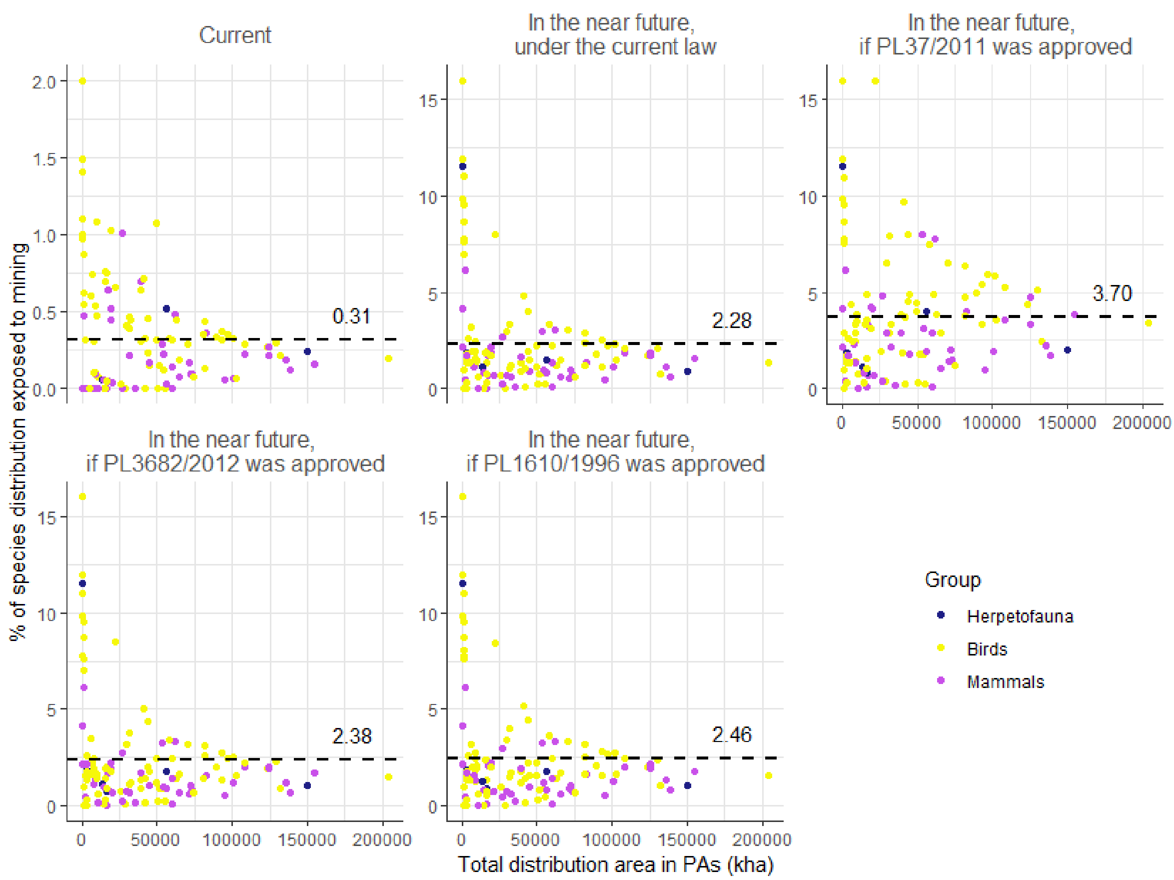


Figure 6. Relationship between species distribution area inside PAs and the percentage of species distribution area exposed to mining in current time and in the near future under the different legislative scenarios. Each point represents a single threatened species. Dashed lines represent the average of the percentage of species distribution exposed to mining in each legislative scenario.

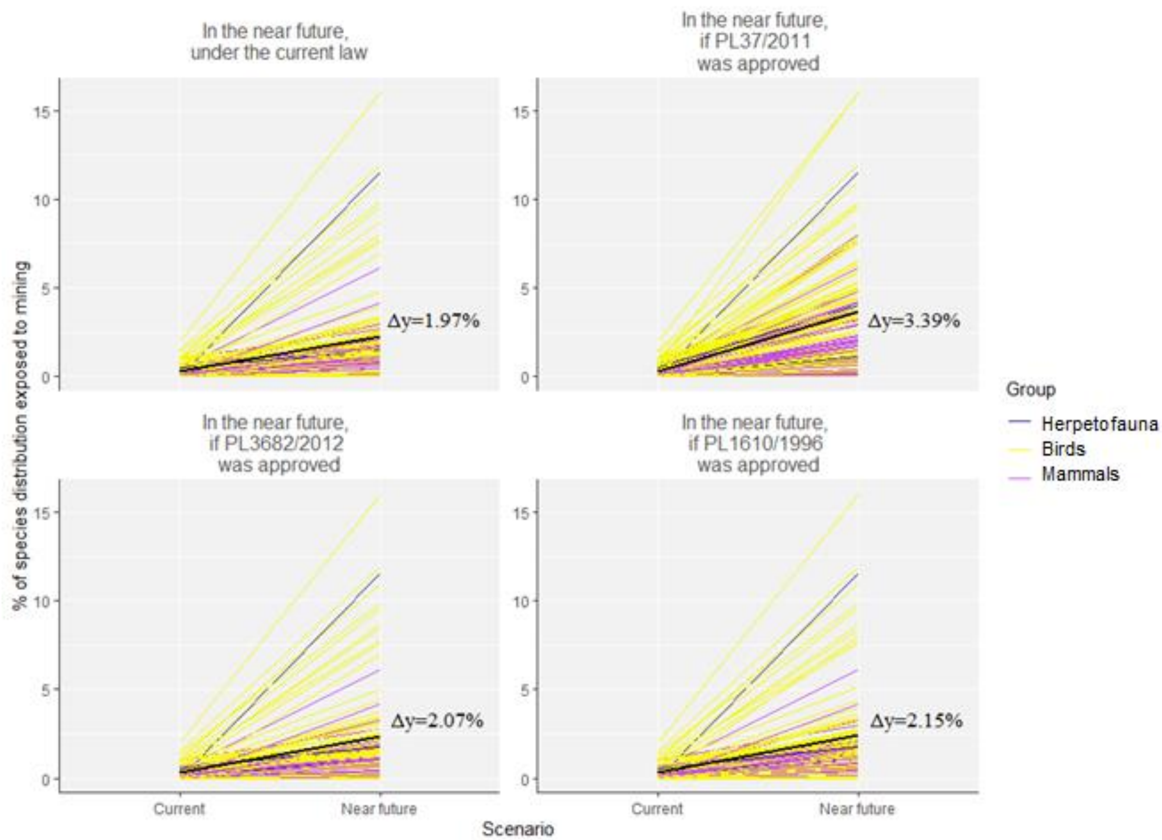


Figure 7. Increase in the percentage of species distribution exposed to mining from current time to the near future, under different legislative scenarios. Each coloured line corresponds to a single species. Black lines represent the average for all species.

Species with smaller distribution ranges show greater variability in the percentage of area exposed to mining (Figure 6), reaching up to 16% of distribution area exposed to mining in the future scenarios. On the other hand, the impact over species with broader distribution tends to approach the average impacted area in PAs of the Brazilian Legal Amazon. In most cases, the most affected species in the future scenarios are birds with limited representativeness in the Legal Amazon (between 5% and 10% of their distribution area in the country), concentrated at the south of Mato Grosso, that is why more proportion of their distribution is exposed to mining. Special situation occurs with *Chamaeza nobilis fulvipectus* and *Picumnus varzeae*, two birds which have their entire distribution area in the states of Amazonas and Pará that would be affected by the current law in the near future by 8% and 7% respectively. Some of the PAs with the highest number of threatened species and the largest areas affected by mining projects are located in the state of Pará (Figure 8).

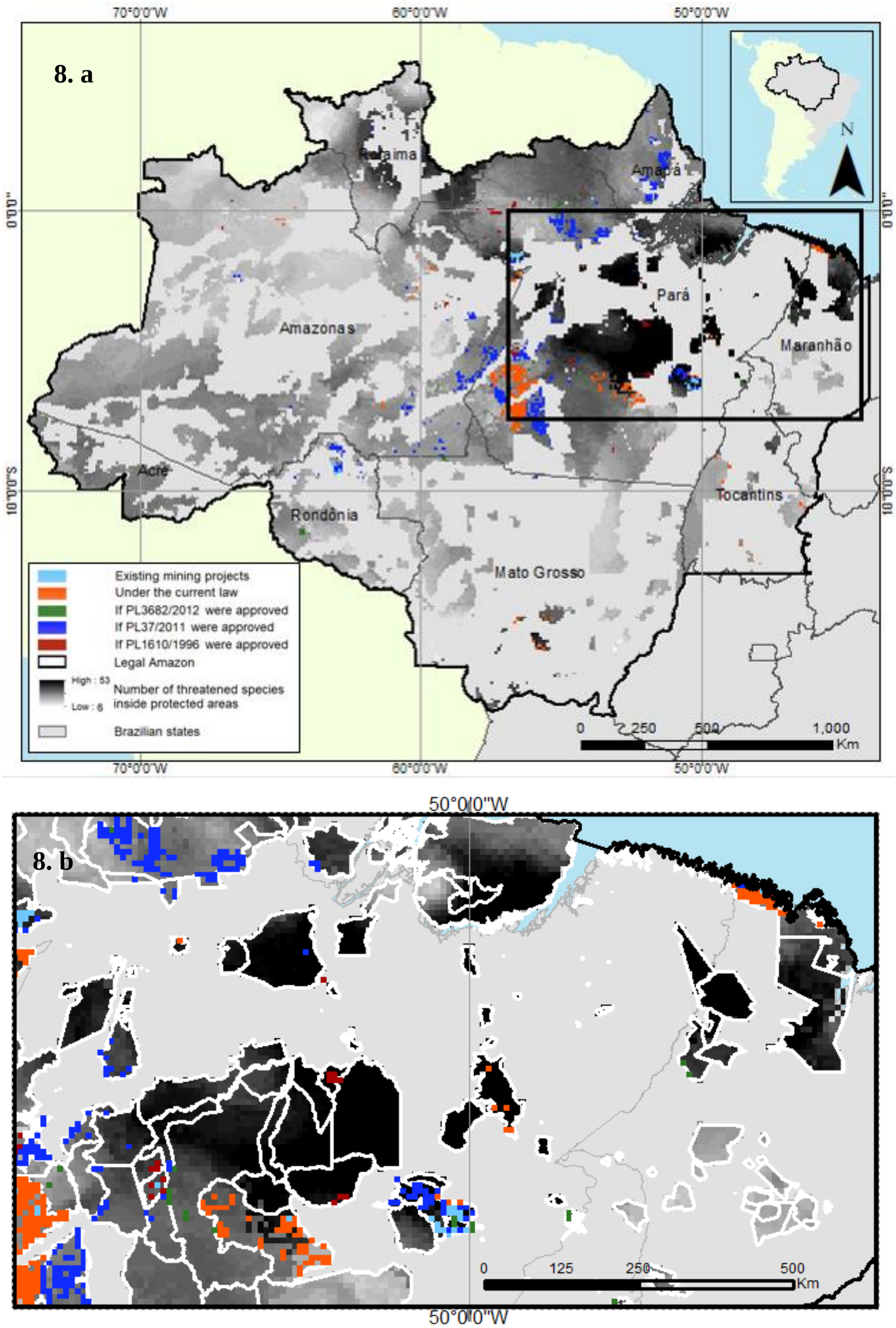


Figure 8.a. Spatial variation in the number of threatened species and Existing and Planned mining projects in Protected Areas of the Legal Amazon. Mining projects are coloured based on their status: Existing (light blue) or Planned for a near future (orange, green, blue and red based on the legislative scenarios). **8.b**. Zoom on the black rectangle in the figure above. The region shows areas with the largest number of threatened species (41-51) and the distribution of mining projects coloured as above. The categories of the PAs and its distribution within the Legal Amazon is presented in the Supplementary Material 3.

All mining projects that are operating or Planned within PAs, are located in 10km-side cells with at least 11 threatened species (Figure 9). In fact, most of them are located in areas that protect between 16 and 30 threatened species. Indigenous lands protect the only 9 kha with more than 50 threatened species.

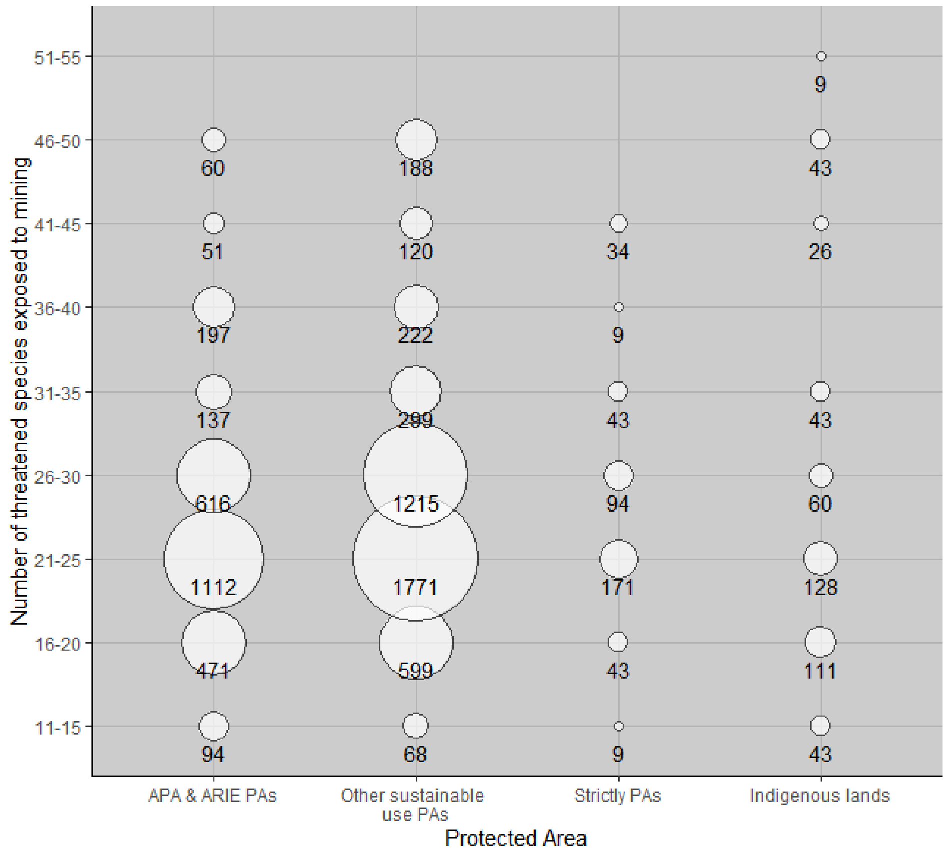


Figure 9. Number of threatened species in areas exposed to Existing and Planned mining projects in each category of PA. The size of the circles indicates the extent of the area regarding the number of threatened species. Black numbers are the total affected areas (kha) by Existing and Planned mining projects in each category of PAs and for each interval of number of threatened species. Intervals in *y* start from 11 because there are not affected areas below that level of number of threatened species.

Currently, 74 species exceed the minimum distribution into the PAs to be considered effectively protected, reaching their Representation Target. The threat of Existing and Planned projects could reduce their Protection Status but never make it across their Representation Target (Figure 10). However, there are 51 species which do not have the minimum distribution protected to reach their Representation Target. The Protection Status of all species declines in the near future in any legislative scenario. Planned mining projects will not shift the Protection Status regarding their Representation Target for any of the species study in any scenario. Indeed, the average Protection Status of all species is very similar among scenarios, including the current one.

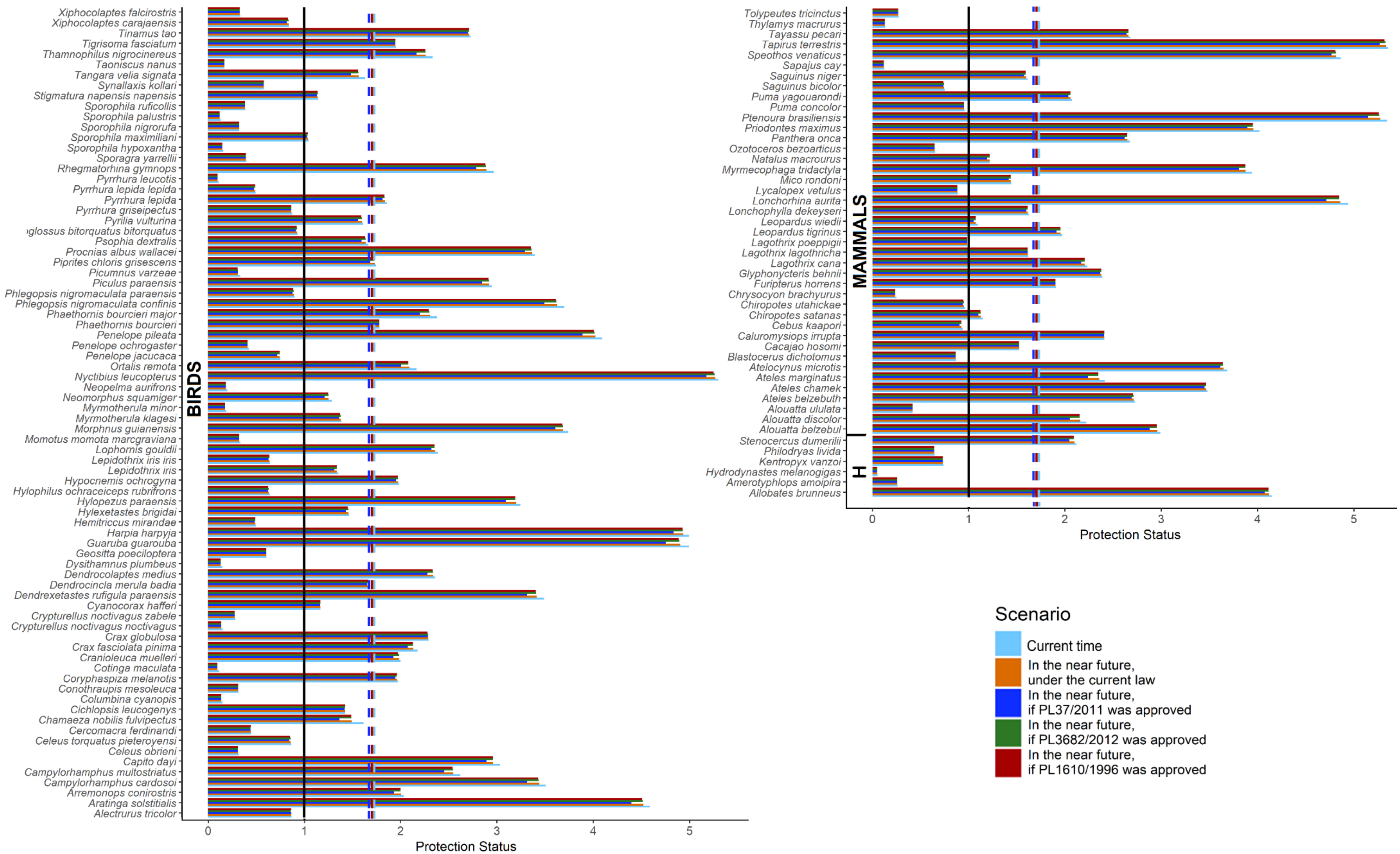


Figure 10. Protection Status of each species in current time and in the near future under the different legislative scenarios. Black line represents the achievement of the Representation Target, that is, the limit where the species has the minimum distribution area in PAs to consider it effectively protected. Thus, species with Protection Status over 1 have reached their Representation Target. Dashed lines are the averages of each legislative scenarios. H= Herpetofauna.

The protection status of species is directly related to the area of distribution (Figure 11) in the current scenario, and there are no differences among the future scenarios (see Supplementary Material 2.4).

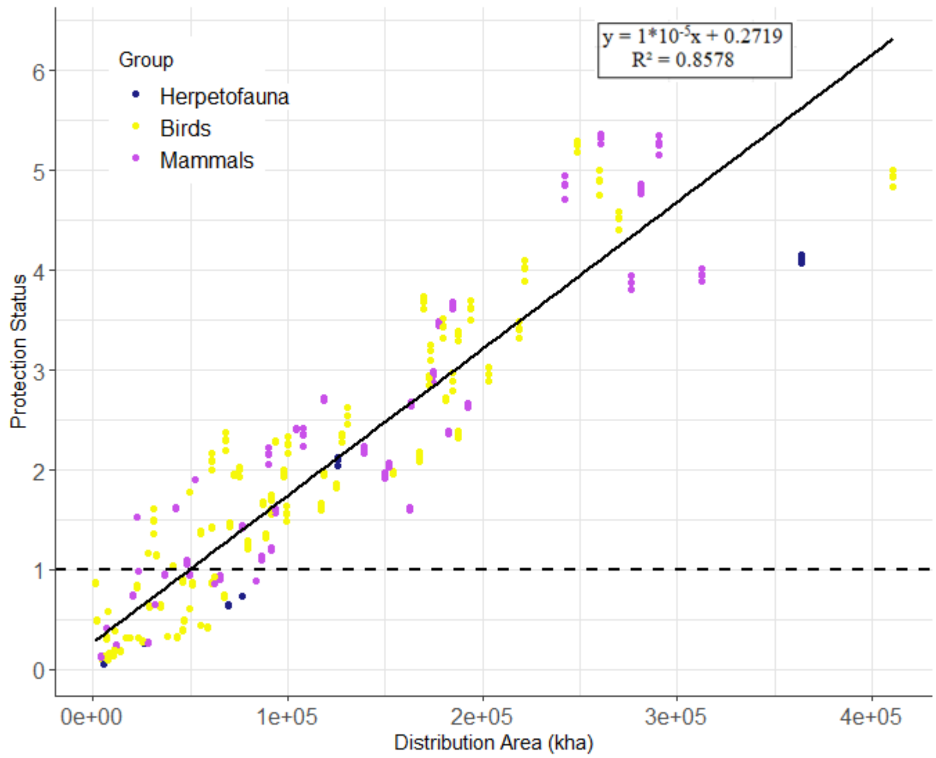


Figure 11. Relationship between the area of distribution and the Protection Status of threatened species in the current time. This relationship is constant among the near-future scenarios (see Supplementary Material 2.4). Species are classified by animal groups. The dashed line represent the Representation Target, where the relative distance to the optimal Protection Status is zero when the Target has been reached but not surpassed, i.e., species under dashed line do not reach their Representation Target.

Moreover, I identified areas with high number of threatened species to select priority area for restoration and conservation. For the restoration areas, I focused on species with a Protection Status between 0.9 and 1: *Lagothrix poeppigii* (0.98), *Chiropotes utahickae* (0.96), *Puma concolor* (0.95), *Cebus kaapori* (0.93), *Pteroglossus bitorquatus bitorquatus* (0.93) and *Phlegopsis nigromaculata paraensis* (0.90). Those species need a relatively small protected area to reach their Representation Target and to be considered effectively protected. In order to propose priority areas for conservation, where Planned mining projects should not be approved even if the PAs downgrade its level of protection, I identified that species with Protection Status between 1 and 1.1 are only *Sporophila maximiliani* (1.04) and *Leopardus wiedii* (1.09), and by applying the second parameter, I found that areas with the higher number of threatened species and likely threatened for Planned mining projects are mostly in Pará (Figure 12).

Ca. 50% of the area that meets the criteria for being prioritized for restoration or conservation is located in the state of Pará (Table 5). Conservation and restoration priority areas are spatially aggregated (Figure 12.a). For instance, I identify six adjacent PAs (Figure 12.b) that present 7 Existing and 159 Planned mining projects that affect almost all species under study. These PAs constitute ca. the third part of the priority areas for restoration and conservation.

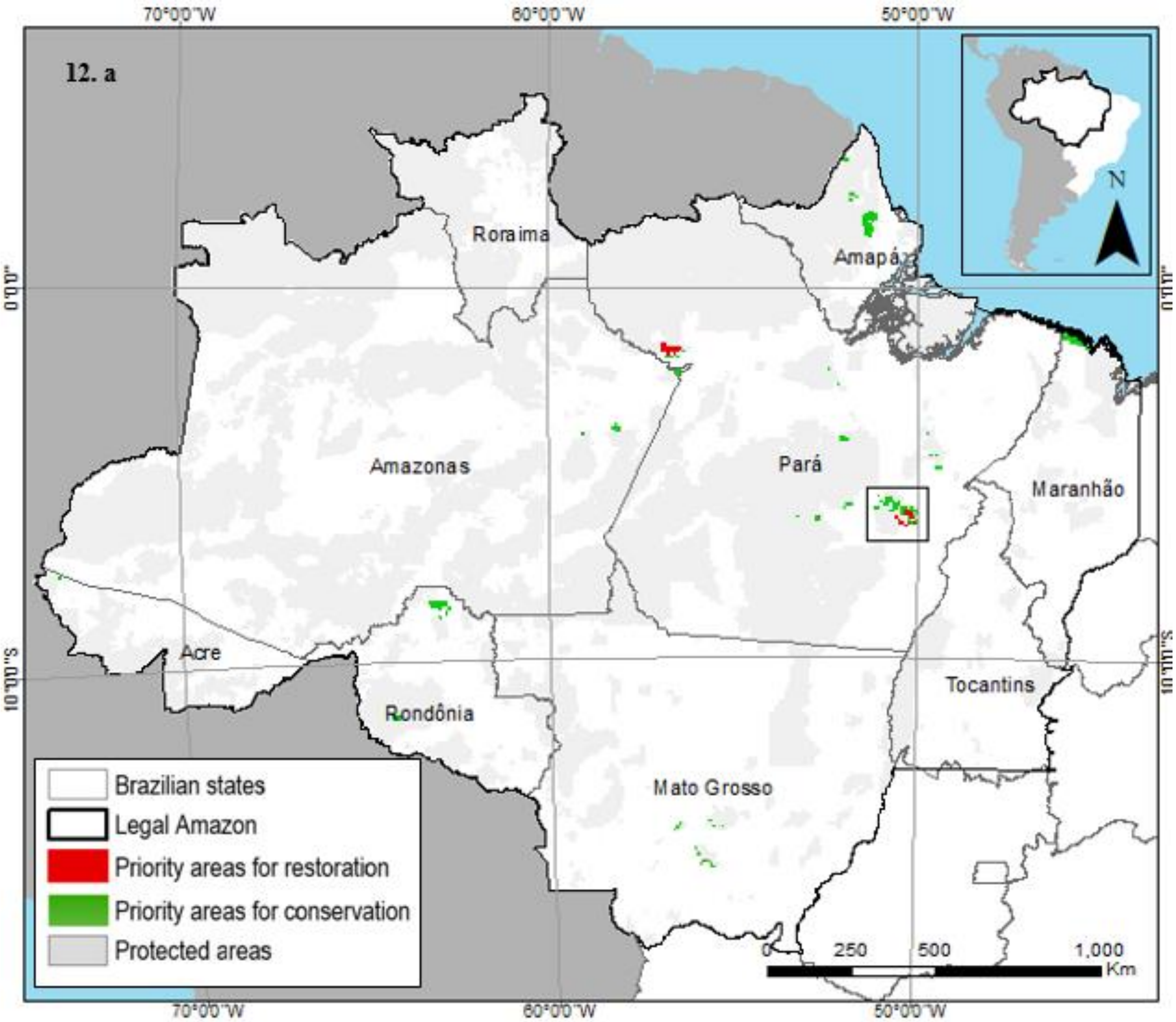
Table 5. Priority areas (kha) for conservation and restoration identified in each state of the Brazilian Legal Amazon.

State	Priority area for conservation	Priority area for restoration	Total
Acre	17.1	0	17.1
Amapá	291.0	0	291.0
Amazonas	120.0	0	120.0
Maranhão	180.0	8.6	188.6
Mato Grosso	111.0	8.6	119.6
Pará	488.0	265.0	753.0
Rondônia	197.0	0	197.0
Total	1404.1	282.2	1686.3

In addition to the increase in the Protection Status of the species which are close but below their Representation Target (Table 4), restoring the 282.2 kha that meet the referenced criteria will benefit 85 more species (see Supplementary Material 2.5). The average increase of the Protection Status would be 0.011 in 73% of the total species under study: 3 amphibians, 1 reptile, 59 birds and 28 mammals.

Table 6. Increase in the Protection Status of the species which are close but below their Representation Target (Protection Status between 0.9 and 1) if prioritized areas were restored.

Species	Group	Current Protection Status	Future Protection Status if priority areas were restoring
Cebus kaapori	Mammals	0.94	0.95
Chiropotes utahickae	Mammals	0.96	0.97
Lagothrix poeppigii	Mammals	0.99	0.99
Phlegopsis nigromaculata	Birds	0.90	0.92
Pteroglossus bitorquatus	Birds	0.93	0.95
Puma concolor	Mammals	0.96	0.96



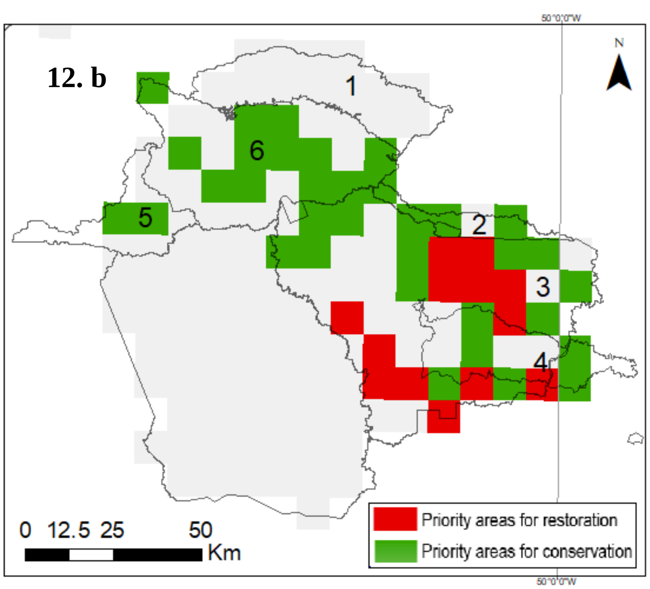


Figure 12.a Priority areas for restoration and conservation in Protected Areas of the Brazilian Legal Amazon. **12.b.** Zoom of the prioritized areas for restoration and conservation in the state of Pará where a third of the total areas is concentrated. Black numbers identify each PA where there are the priority areas for restoration and conservation. The PAs are 1) Do Tapirapé Biological Reserve, 2) Igarapé Gelado Environmental Protection Area, 3) Carajás National Forest, 4) Dos Campos Ferruginosos National Park, 5) Do Itacaiunas National Forest, 6) Do Tapirapéaquiri National Forest.

DISCUSSION

In the near future, the current-law scenario will increase the percentage of the current distribution area of threatened species exposed to mining, and it will be worse if any of the legislative proposals were approved. The number of Planned projects is almost twenty times the Existing ones, and half of their area are inside sustainable use units where today is forbidden. Up to 12.5% of the PAs where mining is permitted would be affected by mining projects in the next years under the current law. Potential projects are almost three times the Planned ones, and would impact all indigenous lands in Pará, the most affected state by Existing, Planned and Potential projects.

Although indigenous lands and strictly PAs have Existing projects inside their dominion due to their implementation before the creation of the PA, sustainable use PAs reach up to 94% of the total number of Existing projects. Pará is the most affected state with 80% of the area of Existing projects, where there are zones at high concentration of threatened species. Current mining projects may be the focal hotspots from where other Planned projects would expand due to the current accessibility.

Mining projects that are Planned for the near future will increase the impact of mining on species distribution for average of 2,3%, even if mining code does not change. These Planned projects will affect mostly birds (74) and mammals (39). This figure may be under estimated taking into account that projects in other sustainable use PAs outside APA and ARIE could be increased. Federal Law 9.985 / 2000 defines the concept of "sustainable use" as "the exploration of the environment to guarantee renewable environmental resources and ecological processes, maintaining biodiversity and other ecological attributes, socially just and economically viable". Surprisingly, 16% of the Existing projects are inside sustainable use areas where mining is not openly allowed. More than 60% of the projects which were approved after the creation of these sustainable use PAs, were implemented in 2016 and 2017. This situation occurs due to the flexibility of the management plans of the PAs and to the possibility opened by the Decree No. 1298 / 94 that approves mining activities with the prior authorization of IBAMA and the environmental licensing. Approving the bill PL 37 / 2011 would increase up to 3,7% the impact on distribution species in the future, the greatest figure compared to the other possible scenarios. This could be explained because more than a half of the Planned projects are inside sustainable use areas where mining is forbidden, in spite of the fact that these PAs cover only 20% of the total protected area in the Legal Amazon. Then, if the trend continues that way, it is expected that in the future the current legislation drives a greater impact than predicted in this study.

The impact on species distribution increases up to 2.4% if PL 3682 / 2012 were approved, and 2.5% if PL 1610 / 1996 were approved. In spite of the small increase in the impacted area, Planned projects in both strictly PAs and indigenous lands are located over areas with high number of threatened species. PL 3682 / 2012 may drive a scenario with small impact due to the 10% restriction area of the bill and because strictly PAs just occupy 16% of the total protected areas in the Legal Amazon. A very different case happens with indigenous lands, that cover more than a half of the PAs in the Legal Amazon but the approval of the bill PL 1610 / 1996 would increase by small figure in the near future. Such situation is because there is a relatively small area of Planned projects inside these PAs. It could be due to the difficult process to meet all requirements requested by the Law. It is worth saying that this is caused by the Federal Constitution attributing the authorization of mining in indigenous lands to the National Congress, depriving the National Department of Mineral Production (DNPM from its initials in Portuguese) of any power of decision on the matter. Therefore, the only one who decides whether or not to grant authorization for research or mining on indigenous lands is the National Congress. Nevertheless, the approval of the bill PL 1610 / 1996 may allow in the next decades indigenous lands such as Xikrin Do Rio Catete or Baú to be almost fully covered by mining projects because the greatest figure of Potential projects are inside of them. If any of the legislative proposals were approved and therefore give free access to the Planned projects inside some protected areas, it may allow requests for mining sites to increase.

The size of species distribution is a well-known determining factor of its vulnerability (IUCN, 2019) As it was expected, the presence of less distribution area, implicates a more variable response of the impact on the species distribution in any current or future scenarios (Figure 6), and thus, the species has less Protection Status then being further away from reach their Representation Target (Figure 10). Most of those species have a small distribution inside the Legal Amazon, they are located in the south of Mato Grosso and beyond the Arc of Deforestation. Other have a restricted distribution area in the states of Pará and Amazonas and are the most vulnerable species in any legislative scenarios.

It is important to consider that this study only assesses the direct impact of mining over the distribution of species. I found that this impact is relatively small compared to the extent of species distribution and the biome itself (Sonter et al., 2017), and this has been used as an argument to approve more mining operations in the region (Sonter et al., 2020). However, the indirect impacts of mining are important, both in terms of forest loss and pollution (Helwege, 2015). Mining-induced deforestation has been found to be 12 times greater than the one occurring within mining leases alone and causes 9% of all deforestation within Brazil's Amazon forest since 2005 (Sonter et al., 2017). These numbers may be a little lower within PAs, as the protective status is expected to impose a barrier to indirect deforestation. Nevertheless, if these numbers would be assumed, the indirect impact of Existing and Planned projects within PAs could reach ca. 5 Mill. ha and ca. 90 Mill. ha, respectively. This mining-induced deforestation would contribute to the habitat loss, fragmentation and degradation that may induce a likely scenario of extinction of some threatened species by 2050 especially in Maranhão, Tocantins, Pará and Rondônia (Wearn et al., 2012). In addition to the deforestation caused by mining in a direct and indirect way, mining operations present a latent risk of water contamination that has already caused heavy damages within the Amazon basin (Malm et al., 1995, 1998; Durrieu, et al., 2005). Great disasters has been dated, as the spill at the Hydro company's refinery in the rivers near Barcarena in the state of Pará (Nogueira, 2018) and the pollution in the Mata Atlantica by the Bento Rodrigues and Brumadinho disasters (Escobar, 2015; Oliveira, 2019). Moreover, mining in indigenous lands could put at risk, in addition of the cultural diversity of the settled indigenous people, more than 100 recorded isolated indigenous tribes in the Legal Amazon, a figure that may increase according to studies carried out by FUNAI (2020).

Areas with the highest number of affected threatened species among the scenarios are located mostly over PAs in the South-eastern region of the state of Pará, the most legal and illegal mining active zone in the last 30 years (Palheta et al. 2017; RAISG, 2020). Moreover, there are more of these areas located in the so-called Arc of Deforestation, a zone of rapid forest loss that includes the states of Acre, Rondônia, south of Amazonas, Mato Grosso, center and north of Tocantins and east of Maranhão (Martino, 2007). It is expected that the areas with highest number of threatened species are in Pará and in the Arc of Deforestation because, as predicted by Laurance et al. (2001) and Soares-Filho et al.(2006), the habitat loss have been accelerated in those zones since 2000. Tocantins and Maranhão are the most affected states because they are located in the border of the Amazon forest (RAISG, 2015), and the state of Pará is being impacted by habitat loss due to the development trends that include deforestation, logging, mining, highways and roads, (Laurance et al., 2001; Soares-Filho et al., 2006; RAISG, 2015). Ocampo-Peñuela and Pimm, (2014) agreed that areas where high concentrations of endemic or endangered species that coincide with habitat loss should be prioritized for conservation. Thus, proposed prioritized areas for restoration and conservation have those issues.

The difference between species' Protection Status values does not show significant variation among legislative scenarios, and none of them causes the Representation Target to be crossed in a negative way. The fact that PAs could be downgraded to allow mining operations among others anthropic activities supports the idea that the level of protection established by PAs may be a poor indicator of the conservation needs (Rodrigues et al. 2004). However, the proposal to prioritize areas for conservation and restoration could make reaching the species' Representation Target more possible and could urge to ensure that some protected areas do not downgrade its level of protection.

The restoration and conservation proposal presented here seeks to obtain positive results for the species, prioritizing those that require less area for their effective protection. However, all of the species that are below their Representation Target urgently need more priority areas dedicated to restoration and conservation. Finally, in line with Rodrigues et al. (1999, 2004) and Spiegel et al. (2012) stated, the results that could be obtained with this proposal show that the geographical identification of the presence of species and the possible anthropic impacts on them is an effective tool for planning new areas of biodiversity protection.

ACKNOWLEDGEMENTS

I would like to acknowledge Carolina Foundation for the Postgraduate Studies C.2018 scholarship that allowed me to attend MSc studies on Ecosystems Restoration at Complutense University. I would also like to thank Sara Villén Pérez for the academic support during all this research, to Paulo De Marco for sharing his work on species distribution models and to Juan Antonio Delgado for his useful and friendly revision of the work.

REFERENCES

Agência Brasil. (2020). *Bolsonaro anuncia PL que regulamenta exploração de terras indígenas*. Retrieved from https://agenciabrasil.ebc.com.br/politica/noticia/2020-02/bolsonaro-envia-projeto-que-regulamenta-exploracao-de-terras-indigenas

Agência Nacional de Mineração. (2019). SIGMINE. Retrieved from http://sigmine.dnpm.gov.br/webmap/

Almeida, C. A. de, Coutinho, A. C., Esquerdo, J. C. D. M., Adami, M., Venturieri, A., Diniz, C. G., … Gomes, A. R. (2016). High spatial resolution land use and land cover mapping of the Brazilian legal Amazon in 2008 using Landsat-5/TM and MODIS data. *Acta Amazonica*, *46*(3), 291–302. https://doi.org/10.1590/1809-4392201505504

Anzolin, R., & Peres, C. (2019). Brazil's indigenous lands under threat. *Science*, *363*(6427), 592. https://doi.org/10.1126/science.aaw7608

Bernard, E., Penna, L. A. O., & Araújo, E. (2014). Downgrading, downsizing, degazettement, and reclassification of protected areas in Brazil. *Conservation Biology*, *28*(4), 939–950. https://doi.org/10.1111/cobi.12298

Brunner, A., Guliison, R., Rice, R., & da Fonseca, G. (2001). Effectiveness of Parks in Protecting Tropical Biodiversity. *Science*, *291*, 125–128. Retrieved from http://science.sciencemag.org/

CEPAL. (2018a). Estado de situación de la minería en América Latina y el Caribe: desafíos y oportunidades para un desarrollo más sostenible. *IX Conferencia de Ministerios de Minería de Las Américas*. Retrieved from https://www.cepal.org/sites/default/files/presentation/files/181116_extendidafinalconferencia_a_los_ministros_mineria_lima.pdf

CEPAL. (2018b). Perspectivas del comercio internacional de América Latina y el Caribe 2018.

(LC/PUB.2018/20-P), https://doi.org/10.18356/486d22b8-es

De Marco, P., Villén, S., Mendes, P., Nóbrega, C., Cortes, L., Castro, T., & Souza, R. (2018). Vulnerability of Cerrado threatened mammals: an integrative landscape and climate modeling approach. *Biodiversity and Conservation*, *29*(5), 1637–1658. https://doi.org/10.1007/s10531-018-1615-x

Durán, A. P., Rauch, J., & Gaston, K. J. (2013). Global spatial coincidence between protected areas and metal mining activities. *Biological Conservation*, *160*, 272–278. https://doi.org/10.1016/j.biocon.2013.02.003

Durrieu, G., Maury-Brachet, R., & Boudou, A. (2005). Goldmining and mercury contamination of the piscivorous fish Hoplias aimara in French Guiana (Amazon basin). *Ecotoxicology and Environmental Safety*, *60*(3), 315–323. https://doi.org/10.1016/j.ecoenv.2004.05.004

Escobar, H. (2015). Mud tsunami wreaks ecological havoc in Brazil: Researchers analyze sludge for heavy metals and assess potential for recovery. *Science*, *350*(6265), 1138–1139. https://doi.org/10.1126/science.350.6265.1138

FUNAI. (2020). Povos Indígenas Isolados e de Recente Contato. Retrieved from http://www.funai.gov.br/index.php/nossas-acoes/povos-indigenas-isolados-e-de-recente-contato

García-Bañuelos, P., Rovito, S. M., & Pineda, E. (2019). Representation of Threatened Biodiversity in Protected Areas and Identification of Complementary Areas for Their Conservation: Plethodontid Salamanders in Mexico. *Tropical Conservation Science*, *12*(351). https://doi.org/10.1177/1940082919834156

Helwege, A. (2015). Challenges with resolving mining conflicts in Latin America. *Extractive Industries and Society*, *2*(1), 73–84. https://doi.org/10.1016/j.exis.2014.10.003

IUCN. (2019). *IUCN Standards and Petitions Committee. 2019. Guidelines for Using the IUCN Red List Categories and Criteria. Version 14*. *1*(August), 1–113. https://doi.org/http://www.iucnredlist.org/documents/RedListGuidelines.pdf.

Jenkins, C. N., Alves, M. A. S., Uezu, A., & Vale, M. M. (2015). Patterns of vertebrate diversity and protection in Brazil. *PLoS ONE*, *10*(12), 1–13. https://doi.org/10.1371/journal.pone.0145064

Jenkins, C., Pimm, S., & Joppa, L. (2013). Global patterns of terrestrial vertebrate diversity and conservation. *Proceedings of the National Academy of Sciences*, *110*(28), E2602–E2610. https://doi.org/10.1073/pnas.1302251110

Laurance, W. F., Cochrane, M. A., Bergen, S., Fearnside, P. M., Delamônica, P., Barber, C., … Fernandes, T. (2001). The Future of the Brazilian Amazon. *Science*, *291*(5503), 438 LP – 439. https://doi.org/10.1126/science.291.5503.438

Malm, O. (1998). Gold mining as a source of mercury exposure in the Brazilian Amazon. *Environmental Research*, *77*(2), 73–78. https://doi.org/10.1006/enrs.1998.3828

Malm, O., Castro, M. B., Bastos, W. R., Branches, F. J. P., Guimarães, J. R. D., Zuffo, C. E., & Pfeiffer, W. C. (1995). An assessment of Hg pollution in different goldmining areas, Amazon Brazil. *Science of the Total Environment*, *175*(2), 127–140. https://doi.org/10.1016/0048-9697(95)04909-6

Martino, D. (2007). Deforestación en la Amazonía: principales factores de presión y perspectivas. *Revista Del Sur, 169,* 3–27.

MMA. *Resolução CONABIO nº06, de 03 de setembro de 2013*. , (2013).

MMA. *Portaria No- 444, de 17 de dezembro de 2014*. , (2014).

Nogueira, M. (2018). Evidence of contamination at Hydro plant in Brazil. *Reuters*. Retrieved from https://www.reuters.com/article/us-norsk-hydro-brazil/evidence-of-contamination-at-hydro-plant-in-brazil-researchers-say-idUSKCN1GL2X6

Nolte, C., Agrawal, A., Silvius, K. M., & Soares-filho, B. S. (2013). *Governance regime and location in fl uence avoided deforestation success of protected areas in the Brazilian Amazon*. *110*(13). https://doi.org/10.1073/pnas.1214786110

Nori, J., Lemes, P., Urbina-Cardona, N., Baldo, D., Lescano, J., & Loyola, R. (2015). Amphibian conservation, land-use changes and protected areas: A global overview. *Biological Conservation*, *191*(July), 367–374. https://doi.org/10.1016/j.biocon.2015.07.028

Ocampo-Peñuela, N., & Pimm, S. L. (2014). Setting Practical Conservation Priorities for Birds in the Western Andes of Colombia. *Conservation Biology, 28*(5), 1260–1270. https://doi.org/10.1111/cobi.12312

Oliveira, J. (2019). Resíduos de Brumadinho já matam os peixes do rio São Francisco. *El País*. Retrieved from https://brasil.elpais.com/brasil/2019/03/21/politica/1553194959_991458.html

Palheta, J. M., Silva, C. N. da, Oliveira Neto, A., & Nascimento, F. R. do. (2017). Conflicts Over the Use of Territory in Mineral Amazon. *Mercator*, *16*(10), 1–18. https://doi.org/10.4215/rm2017.e16023

Pfaff, A., Robalino, J., Herrera, D., & Sandoval, C. (2015). Protected areas impacts on Brazilian Amazon deforestation: Examining conservation - Development interactions to inform planning. *PLoS ONE*, *10*(7). https://doi.org/10.1371/journal.pone.0129460

QGIS Development Team (2020). QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/.

RAISG. (2012). *Amazonía bajo presión*. RAISG, Red Amazónica de Información Socioambiental Georreferenciada.

RAISG. (2015). *Deforestación en la Amazonía (1970-2013)*.

RAISG. (2020). Panamazon ilegal mining map. Retrieved from https://www.amazoniasocioambiental.org/es/radar/mapa-inedito-indica-epidemia-de-garimpo-ilegal-na-panamazonia/

Rodrigues, A. S. L., Akçakaya, H. R., Andelman, S. J., Bakarr, M. I., Boitani, L., Brooks, T. M., … Yan, X. (2004). Global Gap Analysis: Priority Regions for Expanding the Global Protected-Area Network. *BioScience*, *54*(12), 1092. https://doi.org/10.1641/0006-3568(2004)054[1092:ggaprf]2.0.co;2

Rodrigues, A. S. L., Andelman, S. J., Bakarr, M. I., Boitani, L., Brooks, T. M., Cowling, R. M., … Yan, X. (2004). Dependence of the duration of geomagnetic polarity reversals on site latitude. *Nature*, *428*(6983), 637–640. https://doi.org/10.1038/nature02459

Rodrigues, A. S. L., Tratt, R., Wheeler, B. D., & Gaston, K. J. (1999). The performance of existing networks of conservation areas in representing biodiversity. *Proceedings of the Royal Society B: Biological Sciences*, *266*(1427), 1453–1460. https://doi.org/10.1098/rspb.1999.0800

Soares-Filho, B. S., Nepstad, D. C., Curran, L. M., Cerqueira, G. C., Garcia, R. A., Ramos, C. A., … Schlesinger, P. (2006). Modelling conservation in the Amazon basin. *Nature*, *440*(7083), 520–523. https://doi.org/10.1038/nature04389

Sonter, L. J., Barrett, D. J., & Soares-Filho, B. S. (2014). Offsetting the impacts of mining to achieve no net loss of native vegetation. *Conservation Biology*, *28*(4), 1068–1076. https://doi.org/10.1111/cobi.12260

Sonter, Laura J., Barrett, D. J., Moran, C. J., & Soares-Filho, B. S. (2015). A Land System Science meta-analysis suggests we underestimate intensive land uses in land use change dynamics. *Journal of Land Use Science*, *10*(2), 191–204. Retrieved from https://doi.org/10.1080/1747423X.2013.871356

Sonter, Laura J., Herrera, D., Barrett, D. J., Galford, G. L., Moran, C. J., & Soares-Filho, B. S. (2017). Mining drives extensive deforestation in the Brazilian Amazon. *Nature Communications*, *8*(1), 1–7. https://doi.org/10.1038/s41467-017-00557-w

Sonter, Laura J., Moran, C. J., Barrett, D. J., & Soares-Filho, B. S. (2014). Processes of land use change in mining regions. *Journal of Cleaner Production*, *84*(1), 494–501. https://doi.org/10.1016/j.jclepro.2014.03.084

Sonter, Laura J, Ali, S. H., & Watson, J. E. M. (2020). *Mining and biodiversity_ key issues and research needs in conservation science. - PubMed - NCBI*.

Spiegel, S. J., Ribeiro, C. A. A. S., Sousa, R., & Veiga, M. M. (2012). Mapping spaces of environmental dispute: Gis, mining, and surveillance in the Amazon. *Annals of the Association of American Geographers*, *102*(2), 320–349. https://doi.org/10.1080/00045608.2011.641861

Villén-Pérez, S., Mendes, P., Nóbrega, C., Gomes Córtes, L., & De Marco, P. (2018). Mining code changes undermine biodiversity conservation in Brazil. *Environmental Conservation*, *45*(1), 96–99. https://doi.org/10.1017/S0376892917000376

Volpato, M. (2007). Aspectos legais da mineração em terras indígenas. *Revista de Estudos e Pesquisas, FUNAI*, *4*(2), 221–252.

Wearn, O. R., Reuman, D. C., & Ewers, R. M. (2012). Extinction Debt and Windows of Conservation Opportunity in the Brazilian Amazon. *Science*, *337*(July), 228–233.

SUPPLEMENTARY MATERIAL 1 – SPECIES DISTRIBUTION MODELLING PROCEDURES

Data

Species selection was based on the most recent threatened species list of Brazil organized by the Chico Mendez Institute for Biodiversity Conservation (MMA, 2014). Also, study species was selected based on the conservative criteria of the existence of validated occurrence points with a higher percentage of their total range in the Amazon biome and the species occurrence data was assembled from scientific literature and digital databases, including GBIF (https://www.gbif.org) and speciesLink (https://splink.cria.org.br). Additional occurrence records were obtained directly from researchers that participated of the last two workshops held by ICMBio for threatened species evaluation in Brazil. The resultant database included 302 species of mammals, birds, reptiles and amphibians with five or more records.

Environmental data included 19 bioclimatic variables from WordClim (https://www.worldclim.com) and two topographic variables (slope and flow accumulation) from GTOPO30 database (https://www.usgs.gov/). Bioclimatic variables were related to temperature and precipitation mean, minimum, maximum and fluctuation, and averaged for the years 1970-2000 (Fick and Hijmans, 2017). Original variables were obtained at a resolution of 30 arc-second and were upsized to 5 arc minute, which in the region is approximately 9.25 x 9.25 km^2. A principal component analysis (PCA) was applied to deal with variable collinearity issues and reduce model (De Marco, P., Nóbrega, C.C., 2018). Thus the 21 variables were reduced to eight principal components (PCs) that explained up to 96.20% of the total original variance, and PCA eigenvectors were used as model predictors in subsequent analyses (Table SM1.1).

Table SM1.1. PCA eigenvectors, eigenvalues and explained variance

Environmental variables	Principal Components (PCs)							
	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Annual Mean Temperature	0,269	0,256	0,096	-0,040	0,004	0,041	-0,081	0,009
Mean Diurnal Range (Mean of monthly (max temp - min temp)	-0,204	0,206	0,058	0,428	-0,098	-0,189	0,085	0,477

Isothermality (Mean daily range/Temperature anual range) (* 100)	0,242	-0,004	-0,335	0,079	0,028	0,029	-0,105	0,492
Temperature Seasonality (standard deviation *100)	-0,245	0,033	0,394	0,034	0,007	0,012	0,171	-0,096
Max Temperature of Warmest Month	0,136	0,370	0,341	0,063	0,005	0,044	0,087	0,035
Min Temperature of Coldest Month	0,301	0,120	-0,063	-0,138	0,040	0,097	-0,095	-0,018
Temperature Annual Range (Max Temperature of Warmest Month - Min Temperature of Coldest Month)	-0,254	0,119	0,312	0,205	-0,042	-0,082	0,171	0,045
Mean Temperature of Wettest Quarter	0,206	0,306	0,183	0,037	-0,056	-0,075	-0,180	0,055
Mean Temperature of Driest Quarter	0,269	0,178	0,017	-0,094	0,058	0,150	0,072	0,036
Mean Temperature of Warmest Quarter	0,189	0,318	0,327	-0,037	0,016	0,069	0,015	-0,037
Mean Temperature of Coldest Quarter	0,292	0,183	-0,065	-0,047	0,004	0,034	-0,113	0,042
Annual Precipitation	0,275	-0,200	0,076	0,165	-0,055	-0,099	0,159	-0,096
Precipitation of Wettest Month	0,279	-0,077	-0,066	0,218	-0,091	-0,171	0,292	-0,264
Precipitation of Driest Month	0,151	-0,355	0,285	0,035	0,006	0,036	-0,132	0,353
Precipitation Seasonality (Coefficient of Variation)	-0,039	0,293	-0,387	0,248	-0,128	-0,243	0,171	0,166
Precipitation of Wettest Quarter	0,280	-0,086	-0,062	0,220	-0,086	-0,165	0,284	-0,254
Precipitation of Driest Quarter	0,162	-0,353	0,283	0,038	0,004	0,035	-0,102	0,318
Precipitation of Warmest Quarter	0,174	-0,185	0,148	0,294	-0,269	-0,407	-0,440	-0,191
Precipitation of Coldest Quarter	0,211	-0,204	0,063	0,011	0,126	0,178	0,600	0,194
Water Course	0,024	0,012	0,011	0,166	0,920	-0,336	-0,092	-0,057
Slope	-0,024	-0,011	-0,082	0,654	0,101	0,687	-0,199	-0,191
Eigenvalues	9,863	3,861	2,281	1,209	1,011	0,856	0,740	0,450

Explanation (%)	46,966	18,385	10,862	5,756	4,816	4,078	3,523	2,142
Cumulative percentage (%)	46,966	65,351	76,213	81,969	86,785	90,862	94,386	96,528

Ensemble Ecological Niche Models

Ecological Niche Models (ENMs hereoff) were constructed using seven algorithms: Maximum Entropy (MaxEnt), Support Vector Machine (SVM), Generalized Linear Model (GLM), Generalized Additive Model (GAM), Random Forest (RDF), Maximum Likelihood (MLK) and Gaussian (GAU). Those models have some important differences on fitting process and, thus, have different exigencies related to data. In special, GLM and GAM (but in minor level MLK and RDF) has overfitting problems related to the number of samples in relation to the number of variables. GLM and GAM, where only modelled for species with nearly twice the number of occurrence points than variables. Thus, some algorithms were not fitted for some species due to these constrains. For those algorithms that require presence/pseudo-absence data, it was generated a number of pseudo-absences equal to the number of presences available for each species. For those that require presence/background data, 10000 background points were generated for all the species. Accessible area constrains are important to determine where to put background points and have a relevant impact on model results (Barve, N., 2011). Here, we assume that the entire Neotropical region is the accessible area for those modelled species. Thus, both pseudo-absences and background points were randomly distributed across the Neotropical region.

Modeling results from the seven algorithms were ensembled in order to reduce uncertainty in predictions derived from variable performance of algorithms under different modelling conditions (Diniz-Filho et al., 2009; Zhu & Peterson, 2017). Modelling predictions of all algorithms at the cell level were correlated through a Principal Component Analysis (PCA), and the first PCA component re-scaled to a minimum of 0 and a maximum of 1 was used as the final ensemble model (Marmion, et al., 2009.).

Model Evaluation

For ENM evaluation, occurrence data of each species was partitioned in training (70% of data) and testing (30%) datasets and cross-validated (Roberts et al., 2017). Following the suggestion in Liu (2011),two indices were used: the area under the curve (AUC) to assess global model performance independent of threshold, and the true-skill statistic (TSS) to estimate model quality at the suitability threshold applied (see below). Both metric values range from -1 to +1, where a value equal to +1 indicates perfect model performance, minimum overprediction and omission error rates, and values equal to zero or less indicate predictions no better than random (Allouche, Tsoar, & Kadmon, 2006; Boyce, Vernier, Nielsen, & Schmiegelow, 2002; Hirzel, Le Lay, Helfer, Randin, & Guisan, 2006). These evaluations are shown both for individual algorithms and for ensemble models (Tables SM1.2 and SM1.3).

Spatial constraints

ENM often predicts suitable conditions for the persistence of species in areas where its presence is constrained by dispersal limitations, geographic barriers or large distances from source areas (Allouche et al. 2008; Barve et al. 2011). Such commission errors in suitable but inaccessible areas must be minimised to better approach the real distribution of species, especially when ENMs are applied to conservation. For this purpose, it was applied a recently developed technique known as M-SDM (Mendes et al., *in prep*) based on a landscape perspective of species' range. First, suitability results from the ensemble model were converted into presence/absence predictions, using the lowest presence threshold (LPT; Pearson et al. 2007). This resulted in projections of species presence in many contiguous areas (patches). A posteriori M-SDM was then applied, so that the final prediction retained only those patches with known occurrences for the species. This procedure was recently successfully applied to the evaluation of the vulnerability of Mammals (De Marco, et. al, 2018.)

Model construction and data analysis were conducted in the R software v. 3.5.1. (R Core Team, 2018), using the packages stats v. 3.4.1, maxnet (Phillips, 2017) ,dismo v. 1.1-4 (Hijmans, Phillips, Leathwick, & Elith, 2017), randomForest v. 4.6-12 (Liaw & Wiener, 2002), kernlab v. 0.9-25 (Karatzoglou, Smola, Hornik, & Zeileis, 2004), maxlike (Royle, Chandler, Yackulic, & Nichols, 2012) and GRaF v.0.1-15 (Golding, 2017) to fit GLM, GAM, MXS, RDF ,SVM, MLK and GAU models respectively. For pseudo-absence creation and models` predictions we also used the dismo package. The whole modelling routine was performed using the ENM_TheMetaLand package (available at: https://github.com/andrefaa/ENM_TheMetaLand).

Table SM1.2. Evaluation of models using individual algorithms. Algorithm: algorithm used in the model. AUC = area under the curve. TSS = true-skill statistic for THR threshold.

Specie	Algorithm	AUC	TSS
AMPHIBIANS			
Agalychnis granulosa	GAM	NA	NA
Agalychnis granulosa	GAU	0.996	0.98
Agalychnis granulosa	GLM	0.65	0.4
Agalychnis granulosa	GLM	NA	NA
Agalychnis granulosa	MXS	0.952	0.86
Agalychnis granulosa	RDF	1	1
Agalychnis granulosa	SVM	0.996	0.98
Allobates brunneus	GAM	NA	NA
Allobates brunneus	GAU	0.5444	0.2886
Allobates brunneus	GLM	0.48	0.19425
Allobates brunneus	MLK	0.685	0.444
Allobates brunneus	MXS	0.5703	0.2886
Allobates brunneus	RDF	0.6569	0.3886
Allobates brunneus	SVM	0.574	0.2997
Allobates olfersioides	GAM	NA	NA
Allobates olfersioides	GAU	0.9588	0.8666
Allobates olfersioides	GLM	0.7926	0.6166
Allobates olfersioides	MLK	0.9194	0.7916
Allobates olfersioides	MXS	0.972	0.8415
Allobates olfersioides	RDF	0.9783	0.9001
Allobates olfersioides	SVM	0.9651	0.8834
Cycloramphus ohausi	GAM	NA	NA
Cycloramphus ohausi	GAU	1	1
Cycloramphus ohausi	GLM	NA	NA
Cycloramphus ohausi	MXS	1	1
Cycloramphus ohausi	RDF	1	1
Cycloramphus ohausi	SVM	0.975	0.95
Holoaden luederwaldti	GAM	NA	NA
Holoaden luederwaldti	GAU	1	1
Holoaden luederwaldti	GLM	NA	NA
Holoaden luederwaldti	MXS	1	1

Holoaden luederwaldti	RDF	1	1
Holoaden luederwaldti	SVM	1	1
Hypsiboas curupi	GAM	NA	NA
Hypsiboas curupi	GAU	1	1
Hypsiboas curupi	GLM	0.75	0.6665
Hypsiboas curupi	MXS	1	1
Hypsiboas curupi	RDF	1	1
Hypsiboas curupi	SVM	1	1
Hypsiboas semiguttatus	GAM	NA	NA
Hypsiboas semiguttatus	GAU	1	1
Hypsiboas semiguttatus	GLM	NA	NA
Hypsiboas semiguttatus	MLK	0.98133333	0.778
Hypsiboas semiguttatus	MXS	1	1
Hypsiboas semiguttatus	RDF	1	1
Hypsiboas semiguttatus	SVM	1	1
Melanophryniscus dorsalis	GAM	NA	NA
Melanophryniscus dorsalis	GAU	1	1
Melanophryniscus dorsalis	GLM	NA	NA
Melanophryniscus dorsalis	MXS	1	1
Melanophryniscus dorsalis	RDF	1	1
Melanophryniscus dorsalis	SVM	1	1
Melanophryniscus macrogranulosus	GAM	NA	NA
Melanophryniscus macrogranulosus	GAU	1	1
Melanophryniscus macrogranulosus	GLM	NA	NA
Melanophryniscus macrogranulosus	MXS	0.875	0.8125
Melanophryniscus macrogranulosus	RDF	0.78571429	0.64285714
Melanophryniscus macrogranulosus	SVM	1	1
Proceratophrys moratoi	GAM	NA	NA
Proceratophrys moratoi	GAU	1	1
Proceratophrys moratoi	GLM	NA	NA
Proceratophrys moratoi	MXS	1	1
Proceratophrys moratoi	RDF	1	1
Proceratophrys moratoi	SVM	1	1
Scinax duartei	GAM	NA	NA
Scinax duartei	GAU	0.9972	0.9833

Scinax duartei	GLM	0.9305	0.75
Scinax duartei	MXS	0.9972	0.9833
Scinax duartei	RDF	0.9944	0.9666
Scinax duartei	SVM	0.9582	0.8332
Thoropa petropolitana	GAM	NA	NA
Thoropa petropolitana	GAU	1	1
Thoropa petropolitana	GLM	0.667	0.333
Thoropa petropolitana	MXS	1	1
Thoropa petropolitana	RDF	0.9556	0.9334
Thoropa petropolitana	SVM	1	1
Thoropa saxatilis	GAM	NA	NA
Thoropa saxatilis	GAU	1	1
Thoropa saxatilis	GLM	NA	NA
Thoropa saxatilis	MXS	1	1
Thoropa saxatilis	RDF	1	1
Thoropa saxatilis	SVM	1	1
Xenohyla truncata	GAM	NA	NA
Xenohyla truncata	GAU	0.9667	0.9001
Xenohyla truncata	GLM	NA	NA
Xenohyla truncata	MXS	1	1
Xenohyla truncata	RDF	0.9223	0.8002
Xenohyla truncata	SVM	0.926	0.852
REPTILES			
Ameivula abaetensis	GAM	NA	NA
Ameivula abaetensis	GAU	0.95918	0.85714
Ameivula abaetensis	GLM	NA	NA
Ameivula abaetensis	MLK	0.7551	0.57143
Ameivula abaetensis	MXS	0.97959	0.85714
Ameivula abaetensis	RDF	0.93878	0.85714
Ameivula abaetensis	SVM	0.89796	0.71429
Ameivula littoralis	GAM	NA	NA
Ameivula littoralis	GAU	1	1
Ameivula littoralis	GLM	NA	NA
Ameivula littoralis	MLK	1	1
Ameivula littoralis	MXS	1	1

Ameivula littoralis	RDF	1	1
Ameivula littoralis	SVM	1	1
Ameivula nativo	GAM	NA	NA
Ameivula nativo	GAU	1	1
Ameivula nativo	GLM	NA	NA
Ameivula nativo	MLK	0.98765	0.88889
Ameivula nativo	MXS	1	1
Ameivula nativo	RDF	0.98765	0.88889
Ameivula nativo	SVM	1	1
Amerotyphlops amoipira	GAM	NA	NA
Amerotyphlops amoipira	GAU	0.93388	0.81818
Amerotyphlops amoipira	GLM	NA	NA
Amerotyphlops amoipira	MLK	0.72727	0.45455
Amerotyphlops amoipira	MXS	0.97521	0.90909
Amerotyphlops amoipira	RDF	0.97521	0.90909
Amerotyphlops amoipira	SVM	0.99174	0.90909
Atractus serranus	GAM	NA	NA
Atractus serranus	GAU	1	1
Atractus serranus	GLM	NA	NA
Atractus serranus	MLK	1	1
Atractus serranus	MXS	1	1
Atractus serranus	RDF	1	1
Atractus serranus	SVM	1	1
Calamodontophis paucidens	GAM	NA	NA
Calamodontophis paucidens	GAU	1	1
Calamodontophis paucidens	GLM	NA	NA
Calamodontophis paucidens	MLK	0.57812	0.25
Calamodontophis paucidens	MXS	1	1
Calamodontophis paucidens	RDF	0.90625	0.75
Calamodontophis paucidens	SVM	1	1
Chelonia mydas	GAM	NA	NA
Chelonia mydas	GAU	0.93714	0.73913
Chelonia mydas	GLM	0.8712	0.6233
Chelonia mydas	MLK	0.81665	0.48522
Chelonia mydas	MXS	0.85709	0.55826

Chelonia mydas	RDF	0.99139	0.93391
Chelonia mydas	SVM	0.96251	0.83304
Coleodactylus natalensis	GAM	NA	NA
Coleodactylus natalensis	GAU	1	1
Coleodactylus natalensis	GLM	NA	NA
Coleodactylus natalensis	MLK	0.82639	0.75
Coleodactylus natalensis	MXS	1	1
Coleodactylus natalensis	RDF	1	1
Coleodactylus natalensis	SVM	1	1
Colobodactylus dalcyanus	GAM	NA	NA
Colobodactylus dalcyanus	GAU	1	1
Colobodactylus dalcyanus	GLM	NA	NA
Colobodactylus dalcyanus	MLK	0.7	0.4
Colobodactylus dalcyanus	MXS	1	1
Colobodactylus dalcyanus	RDF	1	1
Colobodactylus dalcyanus	SVM	1	1
Contomastix vacariensis	GAM	NA	NA
Contomastix vacariensis	GAU	1	1
Contomastix vacariensis	GLM	NA	NA
Contomastix vacariensis	MLK	0.70833	0.5
Contomastix vacariensis	MXS	1	1
Contomastix vacariensis	RDF	1	1
Contomastix vacariensis	SVM	1	1
Corallus cropanii	GAM	NA	NA
Corallus cropanii	GAU	1	1
Corallus cropanii	GLM	NA	NA
Corallus cropanii	MLK	0.88	0.8
Corallus cropanii	MXS	1	1
Corallus cropanii	RDF	1	1
Corallus cropanii	SVM	1	1
Ditaxodon taeniatus	GAM	NA	NA
Ditaxodon taeniatus	GAU	0.95918	0.85714
Ditaxodon taeniatus	GLM	NA	NA
Ditaxodon taeniatus	MLK	0.57143	0.14286
Ditaxodon taeniatus	MXS	0.93878	0.85714

Ditaxodon taeniatus	RDF	0.93878	0.85714
Ditaxodon taeniatus	SVM	0.93878	0.71429
Heterodactylus lundii	GAM	NA	NA
Heterodactylus lundii	GAU	0.98962	0.94118
Heterodactylus lundii	GLM	0.52	0.4
Heterodactylus lundii	MLK	0.99654	0.94118
Heterodactylus lundii	MXS	0.98962	0.94118
Heterodactylus lundii	RDF	0.99654	0.94118
Heterodactylus lundii	SVM	0.99654	0.94118
Homonota uruguayensis	GAM	NA	NA
Homonota uruguayensis	GAU	1	1
Homonota uruguayensis	GLM	NA	NA
Homonota uruguayensis	MLK	0.63636	0.27273
Homonota uruguayensis	MXS	1	1
Homonota uruguayensis	RDF	1	1
Homonota uruguayensis	SVM	0.96694	0.81818
Hydrodynastes melanogigas	GAM	NA	NA
Hydrodynastes melanogigas	GAU	0.80556	0.66667
Hydrodynastes melanogigas	GLM	NA	NA
Hydrodynastes melanogigas	MLK	0.91667	0.83333
Hydrodynastes melanogigas	MXS	0.80556	0.66667
Hydrodynastes melanogigas	RDF	0.83333	0.66667
Hydrodynastes melanogigas	SVM	0.80556	0.66667
Kentropyx vanzoi	GAM	NA	NA
Kentropyx vanzoi	GAU	1	1
Kentropyx vanzoi	GLM	NA	NA
Kentropyx vanzoi	MLK	0.9375	0.75
Kentropyx vanzoi	MXS	0.96875	0.875
Kentropyx vanzoi	RDF	1	1
Kentropyx vanzoi	SVM	0.96875	0.875
Leposoma annectans	GAU	1	1
Leposoma annectans	MLK	0.83333	0.66667
Leposoma annectans	MXS	1	1
Leposoma annectans	RDF	1	1
Leposoma annectans	SVM	1	1

Leposoma baturitensis	GAM	NA	NA
Leposoma baturitensis	GAU	1	1
Leposoma baturitensis	GLM	NA	NA
Leposoma baturitensis	MLK	0.8	0.6
Leposoma baturitensis	MXS	1	1
Leposoma baturitensis	RDF	1	1
Leposoma baturitensis	SVM	0.92	0.8
Leposoma nanodactylus	GAM	NA	NA
Leposoma nanodactylus	GAU	1	1
Leposoma nanodactylus	GLM	NA	NA
Leposoma nanodactylus	MLK	1	1
Leposoma nanodactylus	MXS	1	1
Leposoma nanodactylus	RDF	1	1
Leposoma nanodactylus	SVM	1	1
Liolaemus lutzae	GAM	NA	NA
Liolaemus lutzae	GAU	1	1
Liolaemus lutzae	GLM	NA	NA
Liolaemus lutzae	MLK	1	1
Liolaemus lutzae	MXS	1	1
Liolaemus lutzae	RDF	1	1
Liolaemus lutzae	SVM	1	1
Liolaemus occipitalis	GAM	NA	NA
Liolaemus occipitalis	GAU	0.9725	0.95
Liolaemus occipitalis	GLM	NA	NA
Liolaemus occipitalis	MLK	0.985	0.95
Liolaemus occipitalis	MXS	0.995	0.95
Liolaemus occipitalis	RDF	0.9675	0.95
Liolaemus occipitalis	SVM	0.9625	0.95
Mesoclemmys hogei	GAM	NA	NA
Mesoclemmys hogei	GAU	1	1
Mesoclemmys hogei	GLM	NA	NA
Mesoclemmys hogei	MLK	0.7551	0.57143
Mesoclemmys hogei	MXS	1	1
Mesoclemmys hogei	RDF	1	1
Mesoclemmys hogei	SVM	0.95918	0.85714

Philodryas livida	GAM	NA	NA
Philodryas livida	GAU	1	1
Philodryas livida	GLM	NA	NA
Philodryas livida	MLK	0.64844	0.375
Philodryas livida	MXS	1	1
Philodryas livida	RDF	1	1
Philodryas livida	SVM	1	1
Stenocercus dumerilii	GAM	NA	NA
Stenocercus dumerilii	GAU	0.98438	0.9375
Stenocercus dumerilii	GLM	0.64	0.2
Stenocercus dumerilii	MLK	0.97656	0.875
Stenocercus dumerilii	MXS	0.98047	0.9375
Stenocercus dumerilii	RDF	1	1
Stenocercus dumerilii	SVM	0.98828	0.9375
Tropidurus hygomi	GAM	NA	NA
Tropidurus hygomi	GAU	0.93388	0.72727
Tropidurus hygomi	GLM	NA	NA
Tropidurus hygomi	MLK	0.92562	0.81818
Tropidurus hygomi	MXS	0.91736	0.81818
Tropidurus hygomi	RDF	1	1
Tropidurus hygomi	SVM	1	1
BIRDS			
Aburria jacutinga	GAM	0.9562	0.80263
Aburria jacutinga	GAU	0.96797	0.84211
Aburria jacutinga	GLM	0.88937	0.68421
Aburria jacutinga	MLK	0.84643	0.64474
Aburria jacutinga	MXS	0.97576	0.84211
Aburria jacutinga	RDF	0.99758	0.94737
Aburria jacutinga	SVM	0.97905	0.89474
Acrobatornis fonsecai	GAM	0.97041	0.84615
Acrobatornis fonsecai	GAU	1	1
Acrobatornis fonsecai	GLM	0.98817	0.92308
Acrobatornis fonsecai	MLK	0.9645	0.92308
Acrobatornis fonsecai	MXS	1	1
Acrobatornis fonsecai	RDF	1	1

Acrobatornis fonsecai	SVM	1	1
Alectrurus tricolor	GAM	0.9579	0.83582
Alectrurus tricolor	GAU	0.9579	0.86567
Alectrurus tricolor	GLM	0.77501	0.50746
Alectrurus tricolor	MLK	0.80307	0.55224
Alectrurus tricolor	MXS	0.97951	0.8209
Alectrurus tricolor	RDF	0.99153	0.92537
Alectrurus tricolor	SVM	0.97639	0.8806
Amadonastur lacernulatus	GAM	0.98257	0.88636
Amadonastur lacernulatus	GAU	0.97921	0.85227
Amadonastur lacernulatus	GLM	0.95713	0.79545
Amadonastur lacernulatus	MLK	0.95028	0.80682
Amadonastur lacernulatus	MXS	0.98308	0.89773
Amadonastur lacernulatus	RDF	0.99199	0.94318
Amadonastur lacernulatus	SVM	0.99212	0.89773
Amazona pretrei	GAM	0.95706	0.84211
Amazona pretrei	GAU	0.98476	0.86842
Amazona pretrei	GLM	0.91482	0.86842
Amazona pretrei	MLK	0.91482	0.78947
Amazona pretrei	MXS	0.98546	0.89474
Amazona pretrei	RDF	0.99307	0.94737
Amazona pretrei	SVM	0.99723	0.94737
Amazona rhodocorytha	GAM	0.97702	0.89412
Amazona rhodocorytha	GAU	0.98408	0.85882
Amazona rhodocorytha	GLM	0.93163	0.78824
Amazona rhodocorytha	MLK	0.9463	0.76471
Amazona rhodocorytha	MXS	0.9773	0.87059
Amazona rhodocorytha	RDF	0.99114	0.95294
Amazona rhodocorytha	SVM	0.98907	0.95294
Amazona vinacea	GAM	0.97612	0.87857
Amazona vinacea	GAU	0.97663	0.87857
Amazona vinacea	GLM	0.91311	0.75714
Amazona vinacea	MLK	0.90888	0.76429
Amazona vinacea	MXS	0.97867	0.87143
Amazona vinacea	RDF	0.9926	0.94286

Amazona vinacea	SVM	0.97898	0.89286
Anodorhynchus leari	GAM	0.93951	0.86957
Anodorhynchus leari	GAU	0.98866	0.91304
Anodorhynchus leari	GLM	0.9414	0.82609
Anodorhynchus leari	MLK	0.89981	0.78261
Anodorhynchus leari	MXS	0.96975	0.91304
Anodorhynchus leari	RDF	1	1
Anodorhynchus leari	SVM	1	1
Anthus nattereri	GAM	0.99143	0.94444
Anthus nattereri	GAU	0.99451	0.96296
Anthus nattereri	GLM	0.92936	0.83333
Anthus nattereri	MLK	0.86077	0.7037
Anthus nattereri	MXS	0.98285	0.94444
Anthus nattereri	RDF	0.98971	0.98148
Anthus nattereri	SVM	0.9976	0.98148
Antilophia bokermanni	GAM	0.9949	0.92857
Antilophia bokermanni	GAU	1	1
Antilophia bokermanni	GLM	1	1
Antilophia bokermanni	MLK	0.94388	0.85714
Antilophia bokermanni	MXS	1	1
Antilophia bokermanni	RDF	1	1
Antilophia bokermanni	SVM	1	1
Aratinga solstitialis	GAM	0.90725	0.75862
Aratinga solstitialis	GAU	0.90963	0.72414
Aratinga solstitialis	GLM	0.93222	0.72414
Aratinga solstitialis	MLK	0.89655	0.72414
Aratinga solstitialis	MXS	0.91439	0.75862
Aratinga solstitialis	RDF	0.98692	0.93103
Aratinga solstitialis	SVM	0.88347	0.72414
Arremonops conirostris	GAM	0.89919	0.65385
Arremonops conirostris	GAU	0.94408	0.7422
Arremonops conirostris	GLM	0.89477	0.63617
Arremonops conirostris	MLK	0.84105	0.5104
Arremonops conirostris	MXS	0.89443	0.60499
Arremonops conirostris	RDF	0.98782	0.92412

Arremonops conirostris	SVM	0.95888	0.78586
Asthenes hudsoni	GAM	0.96658	0.91667
Asthenes hudsoni	GAU	0.99349	0.9375
Asthenes hudsoni	GLM	0.96007	0.875
Asthenes hudsoni	MLK	0.95052	0.8125
Asthenes hudsoni	MXS	0.98698	0.91667
Asthenes hudsoni	RDF	0.99783	0.95833
Asthenes hudsoni	SVM	0.9987	0.97917
Augastes lumachella	GAM	0.96694	0.90909
Augastes lumachella	GAU	0.98347	0.90909
Augastes lumachella	GLM	0.91736	0.81818
Augastes lumachella	MLK	0.92149	0.90909
Augastes lumachella	MXS	0.94835	0.86364
Augastes lumachella	RDF	1	1
Augastes lumachella	SVM	0.9938	0.95455
Automolus lammi	GAM	0.93056	0.75
Automolus lammi	GAU	1	1
Automolus lammi	GLM	0.78472	0.75
Automolus lammi	MLK	0.91667	0.91667
Automolus lammi	MXS	1	1
Automolus lammi	RDF	1	1
Automolus lammi	SVM	1	1
Campylorhamphus cardosoi	GAM	0.90703	0.80952
Campylorhamphus cardosoi	GAU	0.97732	0.85714
Campylorhamphus cardosoi	GLM	0.77324	0.57143
Campylorhamphus cardosoi	MLK	0.85941	0.66667
Campylorhamphus cardosoi	MXS	0.96825	0.85714
Campylorhamphus cardosoi	RDF	0.9932	0.90476
Campylorhamphus cardosoi	SVM	0.98866	0.90476
Campylorhamphus multostriatus	GAM	0.75	0.625
Campylorhamphus multostriatus	GAU	0.98438	0.875
Campylorhamphus multostriatus	GLM	0.75	0.75
Campylorhamphus multostriatus	MLK	0.875	0.75
Campylorhamphus multostriatus	MXS	1	1
Campylorhamphus multostriatus	RDF	1	1

Campylorhamphus multostriatus	SVM	0.98438	0.875
Capito dayi	GAM	0.95041	0.78182
Capito dayi	GAU	0.94512	0.8
Capito dayi	GLM	0.91339	0.74545
Capito dayi	MLK	0.9005	0.67273
Capito dayi	MXS	0.95802	0.8
Capito dayi	RDF	0.98843	0.92727
Capito dayi	SVM	0.95802	0.81818
Carpornis melanocephala	GAM	0.96327	0.90909
Carpornis melanocephala	GAU	0.97215	0.90909
Carpornis melanocephala	GLM	0.95256	0.87879
Carpornis melanocephala	MLK	0.95256	0.84848
Carpornis melanocephala	MXS	0.97215	0.89899
Carpornis melanocephala	RDF	0.99541	0.9596
Carpornis melanocephala	SVM	0.98541	0.91919
Caryothraustes canadensis frontalis	GAM	0.85714	0.85714
Caryothraustes canadensis frontalis	GAU	1	1
Caryothraustes canadensis frontalis	GLM	0.85714	0.85714
Caryothraustes canadensis frontalis	MLK	0.97959	0.85714
Caryothraustes canadensis frontalis	MXS	1	1
Caryothraustes canadensis frontalis	RDF	1	1
Caryothraustes canadensis frontalis	SVM	1	1
Celeus obrieni	GAM	0.99408	0.92308
Celeus obrieni	GAU	1	1
Celeus obrieni	GLM	0.85799	0.69231
Celeus obrieni	MLK	0.95858	0.84615
Celeus obrieni	MXS	1	1
Celeus obrieni	RDF	1	1
Celeus obrieni	SVM	1	1
Celeus torquatus pieteroyensi	GAM	NA	NA
Celeus torquatus pieteroyensi	GAU	0.96	0.8
Celeus torquatus pieteroyensi	GLM	NA	NA
Celeus torquatus pieteroyensi	MLK	0.7	0.4
Celeus torquatus pieteroyensi	MXS	1	1
Celeus torquatus pieteroyensi	RDF	0.72	0.4

Celeus torquatus pieteroyensi	SVM	1	1
Celeus torquatus tinnunculus	GAM	1	1
Celeus torquatus tinnunculus	GAU	0.9975	0.95
Celeus torquatus tinnunculus	GLM	0.9	0.8
Celeus torquatus tinnunculus	MLK	0.9925	0.95
Celeus torquatus tinnunculus	MXS	0.9975	0.95
Celeus torquatus tinnunculus	RDF	1	1
Celeus torquatus tinnunculus	SVM	1	1
Cercomacra ferdinandi	GAM	0.99524	0.93103
Cercomacra ferdinandi	GAU	0.98335	0.93103
Cercomacra ferdinandi	GLM	0.9786	0.89655
Cercomacra ferdinandi	MLK	0.97146	0.86207
Cercomacra ferdinandi	MXS	0.9786	0.89655
Cercomacra ferdinandi	RDF	0.99881	0.96552
Cercomacra ferdinandi	SVM	1	1
Chamaeza nobilis fulvipectus	GAM	0.96296	0.88889
Chamaeza nobilis fulvipectus	GAU	1	1
Chamaeza nobilis fulvipectus	GLM	0.88889	0.88889
Chamaeza nobilis fulvipectus	MLK	0.88889	0.88889
Chamaeza nobilis fulvipectus	MXS	1	1
Chamaeza nobilis fulvipectus	RDF	1	1
Chamaeza nobilis fulvipectus	SVM	1	1
Cichlopsis leucogenys	GAM	0.96488	0.81818
Cichlopsis leucogenys	GAU	0.98864	0.93182
Cichlopsis leucogenys	GLM	0.91839	0.79545
Cichlopsis leucogenys	MLK	0.90393	0.70455
Cichlopsis leucogenys	MXS	0.96074	0.84091
Cichlopsis leucogenys	RDF	0.99483	0.95455
Cichlopsis leucogenys	SVM	0.99535	0.93182
Cyanocorax hafferi	GAM	NA	NA
Cyanocorax hafferi	GAU	1	1
Cyanocorax hafferi	GLM	NA	NA
Cyanocorax hafferi	MLK	0.58333	0.16667
Cyanocorax hafferi	MXS	1	1
Cyanocorax hafferi	RDF	1	1

Cyanocorax hafferi	SVM	1	1
Formicivora paludicola	GAM	0.98817	0.92308
Formicivora paludicola	GAU	1	1
Formicivora paludicola	GLM	1	1
Formicivora paludicola	MLK	0.92308	0.92308
Formicivora paludicola	MXS	1	1
Formicivora paludicola	RDF	1	1
Formicivora paludicola	SVM	1	1
Nyctibius aethereus aethereus	GAM	0.92562	0.81818
Nyctibius aethereus aethereus	GAU	0.98347	0.90909
Nyctibius aethereus aethereus	GLM	0.88843	0.68182
Nyctibius aethereus aethereus	MLK	0.77479	0.72727
Nyctibius aethereus aethereus	MXS	0.98347	0.95455
Nyctibius aethereus aethereus	RDF	0.98554	0.95455
Nyctibius aethereus aethereus	SVM	0.99587	0.95455
Ortalis remota	GAM	NA	NA
Ortalis remota	GAU	0.83333	0.83333
Ortalis remota	GLM	NA	NA
Ortalis remota	MLK	0.91667	0.83333
Ortalis remota	MXS	0.83333	0.83333
Ortalis remota	RDF	0.875	0.83333
Ortalis remota	SVM	0.83333	0.83333
Phaethornis bourcieri major	GAM	0.91358	0.88889
Phaethornis bourcieri major	GAU	1	1
Phaethornis bourcieri major	GLM	0.85185	0.66667
Phaethornis bourcieri major	MLK	0.92593	0.88889
Phaethornis bourcieri major	MXS	1	1
Phaethornis bourcieri major	RDF	1	1
Phaethornis bourcieri major	SVM	1	1
Phaethornis margarettae camargoi	GAM	0.95845	0.94737
Phaethornis margarettae camargoi	GAU	0.99446	0.94737
Phaethornis margarettae camargoi	GLM	0.94737	0.89474
Phaethornis margarettae camargoi	MLK	0.65789	0.31579
Phaethornis margarettae camargoi	MXS	1	1
Phaethornis margarettae camargoi	RDF	1	1

Phaethornis margarettae camargoi	SVM	1	1
Sclerurus macconnelli bahiae	GAM	0.94231	0.88462
Sclerurus macconnelli bahiae	GAU	0.97189	0.88462
Sclerurus macconnelli bahiae	GLM	0.93935	0.88462
Sclerurus macconnelli bahiae	MLK	0.9645	0.80769
Sclerurus macconnelli bahiae	MXS	0.97189	0.84615
Sclerurus macconnelli bahiae	RDF	0.99408	0.92308
Sclerurus macconnelli bahiae	SVM	0.96006	0.92308
Strix huhula albomarginata	GAM	0.79365	0.57143
Strix huhula albomarginata	GAU	0.85488	0.61905
Strix huhula albomarginata	GLM	0.72109	0.61905
Strix huhula albomarginata	MLK	0.60771	0.28571
Strix huhula albomarginata	MXS	0.86395	0.61905
Strix huhula albomarginata	RDF	0.80952	0.7619
Strix huhula albomarginata	SVM	0.96825	0.80952
Trogon collaris eytoni	GAM	0.69136	0.55556
Trogon collaris eytoni	GAU	1	1
Trogon collaris eytoni	GLM	0.95062	0.77778
Trogon collaris eytoni	MLK	0.83951	0.77778
Trogon collaris eytoni	MXS	1	1
Trogon collaris eytoni	RDF	1	1
Trogon collaris eytoni	SVM	1	1
Xenops minutus alagoanus	GAM	0.89286	0.78571
Xenops minutus alagoanus	GAU	1	1
Xenops minutus alagoanus	GLM	0.71939	0.64286
Xenops minutus alagoanus	MLK	0.78571	0.57143
Xenops minutus alagoanus	MXS	1	1
Xenops minutus alagoanus	RDF	1	1
Xenops minutus alagoanus	SVM	1	1
Xiphocolaptes carajaensis	GAM	NA	NA
Xiphocolaptes carajaensis	GAU	1	1
Xiphocolaptes carajaensis	GLM	NA	NA
Xiphocolaptes carajaensis	MLK	0.8	0.6
Xiphocolaptes carajaensis	MXS	1	1
Xiphocolaptes carajaensis	RDF	1	1

Xiphocolaptes carajaensis	SVM	1	1
MAMMALS			
Alouatta belzebul	GAM	0.96775	0.90164
Alouatta belzebul	GAU	0.97286	0.88525
Alouatta belzebul	GLM	0.96802	0.84426
Alouatta belzebul	MLK	0.96621	0.84426
Alouatta belzebul	MXS	0.9736	0.86066
Alouatta belzebul	RDF	0.98502	0.95082
Alouatta belzebul	SVM	0.97259	0.90164
Alouatta clamitans	GAM	0.96903	0.89431
Alouatta clamitans	GAU	0.98164	0.9065
Alouatta clamitans	GLM	0.89631	0.73171
Alouatta clamitans	MLK	0.89363	0.69512
Alouatta clamitans	MXS	0.9812	0.90244
Alouatta clamitans	RDF	0.99207	0.95528
Alouatta clamitans	SVM	0.98939	0.94715
Alouatta discolor	GAM	0.891	0.83871
Alouatta discolor	GAU	0.91103	0.79032
Alouatta discolor	GLM	0.79709	0.67742
Alouatta discolor	MLK	0.87435	0.69355
Alouatta discolor	MXS	0.94485	0.77419
Alouatta discolor	RDF	0.98959	0.8871
Alouatta discolor	SVM	0.95968	0.91935
Alouatta guariba	GAM	0.9257	0.80357
Alouatta guariba	GAU	0.97321	0.85714
Alouatta guariba	GLM	0.9206	0.71429
Alouatta guariba	MLK	0.91709	0.64286
Alouatta guariba	MXS	0.96811	0.83929
Alouatta guariba	RDF	0.99522	0.92857
Alouatta guariba	SVM	0.97066	0.91071
Alouatta ululata	GAM	0.99931	0.97368
Alouatta ululata	GAU	0.99792	0.94737
Alouatta ululata	GLM	0.98546	0.94737
Alouatta ululata	MLK	0.97853	0.92105
Alouatta ululata	MXS	1	1

Alouatta ululata	RDF	1	1
Alouatta ululata	SVM	0.99861	0.97368
Ateles belzebuth	GAM	0.90151	0.78947
Ateles belzebuth	GAU	0.90366	0.78947
Ateles belzebuth	GLM	0.88089	0.70175
Ateles belzebuth	MLK	0.86611	0.70175
Ateles belzebuth	MXS	0.90551	0.73684
Ateles belzebuth	RDF	0.96584	0.82456
Ateles belzebuth	SVM	0.90797	0.78947
Ateles chamek	GAM	0.87019	0.66667
Ateles chamek	GAU	0.90204	0.71795
Ateles chamek	GLM	0.86778	0.59829
Ateles chamek	MLK	0.8333	0.58974
Ateles chamek	MXS	0.89992	0.69231
Ateles chamek	RDF	0.98261	0.86325
Ateles chamek	SVM	0.93257	0.73504
Ateles marginatus	GAM	0.95508	0.88889
Ateles marginatus	GAU	0.94616	0.83333
Ateles marginatus	GLM	0.88237	0.75926
Ateles marginatus	MLK	0.90672	0.7963
Ateles marginatus	MXS	0.97291	0.83333
Ateles marginatus	RDF	0.99143	0.90741
Ateles marginatus	SVM	0.98937	0.96296
Atelocynus microtis	GAM	0.9136	0.7
Atelocynus microtis	GAU	0.9224	0.74
Atelocynus microtis	GLM	0.8944	0.68
Atelocynus microtis	MLK	0.9088	0.72
Atelocynus microtis	MXS	0.922	0.78
Atelocynus microtis	RDF	0.976	0.9
Atelocynus microtis	SVM	0.9216	0.8
Blastocerus dichotomus	GAM	0.84483	0.63636
Blastocerus dichotomus	GAU	0.90066	0.68831
Blastocerus dichotomus	GLM	0.80924	0.57143
Blastocerus dichotomus	MLK	0.80891	0.54545
Blastocerus dichotomus	MXS	0.89172	0.66234

Blastocerus dichotomus	RDF	0.96357	0.77922
Blastocerus dichotomus	SVM	0.93388	0.72727
Brachyteles arachnoides	GAM	0.99782	0.96386
Brachyteles arachnoides	GAU	0.99492	0.93976
Brachyteles arachnoides	GLM	0.98461	0.87952
Brachyteles arachnoides	MLK	0.96894	0.79518
Brachyteles arachnoides	MXS	0.99594	0.95181
Brachyteles arachnoides	RDF	0.99681	0.96386
Brachyteles arachnoides	SVM	0.99782	0.95181
Brachyteles hypoxanthus	GAM	0.94687	0.93506
Brachyteles hypoxanthus	GAU	0.98971	0.94805
Brachyteles hypoxanthus	GLM	0.90842	0.80519
Brachyteles hypoxanthus	MLK	0.89121	0.74026
Brachyteles hypoxanthus	MXS	0.97285	0.87013
Brachyteles hypoxanthus	RDF	0.99916	0.97403
Brachyteles hypoxanthus	SVM	0.99814	0.97403
Bradypus torquatus	GAM	0.98699	0.94393
Bradypus torquatus	GAU	0.99624	0.93458
Bradypus torquatus	GLM	0.97554	0.8785
Bradypus torquatus	MLK	0.95336	0.83178
Bradypus torquatus	MXS	0.99214	0.94393
Bradypus torquatus	RDF	0.99983	0.99065
Bradypus torquatus	SVM	0.99939	0.98131
Cacajao hosomi	GAM	1	1
Cacajao hosomi	GAU	0.99723	0.94737
Cacajao hosomi	GLM	0.95014	0.94737
Cacajao hosomi	MLK	0.99446	0.94737
Cacajao hosomi	MXS	0.98338	0.89474
Cacajao hosomi	RDF	1	1
Cacajao hosomi	SVM	1	1
Callicebus barbarabrownae	GAM	0.951	0.90141
Callicebus barbarabrownae	GAU	1	1
Callicebus barbarabrownae	GLM	0.97858	0.92958
Callicebus barbarabrownae	MLK	0.9875	0.88732
Callicebus barbarabrownae	MXS	1	1

Callicebus barbarabrownae	RDF	1	1
Callicebus barbarabrownae	SVM	1	1
Callicebus coimbrai	GAM	0.99373	0.93814
Callicebus coimbrai	GAU	0.99915	0.97938
Callicebus coimbrai	GLM	0.97917	0.94845
Callicebus coimbrai	MLK	0.98682	0.96907
Callicebus coimbrai	MXS	0.9983	0.96907
Callicebus coimbrai	RDF	0.99979	0.98969
Callicebus coimbrai	SVM	0.99957	0.97938
Callicebus melanochir	GAM	0.98748	0.95652
Callicebus melanochir	GAU	0.99764	0.97826
Callicebus melanochir	GLM	0.98275	0.92391
Callicebus melanochir	MLK	0.99823	0.97826
Callicebus melanochir	MXS	0.99681	0.95652
Callicebus melanochir	RDF	0.99764	0.98913
Callicebus melanochir	SVM	0.99988	0.98913
Callicebus personatus	GAM	0.96729	0.92308
Callicebus personatus	GAU	0.98356	0.89744
Callicebus personatus	GLM	0.91667	0.80769
Callicebus personatus	MLK	0.91732	0.73077
Callicebus personatus	MXS	0.98126	0.89744
Callicebus personatus	RDF	0.99063	0.94872
Callicebus personatus	SVM	0.98669	0.97436
Callistomys pictus	GAM	0.88889	0.88889
Callistomys pictus	GAU	0.98765	0.88889
Callistomys pictus	GLM	1	1
Callistomys pictus	MLK	1	1
Callistomys pictus	MXS	1	1
Callistomys pictus	RDF	1	1
Callistomys pictus	SVM	0.95062	0.88889
Callithrix aurita	GAM	0.97306	0.9
Callithrix aurita	GAU	0.99397	0.94545
Callithrix aurita	GLM	0.98058	0.91818
Callithrix aurita	MLK	0.96628	0.86364
Callithrix aurita	MXS	0.99421	0.95455

Callithrix aurita	RDF	0.99785	0.98182
Callithrix aurita	SVM	0.99992	0.99091
Callithrix flaviceps	GAM	0.98988	0.97183
Callithrix flaviceps	GAU	0.99345	0.95775
Callithrix flaviceps	GLM	0.89744	0.84507
Callithrix flaviceps	MLK	0.91867	0.85915
Callithrix flaviceps	MXS	0.99425	0.94366
Callithrix flaviceps	RDF	0.99861	0.98592
Callithrix flaviceps	SVM	0.9994	0.98592
Caluromysiops irrupta	GAM	0.85799	0.61538
Caluromysiops irrupta	GAU	0.87574	0.69231
Caluromysiops irrupta	GLM	0.85207	0.61538
Caluromysiops irrupta	MLK	0.84615	0.76923
Caluromysiops irrupta	MXS	0.87574	0.69231
Caluromysiops irrupta	RDF	0.92308	0.92308
Caluromysiops irrupta	SVM	0.87574	0.69231
Cebus kaapori	GAM	0.97501	0.95918
Cebus kaapori	GAU	0.97293	0.91837
Cebus kaapori	GLM	0.93919	0.81633
Cebus kaapori	MLK	0.96418	0.81633
Cebus kaapori	MXS	0.99209	0.93878
Cebus kaapori	RDF	0.98251	0.95918
Cebus kaapori	SVM	0.98501	0.91837
Chaetomys subspinosus	GAM	0.91493	0.82609
Chaetomys subspinosus	GAU	0.95747	0.93478
Chaetomys subspinosus	GLM	0.91541	0.80435
Chaetomys subspinosus	MLK	0.91163	0.73913
Chaetomys subspinosus	MXS	0.96645	0.86957
Chaetomys subspinosus	RDF	0.99055	0.95652
Chaetomys subspinosus	SVM	0.98251	0.95652
Chiropotes satanas	GAM	0.98398	0.92453
Chiropotes satanas	GAU	0.97223	0.90566
Chiropotes satanas	GLM	0.9733	0.88679
Chiropotes satanas	MLK	0.96155	0.88679
Chiropotes satanas	MXS	0.97401	0.88679

Chiropotes satanas	RDF	0.98825	0.9434
Chiropotes satanas	SVM	0.98718	0.9434
Chiropotes utahickae	GAM	0.92438	0.80556
Chiropotes utahickae	GAU	0.9321	0.83333
Chiropotes utahickae	GLM	0.92593	0.75
Chiropotes utahickae	MLK	0.91744	0.75
Chiropotes utahickae	MXS	0.97299	0.86111
Chiropotes utahickae	RDF	0.95833	0.86111
Chiropotes utahickae	SVM	0.9591	0.86111
Chrysocyon brachyurus	GAM	0.9648	0.85333
Chrysocyon brachyurus	GAM	0.98791	0.92
Chrysocyon brachyurus	GAU	0.98187	0.92
Chrysocyon brachyurus	GAU	0.99236	0.96
Chrysocyon brachyurus	GLM	0.95822	0.8
Chrysocyon brachyurus	GLM	0.96853	0.86667
Chrysocyon brachyurus	MLK	0.95787	0.78667
Chrysocyon brachyurus	MLK	0.96516	0.8
Chrysocyon brachyurus	MXS	0.98933	0.90667
Chrysocyon brachyurus	MXS	0.99218	0.90667
Chrysocyon brachyurus	RDF	0.99609	0.96
Chrysocyon brachyurus	RDF	0.99964	0.98667
Chrysocyon brachyurus	SVM	0.98844	0.94667
Chrysocyon brachyurus	SVM	0.99947	0.97333
Ctenomys flamarioni	GAM	NA	NA
Ctenomys flamarioni	GAU	1	1
Ctenomys flamarioni	GLM	NA	NA
Ctenomys flamarioni	MLK	0.8	0.6
Ctenomys flamarioni	MXS	1	1
Ctenomys flamarioni	RDF	1	1
Ctenomys flamarioni	SVM	1	1
Eptesicus taddeii	GAM	1	1
Eptesicus taddeii	GAU	1	1
Eptesicus taddeii	GLM	1	1
Eptesicus taddeii	MLK	0.96	0.9
Eptesicus taddeii	MXS	1	1

Eptesicus taddeii	RDF	1	1
Eptesicus taddeii	SVM	1	1
Furipterus horrens	GAM	0.56805	0.23077
Furipterus horrens	GAU	0.80473	0.69231
Furipterus horrens	GLM	0.63905	0.53846
Furipterus horrens	MLK	0.63905	0.30769
Furipterus horrens	MXS	0.79882	0.53846
Furipterus horrens	RDF	0.98817	0.92308
Furipterus horrens	SVM	0.89941	0.69231
Glyphonycteris behnii	GAM	NA	NA
Glyphonycteris behnii	GAU	0.92	0.8
Glyphonycteris behnii	GLM	NA	NA
Glyphonycteris behnii	MLK	0.92	0.8
Glyphonycteris behnii	MXS	0.96	0.8
Glyphonycteris behnii	RDF	1	1
Glyphonycteris behnii	SVM	0.92	0.8
Lagothrix cana	GAM	0.95748	0.88889
Lagothrix cana	GAU	0.96571	0.85185
Lagothrix cana	GLM	0.87654	0.7037
Lagothrix cana	MLK	0.8546	0.62963
Lagothrix cana	MXS	0.94787	0.81481
Lagothrix cana	RDF	0.99451	0.92593
Lagothrix cana	SVM	0.9904	0.88889
Lagothrix lagothricha	GAM	NA	NA
Lagothrix lagothricha	GAU	0.97222	0.83333
Lagothrix lagothricha	GLM	NA	NA
Lagothrix lagothricha	MLK	0.86111	0.83333
Lagothrix lagothricha	MXS	0.97222	0.83333
Lagothrix lagothricha	RDF	0.97222	0.83333
Lagothrix lagothricha	SVM	1	1
Lagothrix poeppigii	GAM	0.9	0.8
Lagothrix poeppigii	GAU	1	1
Lagothrix poeppigii	GLM	0.7	0.7
Lagothrix poeppigii	MLK	1	1
Lagothrix poeppigii	MXS	1	1

Lagothrix poeppigii	RDF	1	1
Lagothrix poeppigii	SVM	1	1
Leontopithecus caissara	GAM	1	1
Leontopithecus caissara	GAU	1	1
Leontopithecus caissara	GLM	0.9375	0.9375
Leontopithecus caissara	MLK	1	1
Leontopithecus caissara	MXS	1	1
Leontopithecus caissara	RDF	1	1
Leontopithecus caissara	SVM	1	1
Leontopithecus chrysomelas	GAM	0.99237	0.95833
Leontopithecus chrysomelas	GAU	0.99623	0.95833
Leontopithecus chrysomelas	GLM	0.9796	0.93981
Leontopithecus chrysomelas	MLK	0.9806	0.93056
Leontopithecus chrysomelas	MXS	0.99543	0.96759
Leontopithecus chrysomelas	RDF	0.9997	0.98148
Leontopithecus chrysomelas	SVM	0.99959	0.98611
Leontopithecus chrysopygus	GAM	0.9838	0.97222
Leontopithecus chrysopygus	GAU	0.97917	0.97222
Leontopithecus chrysopygus	GLM	0.87886	0.83333
Leontopithecus chrysopygus	MLK	0.84105	0.72222
Leontopithecus chrysopygus	MXS	0.99151	0.97222
Leontopithecus chrysopygus	RDF	0.9946	0.97222
Leontopithecus chrysopygus	SVM	0.97531	0.97222
Leontopithecus rosalia	GAM	0.99927	0.98438
Leontopithecus rosalia	GAU	0.99976	0.98438
Leontopithecus rosalia	GLM	0.92188	0.90625
Leontopithecus rosalia	MLK	0.9751	0.84375
Leontopithecus rosalia	MXS	0.99951	0.98438
Leontopithecus rosalia	RDF	1	1
Leontopithecus rosalia	SVM	1	1
Leopardus geoffroyi	GAM	0.89979	0.64167
Leopardus geoffroyi	GAU	0.9175	0.70833
Leopardus geoffroyi	GLM	0.78674	0.59167
Leopardus geoffroyi	MLK	0.70882	0.46667
Leopardus geoffroyi	MXS	0.89708	0.65833

Leopardus geoffroyi	RDF	0.96833	0.89167
Leopardus geoffroyi	SVM	0.93667	0.76667
Leopardus guttulus	GAM	0.97522	0.87963
Leopardus guttulus	GAU	0.98594	0.89815
Leopardus guttulus	GLM	0.91264	0.68519
Leopardus guttulus	MLK	0.90295	0.66667
Leopardus guttulus	MXS	0.98294	0.86111
Leopardus guttulus	RDF	0.99177	0.93519
Leopardus guttulus	SVM	0.98551	0.88889
Leopardus tigrinus	GAM	0.80424	0.55128
Leopardus tigrinus	GAU	0.85092	0.61538
Leopardus tigrinus	GLM	0.80375	0.53846
Leopardus tigrinus	MLK	0.7975	0.51282
Leopardus tigrinus	MXS	0.83613	0.60256
Leopardus tigrinus	RDF	0.94412	0.78205
Leopardus tigrinus	SVM	0.85881	0.65385
Leopardus wiedii	GAM	0.85383	0.64198
Leopardus wiedii	GAU	0.9023	0.67901
Leopardus wiedii	GLM	0.7476	0.4321
Leopardus wiedii	MLK	0.74821	0.41975
Leopardus wiedii	MXS	0.86938	0.67901
Leopardus wiedii	RDF	0.9779	0.8642
Leopardus wiedii	SVM	0.91724	0.77778
Lonchophylla dekeyseri	GAM	0.9414	0.86957
Lonchophylla dekeyseri	GAU	0.98866	0.91304
Lonchophylla dekeyseri	GLM	0.93573	0.82609
Lonchophylla dekeyseri	MLK	0.90737	0.73913
Lonchophylla dekeyseri	MXS	0.97164	0.86957
Lonchophylla dekeyseri	RDF	1	1
Lonchophylla dekeyseri	SVM	0.98299	0.86957
Lonchorhina aurita	GAM	0.8736	0.68
Lonchorhina aurita	GAU	0.8448	0.64
Lonchorhina aurita	GLM	0.7984	0.44
Lonchorhina aurita	MLK	0.816	0.56
Lonchorhina aurita	MXS	0.8816	0.64

Lonchorhina aurita	RDF	0.9504	0.84
Lonchorhina aurita	SVM	0.8448	0.68
Lycalopex vetulus	GAM	0.93367	0.78571
Lycalopex vetulus	GAU	0.96939	0.82143
Lycalopex vetulus	GLM	0.95536	0.85714
Lycalopex vetulus	MLK	0.9477	0.82143
Lycalopex vetulus	MXS	0.95918	0.82143
Lycalopex vetulus	RDF	0.99235	0.92857
Lycalopex vetulus	SVM	0.96811	0.82143
Marmosops paulensis	GAM	0.98633	0.90625
Marmosops paulensis	GAU	0.98926	0.90625
Marmosops paulensis	GLM	0.95996	0.8125
Marmosops paulensis	MLK	0.97266	0.84375
Marmosops paulensis	MXS	0.99414	0.9375
Marmosops paulensis	RDF	0.99805	0.96875
Marmosops paulensis	SVM	0.99805	0.96875
Mazama bororo	GAM	NA	NA
Mazama bororo	GAU	1	1
Mazama bororo	GLM	NA	NA
Mazama bororo	MLK	0.7	0.4
Mazama bororo	MXS	1	1
Mazama bororo	RDF	1	1
Mazama bororo	SVM	1	1
Mazama nana	GAM	0.99196	0.91892
Mazama nana	GAU	0.99781	0.97297
Mazama nana	GLM	0.94814	0.86486
Mazama nana	MLK	0.87801	0.72973
Mazama nana	MXS	0.99343	0.94595
Mazama nana	RDF	1	1
Mazama nana	SVM	1	1
Mico rondoni	GAM	0.84917	0.81818
Mico rondoni	GAU	0.97727	0.95455
Mico rondoni	GLM	0.93802	0.86364
Mico rondoni	MLK	0.58678	0.5
Mico rondoni	MXS	0.94215	0.86364

Mico rondoni	RDF	1	1
Mico rondoni	SVM	0.95868	0.90909
Myrmecophaga tridactyla	GAM	0.80894	0.49029
Myrmecophaga tridactyla	GAU	0.84447	0.53398
Myrmecophaga tridactyla	GLM	0.72151	0.3932
Myrmecophaga tridactyla	MLK	0.73539	0.36893
Myrmecophaga tridactyla	MXS	0.82491	0.50485
Myrmecophaga tridactyla	RDF	0.96604	0.81553
Myrmecophaga tridactyla	SVM	0.87077	0.6165
Natalus macrourus	GAM	0.88967	0.73214
Natalus macrourus	GAU	0.89668	0.67857
Natalus macrourus	GLM	0.76148	0.5
Natalus macrourus	MLK	0.80325	0.55357
Natalus macrourus	MXS	0.95026	0.76786
Natalus macrourus	RDF	0.98438	0.94643
Natalus macrourus	SVM	0.93559	0.75
Ozotoceros bezoarticus	GAM	0.90667	0.73333
Ozotoceros bezoarticus	GAU	0.92198	0.71111
Ozotoceros bezoarticus	GLM	0.81235	0.51111
Ozotoceros bezoarticus	MLK	0.8079	0.62222
Ozotoceros bezoarticus	MXS	0.94815	0.82222
Ozotoceros bezoarticus	RDF	0.9916	0.93333
Ozotoceros bezoarticus	SVM	0.95407	0.8
Panthera onca	GAM	0.74325	0.41558
Panthera onca	GAU	0.76564	0.42208
Panthera onca	GLM	0.63999	0.27273
Panthera onca	MLK	0.63	0.31818
Panthera onca	MXS	0.73583	0.36364
Panthera onca	RDF	0.93329	0.7987
Panthera onca	SVM	0.7656	0.46753
Phyllomys brasiliensis	GAM	NA	NA
Phyllomys brasiliensis	GAU	1	1
Phyllomys brasiliensis	GLM	NA	NA
Phyllomys brasiliensis	MLK	0.96	0.8
Phyllomys brasiliensis	MXS	1	1

Phyllomys brasiliensis	RDF	1	1
Phyllomys brasiliensis	SVM	1	1
Priodontes maximus	GAM	0.8027	0.48201
Priodontes maximus	GAU	0.81549	0.51079
Priodontes maximus	GLM	0.73801	0.45324
Priodontes maximus	MLK	0.7495	0.43885
Priodontes maximus	MXS	0.81797	0.47482
Priodontes maximus	RDF	0.96398	0.84173
Priodontes maximus	SVM	0.83816	0.59712
Ptenoura brasiliensis	GAM	0.83471	0.56693
Ptenoura brasiliensis	GAU	0.83849	0.56693
Ptenoura brasiliensis	GLM	0.8158	0.56693
Ptenoura brasiliensis	MLK	0.78858	0.48031
Ptenoura brasiliensis	MXS	0.83117	0.5748
Ptenoura brasiliensis	RDF	0.95883	0.7874
Ptenoura brasiliensis	SVM	0.86645	0.64567
Puma concolor	GAM	0.73581	0.37255
Puma concolor	GAU	0.77324	0.39216
Puma concolor	GLM	0.67749	0.29412
Puma concolor	MLK	0.68249	0.28105
Puma concolor	MXS	0.7314	0.37582
Puma concolor	RDF	0.95693	0.78105
Puma concolor	SVM	0.78893	0.43791
Puma yagouarondi	GAM	0.72219	0.35135
Puma yagouarondi	GAU	0.77928	0.42703
Puma yagouarondi	GLM	0.65224	0.23243
Puma yagouarondi	MLK	0.6353	0.23784
Puma yagouarondi	MXS	0.73329	0.36757
Puma yagouarondi	RDF	0.95293	0.76757
Puma yagouarondi	SVM	0.80877	0.48108
Saguinus bicolor	GAM	0.98616	0.88235
Saguinus bicolor	GAU	1	1
Saguinus bicolor	GLM	0.90311	0.88235
Saguinus bicolor	MLK	0.90311	0.88235
Saguinus bicolor	MXS	1	1

Saguinus bicolor	RDF	1	1
Saguinus bicolor	SVM	1	1
Saguinus niger	GAM	0.976	0.92
Saguinus niger	GAU	0.984	0.96
Saguinus niger	GLM	0.9744	0.84
Saguinus niger	MLK	0.9552	0.76
Saguinus niger	MXS	0.9888	0.96
Saguinus niger	RDF	1	1
Saguinus niger	SVM	0.9856	0.96
Sapajus cay	GAM	0.86427	0.78947
Sapajus cay	GAU	0.95291	0.89474
Sapajus cay	GLM	0.85319	0.78947
Sapajus cay	MLK	0.71468	0.68421
Sapajus cay	MXS	0.96953	0.94737
Sapajus cay	RDF	0.95291	0.84211
Sapajus cay	SVM	0.98338	0.94737
Sapajus flavius	GAM	0.99376	0.93548
Sapajus flavius	GAU	1	1
Sapajus flavius	GLM	0.94485	0.80645
Sapajus flavius	MLK	0.98023	0.87097
Sapajus flavius	MXS	0.99896	0.96774
Sapajus flavius	RDF	1	1
Sapajus flavius	SVM	1	1
Sapajus robustus	GAM	0.9826	0.90625
Sapajus robustus	GAU	0.98987	0.89844
Sapajus robustus	GLM	0.93353	0.78125
Sapajus robustus	MLK	0.93304	0.78906
Sapajus robustus	MXS	0.97888	0.83594
Sapajus robustus	RDF	0.99908	0.97656
Sapajus robustus	SVM	0.99756	0.94531
Sapajus xanthosternos	GAM	0.96995	0.90826
Sapajus xanthosternos	GAU	0.99301	0.92661
Sapajus xanthosternos	GLM	0.9713	0.85321
Sapajus xanthosternos	MLK	0.95834	0.82569
Sapajus xanthosternos	MXS	0.97492	0.91743

Sapajus xanthosternos	RDF	0.99933	0.98165
Sapajus xanthosternos	SVM	0.99739	0.9633
Speothos venaticus	GAM	0.71702	0.37727
Speothos venaticus	GAU	0.73118	0.35
Speothos venaticus	GLM	0.66488	0.32727
Speothos venaticus	MLK	0.69434	0.32273
Speothos venaticus	MXS	0.72981	0.36364
Speothos venaticus	RDF	0.939	0.77727
Speothos venaticus	SVM	0.75444	0.42727
Tapirus terrestris	GAM	0.705	0.358
Tapirus terrestris	GAU	0.80059	0.46023
Tapirus terrestris	MLK	0.70464	0.33523
Tapirus terrestris	MXS	0.7583	0.38636
Tapirus terrestris	RDF	0.96785	0.83523
Tapirus terrestris	SVM	0.81214	0.5
Tayassu pecari	GAM	0.732	0.36
Tayassu pecari	GAU	0.81189	0.46032
Tayassu pecari	MLK	0.75483	0.39153
Tayassu pecari	MXS	0.76696	0.43122
Tayassu pecari	RDF	0.95973	0.81746
Tayassu pecari	SVM	0.84708	0.53968
Thalpomys lasiotis	GAM	NA	NA
Thalpomys lasiotis	GAU	1	1
Thalpomys lasiotis	MLK	0.78571	0.57143
Thalpomys lasiotis	MXS	1	1
Thalpomys lasiotis	RDF	1	1
Thalpomys lasiotis	SVM	0.97959	0.85714
Thylamys macrurus	GAM	1	1
Thylamys macrurus	GAU	0.97449	0.92857
Thylamys macrurus	MLK	0.98469	0.92857
Thylamys macrurus	MXS	1	1
Thylamys macrurus	RDF	1	1
Thylamys macrurus	SVM	1	1
Tolypeutes tricinctus	GAM	0.981	0.947
Tolypeutes tricinctus	GAU	0.96082	0.84127

Tolypeutes tricinctus	MLK	0.9384	0.81746
Tolypeutes tricinctus	MXS	0.95736	0.84921
Tolypeutes tricinctus	RDF	0.97354	0.9127
Tolypeutes tricinctus	SVM	0.97323	0.88889
Wilfredomys oenax	GAM	NA	NA
Wilfredomys oenax	GAU	0.97531	0.88889
Wilfredomys oenax	MLK	0.87654	0.77778
Wilfredomys oenax	MXS	1	1
Wilfredomys oenax	RDF	0.97531	0.88889
Wilfredomys oenax	SVM	0.97531	0.88889
Xeronycteris vieirai	GAM	NA	NA
Xeronycteris vieirai	GAU	1	1
Xeronycteris vieirai	MLK	0.97959	0.85714
Xeronycteris vieirai	MXS	0.95918	0.85714
Xeronycteris vieirai	RDF	1	1
Xeronycteris vieirai	SVM	0.97959	0.85714

Table SM1.3. Ensemble model evaluation. N = number of occurrence points. Range= Range sizes in number of cells predicted based on current THR choice. AUC = area under the curve. THR = lowest presence threshold that maximize sensitivity plus specificity. MAX_TSS = TSS based on the threshold that maximize sensitivity plus specificity. OMISS = Omission rate of current threshold. RES=Restrict, it means that only patches of suitable areas with existent occurrence points are includen in the final model. ENS=ensemble, it means that the all suitable areas are includen in the final model

Specie	Model	N	RANGE	AUC	THR	MAX TSS	OMISS
ANPHIBIANS							
Agalychnis granulosa	RES	16	1934	1	0.43332458	1	0
Allobates brunneus	RES	30	98937	0.89666667	0.61231655	0.66666667	0
Allobates goianus	RES	5	1995	1	0.48045745	1	0
Allobates olfersioides	RES	42	24798	0.99886621	0.38172281	0.97619048	0
Bolitoglossa paraensis	RES	5	146	1	0.94467813	1	0
Cycloramphus ohausi	RES	6	62	1	0.77479023	1	0
Holoaden luederwaldti	RES	6	343	1	0.385593	1	0
Hypsiboas curupi	RES	11	593	1	0.81094873	1	0
Hypsiboas semiguttatus	RES	29	4901	1	0.56887192	1	0
Ischnocnema manezinho	RES	6	677	1	0.56833684	1	0

Melanophryniscus cambaraensis	RES	5	59	1	0.86748141	1	0
Melanophryniscus dorsalis	RES	15	970	1	0.28169522	1	0
Melanophryniscus macrogranulosus	RES	6	1887	1	0.57957518	1	0
Paratelmatobius lutzii	RES	5	908	1	0.64489746	1	0
Proceratophrys moratoi	RES	6	69	1	0.95150524	1	0
Scinax duartei	RES	19	4889	1	0.43568707	1	0
Thoropa petropolitana	RES	11	3577	1	0.53575343	1	0
Thoropa saxatilis	RES	14	1081	1	0.53506404	1	0
Xenohyla truncata	RES	11	1701	1	0.44099402	1	0
REPTILES							
Ameivula abaetensis	RES	7	36706	0.97959184	0.40035951	0.85714286	0
Ameivula littoralis	RES	8	108	1	0.82029074	1	0
Ameivula nativo	RES	9	1184	1	0.76108408	1	0
Amerotyphlops amoipira	RES	11	14821	0.97520661	0.82115042	0.81818182	0.18181818
Atractus serranus	RES	10	1495	1	0.44397631	1	0
Calamodontophis paucidens	RES	8	1473	1	0.55529845	1	0
Chelonia mydas	RES	162	27999	0.96922921	0.26964474	0.87422144	0.03816794
Coleodactylus natalensis	RES	12	1050	1	0.63953424	1	0
Colobodactylus dalcyanus	RES	5	500	1	0.66782826	1	0
Contomastix vacariensis	RES	6	1781	1	0.55322701	1	0
Corallus cropanii	RES	5	226	1	0.83155024	1	0
Ditaxodon taeniatus	RES	7	1969	1	0.71904546	1	0
Heterodactylus lundii	RES	17	8853	0.97923875	0.15189332	0.88235294	0
Homonota uruguayensis	RES	9	7172	1	0.64436257	1	0
Hydrodynastes melanogigas	RES	6	3812	1	0.86779541	1	0
Kentropyx vanzoi	RES	9	15193	1	0.4309057	1	0
Leposoma annectans	RES	6	881	1	0.78257406	1	0
Leposoma baturitensis	RES	6	13	1	0.91371918	1	0
Leposoma nanodactylus	RES	5	127	1	0.69038588	1	0
Liolaemus lutzae	RES	7	224	1	0.72327614	1	0
Liolaemus occipitalis	RES	21	327	1	0.58642101	1	0
Mesoclemmys hogei	RES	7	7925	1	0.61603916	1	0
Philodryas livida	RES	8	24162	1	0.64156783	1	0
Stenocercus dumerilii	RES	16	28875	1	0.21423656	1	0
Tropidurus hygomi	RES	11	1260	0.97520661	0.79187363	0.81818182	0.18181818
BIRDS							
Aburria jacutinga	RES	76	20441	0.9890928	0.45100096	0.90789474	0.02631579

Acrobatornis fonsecai	ENS	13	3475	1	0.43119928	1	0
Alectrurus tricolor	ENS	67	50292	0.99509913	0.5108254	0.94029851	0
Amadonastur lacernulatus	ENS	88	25182	0.98411674	0.35757691	0.875	0
Amazona pretrei	ENS	38	5329	1	0.52266026	1	0
Amazona rhodocorytha	ENS	86	16287	0.99296822	0.44940892	0.94252874	0
Amazona vinacea	ENS	141	19017	0.99331307	0.49479035	0.92887538	0.02857143
Anodorhynchus leari	ENS	23	5411	1	0.47918513	1	0
Anthus nattereri	ENS	56	11810	0.98786718	0.72741628	0.98275862	0
Antilophia bokermanni	ENS	14	385	1	0.74435067	1	0
Aratinga solstitialis	ENS	25	79343	0.96551724	0.4488894	0.82758621	0
Arremonops conirostris	ENS	963	34966	0.96662059	0.47451144	0.84951821	0.03222453
Asthenes hudsoni	ENS	48	7221	1	0.45123485	1	0
Augastes lumachella	ENS	22	8087	1	0.67908967	1	0
Automolus lammi	ENS	12	1072	1	0.48189548	1	0
Campylorhamphus cardosoi	ENS	21	29896	1	0.545663	1	0
Campylorhamphus multostriatus	ENS	8	25948	1	0.77062774	1	0
Capito dayi	ENS	55	39649	0.98413223	0.48606089	0.89090909	0
Carpornis melanocephala	ENS	99	5299	0.99020508	0.43988436	0.91919192	0.06060606
Caryothraustes canadensis frontalis	ENS	7	169	1	0.91500616	1	0
Celeus obrieni	ENS	13	9578	1	0.63917196	1	0
Celeus torquatus pieteroyensi	ENS	5	10038	1	0.61133027	1	0
Celeus torquatus tinnunculus	ENS	20	5625	0.955	0.31993505	0.95	0
Cercomacra ferdinandi	ENS	29	18642	0.99881094	0.52988255	0.96551724	0
Chamaeza nobilis fulvipectus	ENS	9	7112	1	0.66873789	1	0
Cichlopsis leucogenys	ENS	44	37957	0.99741736	0.42706949	0.95454545	0
Circus cinereus	ENS	865	43598	0.93673469	0.63645332	0.75574299	0.08439306
Claravis geoffroyi	ENS	22	12867	0.99793388	0.37231115	0.95454545	0
Columbina cyanopis	ENS	6	10871	1	0.74137521	1	0
Conopophaga lineata cearae	ENS	15	2877	1	0.62260467	1	0
Conopophaga melanops nigrifrons	ENS	16	745	1	0.50089848	1	0
Conothraupis mesoleuca	ENS	5	6576	1	0.83361578	1	0
Coryphaspiza melanotis	ENS	58	60633	0.93757432	0.60760993	0.81034483	0.01724138
Coryphistera alaudina	ENS	501	24796	0.98111561	0.61061603	0.91616766	0.00199601
Cotinga maculata	ENS	32	15388	0.99511719	0.34407237	0.96875	0.03125
Cranioleuca muelleri	ENS	10	16596	1	0.63963896	1	0
Crax blumenbachii	ENS	25	16803	1	0.37840471	1	0

Crax fasciolata pinima	ENS	26	30837	0.95857988	0.59698367	0.84615385	0
Crax globulosa	ENS	19	20630	0.99722992	0.50259787	0.94736842	0
Crypturellus noctivagus noctivagus	ENS	25	25845	0.9872	0.4471336	0.92	0
Crypturellus noctivagus zabele	ENS	17	43348	0.98961938	0.40148902	0.88235294	0
Curaeus forbesi	ENS	29	13891	0.98929845	0.47183341	0.93103448	0.03448276
Cyanocorax hafferi	ENS	6	6567	1	0.82890207	1	0
Cyanopsitta spixii	ENS	10	2974	1	0.69983631	1	0
Dendrexetastes rufigula paraensis	ENS	11	37310	0.92561983	0.6999256	0.72727273	0
Dendrocincla merula badia	ENS	9	14709	0.95061728	0.34384146	0.77777778	0
Dendrocincla taunayi	ENS	13	675	1	0.51988602	1	0
Dendrocolaptes medius	ENS	9	27674	0.9382716	0.4011794	0.77777778	0
Dryocopus galeatus	ENS	66	13415	0.9947061	0.38146532	0.96385542	0
Dysithamnus plumbeus	ENS	39	20328	0.99079553	0.56527585	0.94871795	0
Eleoscytalopus psychopompus	ENS	7	133	1	0.53511369	1	0
Formicivora erythronotos	ENS	7	935	1	0.59720594	1	0
Formicivora grantsaui	ENS	11	1779	1	0.61940074	1	0
Formicivora littoralis	ENS	6	9	1	0.92965633	1	0
Formicivora paludicola	ENS	13	371	1	0.59301162	1	0
Geositta poeciloptera	ENS	43	21239	0.97295836	0.4685671	0.86046512	0.04651163
Glaucis dohrnii	ENS	21	2001	1	0.57443208	1	0
Grallaria varia intercedens	ENS	10	3627	1	0.57278955	1	0
Guaruba guarouba	ENS	26	54003	0.89940828	0.45672515	0.73076923	0
Gubernatrix cristata	ENS	72	31855	0.99266834	0.64755535	0.91742234	0.01408451
Harpia harpyja	ENS	264	92211	0.8799418	0.61193407	0.57751355	0.06818182
Hemitriccus furcatus	ENS	40	9253	0.99375	0.35874078	0.975	0
Hemitriccus kaempferi	ENS	18	658	1	0.41027549	1	0
Hemitriccus mirandae	ENS	34	4470	0.99480969	0.57347161	0.97058824	0.02941176
Herpsilochmus pileatus	ENS	45	19825	0.96987654	0.40513012	0.8	0.13333333
Hylexetastes brigidai	ENS	8	9372	1	0.76362324	1	0
Hylopezus paraensis	ENS	12	34305	0.97916667	0.47133633	0.83333333	0
Hylophilus ochraceiceps rubrifrons	ENS	9	5392	1	0.49385771	1	0
Hypocnemis ochrogyna	ENS	40	25990	0.976875	0.72478753	0.875	0.025
Iodopleura pipra	ENS	52	8981	0.96486686	0.59417939	0.90384615	0.03846154
Iodopleura pipra leucopygia	ENS	17	34286	0.99653979	0.38313061	0.94117647	0

Lepidocolaptes wagleri	ENS	14	5487	1	0.69627821	1	0
Lepidothrix iris	ENS	18	38168	0.97222222	0.50764585	0.83333333	0
Lepidothrix iris iris	ENS	11	5679	1	0.77375603	1	0
Leptasthenura platensis	ENS	272	21572	0.98043204	0.67466211	0.91357031	0.01838235
Leptodon forbesi	ENS	11	485	1	0.57805085	1	0
Lophornis gouldii	ENS	20	32304	0.91	0.77940047	0.85	0
Mergus octosetaceus	ENS	34	7272	0.98183391	0.64074677	0.94117647	0
Merulaxis stresemanni	ENS	10	5796	0.98	0.7050696	0.9	0
Momotus momota marcgraviana	ENS	11	21533	1	0.59714925	1	0
Morphnus guianensis	ENS	114	53271	0.9208002	0.53247356	0.69733687	0.12280702
Myrmeciza ruficaudus	ENS	35	18748	0.99755102	0.38493529	0.94285714	0
Myrmotherula klagesi	ENS	24	6807	0.99131944	0.68324202	0.91666667	0.04166667
Myrmotherula minor	ENS	63	40332	0.98135551	0.35026386	0.87301587	0
Myrmotherula snowi	ENS	10	961	1	0.63667655	1	0
Myrmotherula urosticta	ENS	52	10017	0.99593195	0.38329041	0.96153846	0.01923077
Nemosia rourei	ENS	8	3722	1	0.63577086	1	0
Neomorphus geoffroyi dulcis	ENS	7	7495	1	0.77634299	1	0
Neomorphus squamiger	ENS	7	18887	1	0.72011685	1	0
Neopelma aurifrons	ENS	46	23072	0.9952741	0.55451953	0.95652174	0.02173913
Nothura minor	ENS	26	13478	0.99112426	0.75684637	0.92307692	0
Nyctibius aethereus aethereus	ENS	14	10012	1	0.69096047	1	0
Nyctibius leucopterus	ENS	32	55981	0.94824219	0.43243429	0.84375	0
Odontophorus capueira plumbeicollis	ENS	6	1053	1	0.6369046	1	0
Ortalis remota	ENS	12	9446	0.6875	0.8541984	0.5	0.5
Penelope jacucaca	ENS	50	48573	0.96571429	0.4287045	0.85714286	0
Penelope ochrogaster	ENS	55	25187	0.99603306	0.49057025	0.96363636	0
Penelope pileata	ENS	43	48656	0.97566252	0.44453034	0.88372093	0
Penelope superciliaris alagoensis	ENS	12	455	1	0.73917449	1	0
Phaethornis bourcieri	ENS	131	42069	0.91323349	0.50830919	0.77862595	0.03816794
Phaethornis bourcieri major	ENS	9	12410	0.96296296	0.75070262	0.88888889	0
Phaethornis margarettae	ENS	5	1117	1	0.40458065	1	0
Phaethornis margarettae camargoi	ENS	19	519	1	0.43507314	1	0
Phlegopsis nigromaculata confinis	ENS	11	37136	0.98347107	0.47704563	0.90909091	0

Phlegopsis nigromaculata paraensis	ENS	16	7771	0.9921875	0.51369572	0.9375	0
Phylloscartes beckeri	ENS	14	5563	0.99489796	0.63856113	0.92857143	0
Phylloscartes ceciliae	ENS	20	1502	1	0.49646848	1	0
Phylloscartes roquettei	ENS	18	6595	1	0.60373718	1	0
Piculus paraensis	ENS	9	37217	0.98765432	0.44713226	0.88888889	0
Piculus polyzonus	ENS	10	19566	1	0.4696677	1	0
Picumnus varzeae	ENS	13	906	1	0.74723488	1	0
Pionus reichenowi	ENS	11	2434	1	0.72756237	1	0
Piprites chloris grisescens	ENS	5	19566	0.96	0.68927127	0.8	0
Platyrinchus mystaceus niveigularis	ENS	17	1200	1	0.5484947	1	0
Procnias albus wallacei	ENS	35	33378	0.96408163	0.61956835	0.8	0
Pseudoseisura lophotes	ENS	609	32104	0.9648917	0.70317322	0.85878489	0.01477833
Psophia dextralis	ENS	27	20113	0.97119342	0.70637065	0.96296296	0
Pteroglossus bitorquatus bitorquatus	ENS	18	12683	1	0.61135733	1	0
Pyriglena atra	ENS	27	6422	1	0.40381941	1	0
Pyriglena pernambucensis	ENS	21	692	1	0.48427141	1	0
Pyrilia vulturina	ENS	14	13559	1	0.69273019	1	0
Pyrrhura cruentata	ENS	61	11985	0.97957538	0.46976015	0.8852459	0.06557377
Pyrrhura griseipectus	ENS	10	2517	1	0.65058398	1	0
Pyrrhura lepida	ENS	32	35096	0.92773438	0.62206525	0.84375	0
Pyrrhura lepida lepida	ENS	8	9364	1	0.7041291	1	0
Pyrrhura leucotis	ENS	57	25699	0.9596799	0.53603148	0.84210526	0.01754386
Pyrrhura pfrimeri	ENS	11	842	1	0.83111161	1	0
Rhegmatorhina gymnops	ENS	29	33067	1	0.5691905	1	0
Rhopornis ardesiacus	ENS	23	5868	1	0.40334845	1	0
Schiffornis turdina intermedia	ENS	13	1195	1	0.41754833	1	0
Sclerurus caudacutus umbretta	ENS	5	1735	1	0.79385579	1	0
Sclerurus cearensis	ENS	15	3004	1	0.61835474	1	0
Sclerurus macconnelli bahiae	ENS	26	9312	0.98964497	0.43439415	0.92307692	0
Scytalopus diamantinensis	ENS	16	717	1	0.59602255	1	0
Scytalopus iraiensis	ENS	46	6189	0.99385633	0.65847176	0.95652174	0
Scytalopus novacapitalis	ENS	22	2460	0.99793388	0.64558947	0.95454545	0
Sporagra yarrellii	ENS	36	47207	0.97916667	0.20097773	0.88888889	0
Sporophila beltoni	ENS	6	4248	1	0.52362347	1	0

Sporophila falcirostris	ENS	64	17379	0.99747243	0.47686893	0.97058824	0
Sporophila frontalis	ENS	113	17801	0.9938125	0.46249261	0.95121951	0
Sporophila hypoxantha	ENS	255	33145	0.96937225	0.62412143	0.84860921	0.01960784
Sporophila maximiliani	ENS	14	31192	0.98469388	0.80830753	0.92857143	0.07142857
Sporophila melanogaster	ENS	70	20597	0.99632653	0.38992897	0.95714286	0
Sporophila nigrorufa	ENS	10	10506	1	0.8690688	1	0
Sporophila palustris	ENS	82	25930	0.96921475	0.62787372	0.86585366	0.03658537
Sporophila ruficollis	ENS	145	44077	0.97897741	0.56352174	0.86206897	0.03448276
Stigmatura napensis napensis	ENS	7	6049	1	0.80336499	1	0
Strix huhula albomarginata	ENS	21	39937	0.9569161	0.5752871	0.76190476	0
Stymphalornis acutirostris	ENS	36	2357	1	0.28365013	1	0
Synallaxis infuscata	ENS	26	2050	1	0.49962038	1	0
Synallaxis kollari	ENS	38	6829	1	0.38692135	1	0
Tangara cyanocephala cearensis	ENS	7	674	1	0.43370312	1	0
Tangara fastuosa	ENS	50	9066	0.9948	0.38166085	0.94	0.02
Tangara peruviana	ENS	50	8907	1	0.33904204	1	0
Tangara velia signata	ENS	10	21320	0.95	0.75277007	0.9	0
Taoniscus nanus	ENS	25	20450	0.98717949	0.55135447	0.92307692	0
Terenura sicki	ENS	17	986	0.99653979	0.46371594	0.94117647	0
Thalurania watertonii	ENS	24	855	1	0.5594694	1	0
Thamnophilus aethiops distans	ENS	11	256	1	0.7001285	1	0
Thamnophilus caerulescens cearensis	ENS	10	739	1	0.73000371	1	0
Thamnophilus caerulescens pernambucensis	ENS	8	2836	0.96875	0.63456494	0.875	0
Thamnophilus nigrocinereus	ENS	31	25913	0.95213319	0.50561416	0.90322581	0
Thripophaga macroura	ENS	46	10403	0.9858156	0.50341123	0.95744681	0
Tigrisoma fasciatum	ENS	504	37652	0.95313287	0.45316681	0.77777778	0.12698413
Tijuca condita	ENS	7	1256	1	0.64504492	1	0
Tinamus tao	ENS	214	54719	0.94752817	0.5985741	0.77102804	0.09345794
Touit melanonotus	ENS	25	6691	0.9936	0.43098408	0.96	0.04
Touit surdus	ENS	54	11457	0.98868313	0.53285807	0.90740741	0.07407407
Trogon collaris eytoni	ENS	9	994	1	0.69426912	1	0
Xanthopsar flavus	ENS	114	8602	0.97768544	0.66954917	0.95614035	0.00877193
Xenops minutus alagoanus	ENS	14	637	1	0.63150883	1	0
Xiphocolaptes carajaensis	ENS	5	3304	1	0.89337289	1	0
Xiphocolaptes falcirostris	ENS	16	28690	1	0.64217454	1	0

Xipholena atropurpurea	ENS	34	2242	1	0.61799562	1	0
MAMMALS							
Alouatta belzebul	RES	122	28781	0.96835528	0.35057596	0.90163934	0
Alouatta clamitans	RES	248	21957	0.98289431	0.52166404	0.944	0
Alouatta discolor	RES	62	12363	0.99531738	0.74193138	0.9516129	0.01612903
Alouatta guariba	RES	56	5564	1	0.62529869	1	0
Alouatta ululata	RES	38	3347	1	0.49632588	1	0
Ateles belzebuth	RES	57	23891	0.89381348	0.74354611	0.70175439	0.19298246
Ateles chamek	RES	117	35435	0.96288991	0.69536739	0.82051282	0.07692308
Ateles marginatus	RES	39	14783	0.9620133	0.6381949	0.92592593	0
Atelocynus microtis	RES	50	45505	0.9436	0.48371355	0.8	0.04
Blastocerus dichotomus	RES	77	56207	0.95429246	0.65651094	0.76623377	0.01298701
Brachyteles arachnoides	RES	83	6280	0.99695166	0.3973297	0.97590361	0
Brachyteles hypoxanthus	RES	77	10430	0.99342216	0.71703797	0.96103896	0
Bradypus torquatus	RES	107	3298	0.99240108	0.30226248	0.97196262	0
Cacajao hosomi	RES	19	2953	1	0.6877238	1	0
Callicebus barbarabrownae	RES	71	3976	0.99900813	0.55318106	0.98591549	0
Callicebus coimbrai	RES	98	947	1	0.44111466	1	0
Callicebus melanochir	RES	93	1978	0.99768733	0.40928503	0.9893617	0
Callicebus personatus	RES	78	13608	0.97978304	0.69997983	0.94871795	0
Callistomys pictus	RES	9	2215	1	0.35358665	1	0
Callithrix aurita	RES	110	5648	0.99991736	0.57017756	0.99090909	0
Callithrix flaviceps	RES	71	3420	0.99821464	0.79975281	0.97183099	0
Caluromysiops irrupta	RES	13	26178	1	0.26148947	1	0
Cebus kaapori	RES	49	9560	0.99666805	0.52237762	0.97959184	0
Chaetomys subspinosus	RES	46	4332	0.99952741	0.33770119	0.97826087	0
Chiropotes satanas	RES	53	12835	0.99786401	0.42408059	0.98113208	0
Chiropotes utahickae	RES	36	6250	0.9537037	0.72704195	0.80555556	0.08333333
Chrysocyon brachyurus	RES	75	10652	0.98328889	0.55097672	0.96	0.01333333
Ctenomys flamarioni	RES	5	483	1	0.6292679	1	0
Eptesicus taddeii	RES	10	2165	1	0.76278017	1	0
Furipterus horrens	RES	13	22736	0.96449704	0.77128833	0.84615385	0
Glyphonycteris behnii	RES	5	48979	0.96	0.43285888	0.8	0
Lagothrix cana	RES	27	18874	0.96844993	0.69944807	0.92592593	0
Lagothrix lagothricha	RES	6	6704	1	0.70711582	1	0
Lagothrix poeppigii	RES	10	2704	1	0.81794988	1	0
Leontopithecus caissara	RES	17	368	1	0.38165208	1	0
Leontopithecus chrysomelas	RES	217	4008	0.99728169	0.28274972	0.99082569	0
Leontopithecus chrysopygus	RES	36	1757	0.98919753	0.71043729	0.97222222	0

Leontopithecus rosalia	RES	64	599	1	0.49811103	1	0
Leopardus geoffroyi	RES	120	46072	0.968125	0.70976037	0.86666667	0.025
Leopardus guttulus	RES	108	21522	0.96519204	0.49445372	0.89814815	0.00925926
Leopardus tigrinus	RES	78	63576	0.96252465	0.48137002	0.83333333	0.02564103
Leopardus wiedii	RES	81	48580	0.96890718	0.49515435	0.82716049	0.0617284
Lonchophylla dekeyseri	RES	23	47640	0.92060491	0.5408211	0.73913043	0
Lonchorhina aurita	RES	25	80335	0.9952	0.5170118	0.92	0
Lycalopex vetulus	RES	28	24016	0.96556122	0.6427273	0.85714286	0
Marmosops paulensis	RES	32	9246	0.98730469	0.38951515	0.90625	0
Mazama bororo	RES	5	592	1	0.8112377	1	0
Mazama nana	RES	37	10105	0.9963477	0.47969562	0.97297297	0
Mico rondoni	RES	22	11036	0.95867769	0.67264281	0.86363636	0
Myrmecophaga tridactyla	RES	206	78411	0.90538694	0.71688804	0.67961165	0.0631068
Natalus macrourus	RES	56	29765	0.97576531	0.77243296	0.92857143	0
Ozotoceros bezoarticus	RES	45	49180	0.96592593	0.68792058	0.91111111	0
Panthera onca	RES	154	97282	0.88189408	0.60431017	0.61038961	0.07792208
Phyllomys brasiliensis	RES	5	361	1	0.9509651	1	0
Priodontes maximus	RES	139	62405	0.91061539	0.80413046	0.71942446	0.07913669
Ptenoura brasiliensis	RES	127	69976	0.90805382	0.6461562	0.75590551	0.04724409
Puma concolor	RES	307	71244	0.83860665	0.63640755	0.51453612	0.26143791
Puma yagouarondi	RES	185	101593	0.84686633	0.51087652	0.56216216	0.10810811
Saguinus bicolor	RES	17	2359	1	0.56273494	1	0
Saguinus niger	RES	25	12996	0.9968	0.59228536	0.96	0.04
Sapajus cay	RES	19	5664	1	0.72053108	1	0
Sapajus flavius	RES	32	748	1	0.54691954	1	0
Sapajus robustus	RES	129	6411	0.99513221	0.62874396	0.96923077	0
Sapajus xanthosternos	RES	110	7719	0.99512356	0.52312513	0.98198198	0
Speothos venaticus	RES	221	93294	0.84619165	0.57460066	0.57117117	0.1
Tapirus terrestris	RES	176	97056	0.88913998	0.61696692	0.66477273	0.05681818
Tayassu pecari	RES	378	72254	0.84927634	0.50779666	0.54497354	0.19047619
Thalpomys lasiotis	RES	7	546	1	0.79055975	1	0
Thylamys macrurus	RES	14	6368	1	0.74458246	1	0
Tolypeutes tricinctus	RES	126	18658	0.98280423	0.66498779	0.94444444	0
Wilfredomys oenax	RES	9	17404	0.98765432	0.55892986	0.88888889	0
Xeronycteris vieirai	RES	7	2795	1	0.62416035	1	0

SUPPLEMENTARY MATERIAL 2 – COMPLEMENTARY RESULTS

Table SM2.1. Percentage of distribution exposed by Existing and Planned mining projects if any of the legislative scenarios were approved. Values of the near future scenarios includes the affectation of Existing mining projects. Likewise, values of the near future scenarios in the different proposal laws include the affectation of the current law in the near future. B=Birds, A=Amphibians, M=Mammals, R=Reptiles.

ID	Specie and animal group		Today	In the near future, under the current law	In the near future, if PL37/2011 were approved	In the near future, if PL3682/2012 were approved	In the near future, if PL1610/1996 were approved
1	*Alectrurus tricolor*	B	0.049	0.685	0.685	0.832	0.685
2	*Allobates brunneus*	A	0.237	0.899	2.018	1.051	1.068
3	*Alouatta belzebul*	M	0.360	1.318	3.975	1.535	1.648
4	*Alouatta discolor*	M	0.289	2.966	7.985	3.287	3.287
5	*Alouatta ululata*	M	0.000	0.426	0.426	0.426	0.426
6	*Amerotyphlops amoipira*	R	0.000	1.892	1.892	1.892	1.892
7	*Aratinga solstitialis*	B	0.268	1.692	4.380	1.884	2.015
8	*Arremonops conirostris*	B	0.151	1.494	4.861	1.759	1.532
9	*Ateles belzebuth*	M	0.167	0.560	1.407	0.584	0.882
10	*Ateles chamek*	M	0.053	0.435	0.941	0.488	0.488
11	*Ateles marginatus*	M	0.482	3.002	7.766	3.291	3.346
12	*Atelocynus microtis*	M	0.067	1.094	1.952	1.165	1.228
13	*Blastocerus dichotomus*	M	0.048	0.678	0.678	0.823	0.678
14	*Cacajao hosomi*	M	0.000	0.000	0.102	0.000	0.102
15	*Caluromysiops irrupta*	M	0.000	0.070	0.126	0.098	0.112
16	*Campylorhamphus cardosoi*	B	0.351	2.240	5.895	2.460	2.636
17	*Campylorhamphus multostriatus*	B	0.291	3.026	6.488	3.159	3.293
18	*Capito dayi*	B	0.135	2.393	4.735	2.549	2.497
19	*Cebus kaapori*	M	0.523	1.873	4.138	1.960	2.221
20	*Celeus obrieni*	B	0.000	2.600	2.600	2.600	2.600
21	*Celeus torquatus pieteroyensi*	B	0.746	1.918	3.570	2.025	2.397
22	*Cercomacra ferdinandi*	B	0.100	1.294	1.393	1.493	1.294
23	*Chamaeza nobilis fulvipectus*	B	0.659	7.991	15.981	8.456	8.379
24	*Chiropotes satanas*	M	1.001	2.659	4.754	2.753	2.940
25	*Chiropotes utahickae*	M	0.638	1.718	3.240	1.718	2.111
26	*Chrysocyon brachyurus*	M	0.472	6.132	6.132	6.132	6.132

27	*Cichlopsis leucogenys*	B	0.000	0.000	0.417	0.060	0.030
28	*Columbina cyanopis*	B	1.000	11.000	11.000	11.000	11.000
29	*Conothraupis mesoleuca*	B	0.000	1.340	1.340	1.340	1.340
30	*Coryphaspiza melanotis*	B	0.148	0.774	1.745	0.868	0.823
31	*Cotinga maculata*	B	2.000	16.000	16.000	16.000	16.000
32	*Cranioleuca muelleri*	B	0.310	1.085	4.013	1.171	1.533
33	*Crax fasciolata pinima*	B	0.311	2.250	4.882	2.427	2.448
34	*Crax globulosa*	B	0.000	0.214	0.276	0.260	0.444
35	*Crypturellus noctivagus noctivagus*	B	0.870	9.565	9.565	9.565	9.565
36	*Crypturellus noctivagus zabele*	B	0.000	1.754	1.754	1.754	1.754
37	*Cyanocorax hafferi*	B	0.000	0.000	0.286	0.057	0.000
38	*Dendrexetastes rufigula paraensis*	B	0.366	2.537	5.367	2.757	2.784
39	*Dendrocincla merula badia*	B	0.300	0.879	1.865	0.879	1.179
40	*Dendrocolaptes medius*	B	0.445	1.214	3.845	1.403	1.430
41	*Dysithamnus plumbeus*	B	1.099	10.989	10.989	10.989	10.989
42	*Furipterus horrens*	M	0.000	0.121	0.193	0.121	0.193
43	*Geositta poeciloptera*	B	0.078	0.622	0.777	0.622	0.622
44	*Glyphonycteris behnii*	M	0.078	0.570	1.011	0.635	0.609
45	*Guaruba guarouba*	B	0.295	2.081	5.075	2.265	2.390
46	*Harpia harpyja*	B	0.191	1.367	3.379	1.494	1.583
47	*Hemitriccus mirandae*	B	0.000	0.962	2.885	0.962	0.962
48	*Hydrodynastes melanogigas*	R	0.000	11.538	11.538	11.538	11.538
49	*Hylexetastes brigidai*	B	0.457	1.075	2.876	1.075	1.478
50	*Hylopezus paraensis*	B	0.332	1.765	4.962	1.983	2.030
51	*Hylophilus ochraceiceps rubrifrons*	B	0.307	1.943	3.374	1.943	2.761
52	*Hypocnemis ochrogyna*	B	0.125	0.810	1.745	0.873	0.857
53	*Kentropyx vanzoi*	R	0.051	0.772	0.823	0.772	0.926
54	*Lagothrix cana*	M	0.141	1.323	2.899	1.365	1.393
55	*Lagothrix lagothricha*	M	0.000	0.255	0.351	0.255	0.447
56	*Lagothrix poeppigii*	M	0.000	0.000	0.000	0.154	0.000
57	*Leopardus tigrinus*	M	0.221	0.961	3.135	0.993	1.213
58	*Leopardus wiedii*	M	0.439	2.108	4.172	2.196	2.196
59	*Lepidothrix iris*	B	0.473	1.524	3.521	1.629	1.918
60	*Lepidothrix iris iris*	B	0.450	1.169	3.327	1.169	1.709
61	*Lonchophylla dekeyseri*	M	0.171	0.930	1.803	1.044	0.987

62	*Lonchorhina aurita*	M	0.217	1.843	4.717	2.006	2.101
63	*Lophornis gouldii*	B	0.182	1.467	2.894	1.609	1.713
64	*Lycalopex vetulus*	M	0.041	0.660	0.660	0.660	0.784
65	*Mico rondoni*	M	0.211	0.581	2.114	0.687	0.581
66	*Momotus momota marcgraviana*	B	0.605	3.177	4.387	3.480	3.177
67	*Morphnus guianensis*	B	0.066	1.485	3.539	1.551	1.650
68	*Myrmecophaga tridactyla*	M	0.220	1.844	3.554	1.953	1.969
69	*Myrmotherula klagesi*	B	0.032	0.709	1.901	0.709	0.966
70	*Myrmotherula minor*	B	0.543	7.609	7.609	7.609	7.609
71	*Natalus macrourus*	M	0.405	0.666	2.924	0.753	0.753
72	*Neomorphus squamiger*	B	0.406	2.985	6.462	3.187	3.390
73	*Neopelma aurifrons*	B	0.621	8.696	8.696	8.696	8.696
74	*Nyctibius leucopterus*	B	0.212	0.784	2.453	0.906	1.066
75	*Ortalis remota*	B	0.449	3.959	7.937	4.349	4.388
76	*Ozotoceros bezoarticus*	M	0.094	1.318	1.318	1.318	1.318
77	*Panthera onca*	M	0.093	0.979	2.016	1.060	1.060
78	*Penelope jacucaca*	B	0.695	1.337	4.920	1.444	1.337
79	*Penelope ochrogaster*	B	0.102	2.444	2.444	2.444	2.444
80	*Penelope pileata*	B	0.283	2.065	5.245	2.245	2.434
81	*Phaethornis bourcieri*	B	0.000	0.213	0.293	0.213	0.293
82	*Phaethornis bourcieri major*	B	0.388	3.338	7.857	3.726	3.979
83	*Philodryas livida*	R	0.062	1.108	1.108	1.108	1.293
84	*Phlegopsis nigromaculata confinis*	B	0.319	2.310	5.838	2.503	2.696
85	*Phlegopsis nigromaculata paraensis*	B	0.761	1.849	3.371	1.958	2.338
86	*Piculus paraensis*	B	0.355	1.222	3.748	1.389	1.587
87	*Picumnus varzeae*	B	0.000	6.989	7.527	6.989	8.065
88	*Piprites chloris grisescens*	B	0.323	1.051	3.698	1.435	1.414
89	*Priodontes maximus*	M	0.265	1.738	3.320	1.915	1.881
90	*Procnias albus wallacei*	B	0.310	1.130	3.291	1.322	1.550
91	*Psophia dextralis*	B	0.234	1.954	4.532	1.978	2.247
92	*Ptenoura brasiliensis*	M	0.160	1.524	3.834	1.667	1.793
93	*Pteroglossus bitorquatus bitorquatus*	B	1.024	1.693	3.118	1.782	1.960
94	*Puma concolor*	M	0.059	0.820	0.820	0.937	0.820
95	*Puma yagouarondi*	M	0.030	0.809	1.903	0.914	0.839
96	*Pyrilia vulturina*	B	0.634	1.333	3.868	1.355	1.770

97	*Pyrrhura griseipectus*	B	0.000	0.943	0.943	0.943	0.943
98	*Pyrrhura lepida*	B	0.533	1.546	2.869	1.718	1.873
99	*Pyrrhura lepida lepida*	B	1.071	2.240	4.479	2.434	2.240
100	*Pyrrhura leucotis*	B	1.493	11.940	11.940	11.940	11.940
101	*Rhegmatorhina gymnops*	B	0.437	2.904	6.349	3.081	3.185
102	*Saguinus bicolor*	M	0.000	1.104	2.318	1.104	1.545
103	*Saguinus niger*	M	0.694	1.606	2.864	1.692	1.931
104	*Sapajus cay*	M	0.000	2.128	2.128	2.128	2.128
105	*Speothos venaticus*	M	0.181	1.137	2.211	1.174	1.324
106	*Sporagra yarrellii*	B	0.737	1.966	2.457	2.211	1.966
107	*Sporophila hypoxantha*	B	0.971	7.767	7.767	7.767	7.767
108	*Sporophila maximiliani*	B	0.051	0.709	1.519	0.861	0.709
109	*Sporophila nigrorufa*	B	0.000	0.289	0.289	0.289	0.289
110	*Sporophila palustris*	B	1.408	9.859	9.859	9.859	9.859
111	*Sporophila ruficollis*	B	0.317	1.587	1.587	1.587	1.587
112	*Stenocercus dumerilii*	R	0.512	1.506	3.961	1.762	1.792
113	*Stigmatura napensis napensis*	B	0.000	0.318	1.060	0.318	0.530
114	*Synallaxis kollari*	B	0.000	0.000	0.299	0.000	0.000
115	*Tangara velia signata*	B	0.710	4.785	9.653	4.994	5.140
116	*Taoniscus nanus*	B	0.000	0.000	0.000	0.000	0.000
117	*Tapirus terrestris*	M	0.122	0.587	1.699	0.685	0.837
118	*Tayassu pecari*	M	0.092	0.727	1.477	0.784	0.773
119	*Thamnophilus nigrocinereus*	B	0.322	3.281	7.456	3.369	3.618
120	*Thylamys macrurus*	M	0.000	4.167	4.167	4.167	4.167
121	*Tigrisoma fasciatum*	B	0.000	0.080	0.261	0.161	0.121
122	*Tinamus tao*	B	0.079	0.635	1.190	0.703	0.680
123	*Tolypeutes tricinctus*	M	0.000	1.695	1.695	2.179	1.695
124	*Xiphocolaptes carajaensis*	B	1.078	1.438	3.863	1.438	2.066
125	*Xiphocolaptes falcirostris*	B	0.000	1.318	1.318	1.647	1.318

Table SM2.2. Summary of statistics of the percentage of species distribution exposed to mining in each type of PA in the near future regarding the current law and the three legislative proposals. This results are the sum of the impact of Existing and Planned mining projects over the species distribution.

Statistic	APA & ARIE PAs, if there is no changes in the legislation	Other sustainable use PAs, , if PL37/2011 were approved	Strictly PAs, if PL3682/2012 were approved	Indigenous lands, , if PL1610/1996 were approved
Min.	0.0000	0.0000	0.0000	0.0000
1st Qu.	0.672	0.0000	0.0000	0.0000
Median	1.130	1.241	0.08264	0.1347
Mean	2.080	1.616	0.10181	0.1842
3rd Qu.	1.942	2.796	0.17122	0.3251
Max.	16.0000	8.440	0.48426	1.0753

Table SM2.3. Summary of statistics of the percentage of species distribution exposed to mining in each legislative scenario.

Statistic	Current and near future legislative scenarios				
	Current	In the near future, under the current law	In the near future, if PL37/2011 were approved	In the near future, if PL3682/2012 were approved	In the near future, if PL1610/1996 were approved
Min	0.0000	0.0000	0.0000	0.0000	0.0000
1st Qu	0.0486	0.7885	1.4940	0.8865	0.8911
Median	0.2192	1.4376	3.1360	1.5706	1.6708
Mean	0.3127	2.2823	3.7020	2.3820	2.4633
3rd Qu	0.4496	2.2513	4.7980	2.4366	2.4522
Max	2.0000	16.0000	16.0250	16.0000	16.0000
# of species	97	119	123	122	121

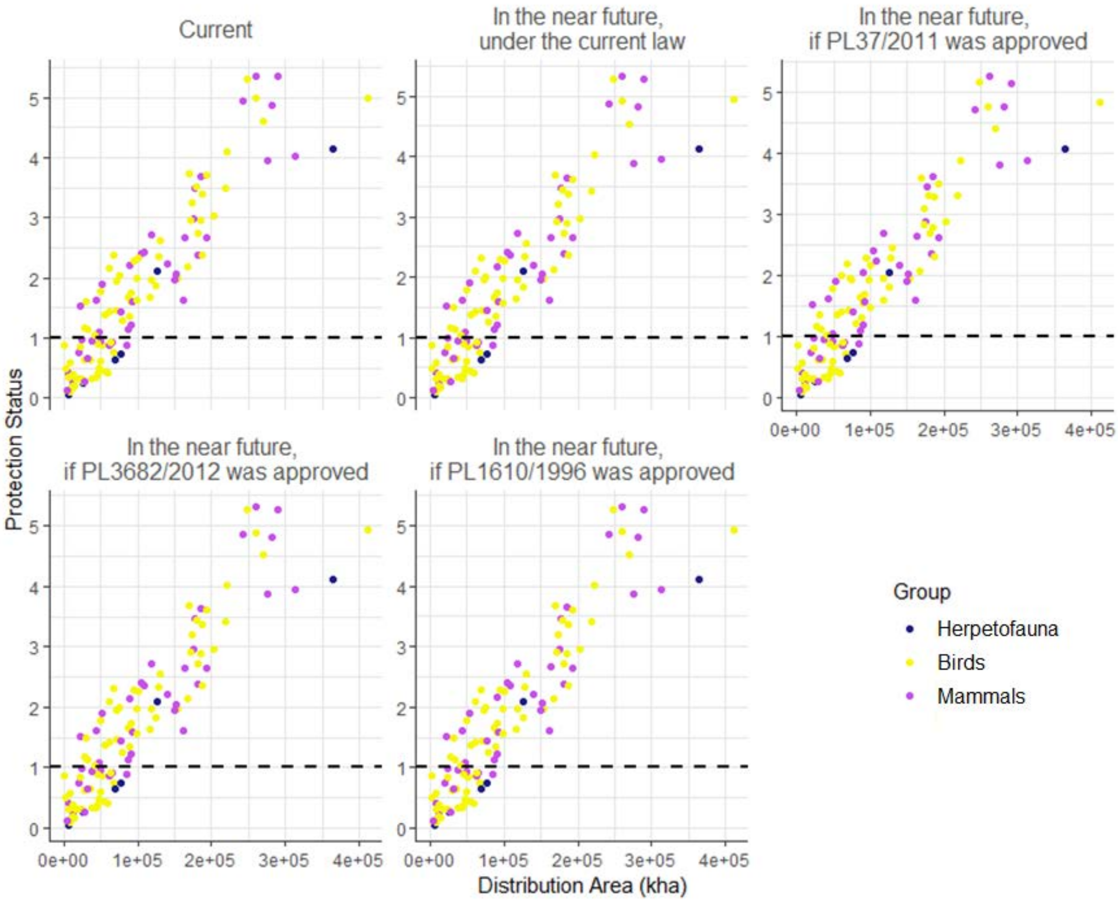


Figure SM2.4. Relationship between the area of distribution and the Protection Status of threatened species in the current time and in the near-future scenarios. Species are classified by animal groups. The dashed line represent the Representation Target, where the relative distance to the optimal Protection Status is zero when the Target has been reached but not surpassed, i.e., species under dashed line do not reach their Representation Target.

Table SM2.5. Change in the Protection Status if priority areas were restored. Species with Protection Status over 1 have reached their Representation Target.

specie	Group	Current Protection Status	Priority area for restoration	Future Protection Status if priority areas were restored
Alectrurus tricolor	Birds	0.869	8.556	0.870
Allobates brunneus	Herpetofauna	4.148	273.792	4.165
Alouatta belzebul	Mammals	2.990	273.792	3.011
Alouatta discolor	Mammals	2.221	102.672	2.232
Aratinga solstitialis	Birds	4.590	273.792	4.613

Arremonops conirostris	Birds	2.032	8.556	2.036
Ateles belzebuth	Mammals	2.725	119.784	2.734
Ateles marginatus	Mammals	2.416	265.236	2.438
Atelocynus microtis	Mammals	3.684	8.556	3.687
Blastocerus dichotomus	Mammals	0.870	8.556	0.871
Campylorhamphus cardosoi	Birds	3.510	265.236	3.533
Campylorhamphus multostriatus	Birds	2.621	162.564	2.635
Cebus kaapori	Mammals	0.939	102.672	0.949
Celeus torquatus pieteroyensi	Birds	0.868	119.784	0.881
Cercomacra ferdinandi	Birds	0.450	8.556	0.451
Chamaeza nobilis fulvipectus	Birds	1.616	102.672	1.634
Chiropotes satanas	Mammals	1.145	273.792	1.168
Chiropotes utahickae	Mammals	0.962	111.228	0.975
Chrysocyon brachyurus	Mammals	0.253	8.556	0.256
Columbina cyanopis	Birds	0.153	8.556	0.156
Coryphaspiza melanotis	Birds	1.977	8.556	1.980
Cotinga maculata	Birds	0.116	8.556	0.121
Cranioleuca muelleri	Birds	2.002	154.008	2.014
Crax fasciolata pinima	Birds	2.177	102.672	2.187
Crypturellus noctivagus noctivagus	Birds	0.155	8.556	0.157
Dendrexetastes rufigula paraensis	Birds	3.491	265.236	3.514
Dendrocincla merula badia	Birds	1.681	119.784	1.691
Dendrocolaptes medius	Birds	2.359	273.792	2.380
Dysithamnus plumbeus	Birds	0.150	8.556	0.153
Geositta poeciloptera	Birds	0.610	8.556	0.611
Glyphonycteris behnii	Mammals	2.389	8.556	2.391
Guaruba guarouba	Birds	4.995	273.792	5.021
Harpia harpyja	Birds	4.999	273.792	5.016
Hylexetastes brigidai	Birds	1.468	145.452	1.481
Hylopezus paraensis	Birds	3.247	273.792	3.267
Hylophilus ochraceiceps rubrifrons	Birds	0.644	25.668	0.648
Kentropyx vanzoi	Herpetofauna	0.740	8.556	0.741
Leopardus tigrinus	Mammals	1.971	119.784	1.980
Leopardus wiedii	Mammals	1.094	85.560	1.104
Lepidothrix iris	Birds	1.357	154.008	1.370

Lepidothrix iris iris	Birds	0.647	42.780	0.653
Lonchophylla dekeyseri	Mammals	1.626	8.556	1.630
Lonchorhina aurita	Mammals	4.940	162.564	4.958
Lophornis gouldii	Birds	2.389	111.228	2.397
Lycalopex vetulus	Mammals	0.888	8.556	0.889
Momotus momota marcgraviana	Birds	0.336	34.224	0.340
Myrmecophaga tridactyla	Mammals	3.943	145.452	3.957
Myrmotherula klagesi	Birds	1.389	8.556	1.390
Myrmotherula minor	Birds	0.194	8.556	0.196
Natalus macrourus	Mammals	1.220	94.116	1.229
Neomorphus squamiger	Birds	1.289	111.228	1.299
Neopelma aurifrons	Birds	0.204	8.556	0.207
Nyctibius leucopterus	Birds	5.300	265.236	5.322
Ortalis remota	Birds	2.169	145.452	2.186
Ozotoceros bezoarticus	Mammals	0.655	8.556	0.656
Panthera onca	Mammals	2.672	25.668	2.675
Penelope jacucaca	Birds	0.754	111.228	0.764
Penelope ochrogaster	Birds	0.424	8.556	0.425
Penelope pileata	Birds	4.097	273.792	4.119
Phaethornis bourcieri major	Birds	2.380	145.452	2.397
Philodryas livida	Herpetofauna	0.648	8.556	0.649
Phlegopsis nigromaculata confinis	Birds	3.701	273.792	3.723
Phlegopsis nigromaculata paraensis	Birds	0.903	119.784	0.917
Piculus paraensis	Birds	2.949	273.792	2.969
Piprites chloris grisescens	Birds	1.748	119.784	1.759
Priodontes maximus	Mammals	4.018	222.456	4.036
Procnias albus wallacei	Birds	3.396	265.236	3.417
Psophia dextralis	Birds	1.669	102.672	1.676
Ptenoura brasiliensis	Mammals	5.346	196.788	5.362
Pteroglossus bitorquatus bitorquatus	Birds	0.933	196.788	0.952
Puma concolor	Mammals	0.959	8.556	0.960
Puma yagouarondi	Mammals	2.073	17.112	2.075
Pyrilia vulturina	Birds	1.613	248.124	1.634
Pyrrhura lepida	Birds	1.859	256.680	1.879

Pyrrhura lepida lepida	Birds	0.497	94.116	0.508
Pyrrhura leucotis	Birds	0.114	8.556	0.117
Rhegmatorhina gymnops	Birds	2.966	265.236	2.989
Saguinus niger	Mammals	1.610	265.236	1.633
Speothos venaticus	Mammals	4.865	239.568	4.883
Sporagra yarrellii	Birds	0.401	51.336	0.407
Sporophila hypoxantha	Birds	0.162	8.556	0.165
Sporophila maximiliani	Birds	1.045	8.556	1.046
Sporophila palustris	Birds	0.134	8.556	0.138
Sporophila ruficollis	Birds	0.390	8.556	0.393
Stenocercus dumerilii	Herpetofauna	2.120	273.792	2.142
Tangara velia signata	Birds	1.634	256.680	1.657
Tapirus terrestris	Mammals	5.358	154.008	5.370
Tayassu pecari	Mammals	2.678	8.556	2.681
Thamnophilus nigrocinereus	Birds	2.334	154.008	2.348
Tinamus tao	Birds	2.730	8.556	2.732
Xiphocolaptes carajaensis	Birds	0.844	102.672	0.862

SUPPLEMENTARY MATERIAL 3 – SUPPORT MATERIAL

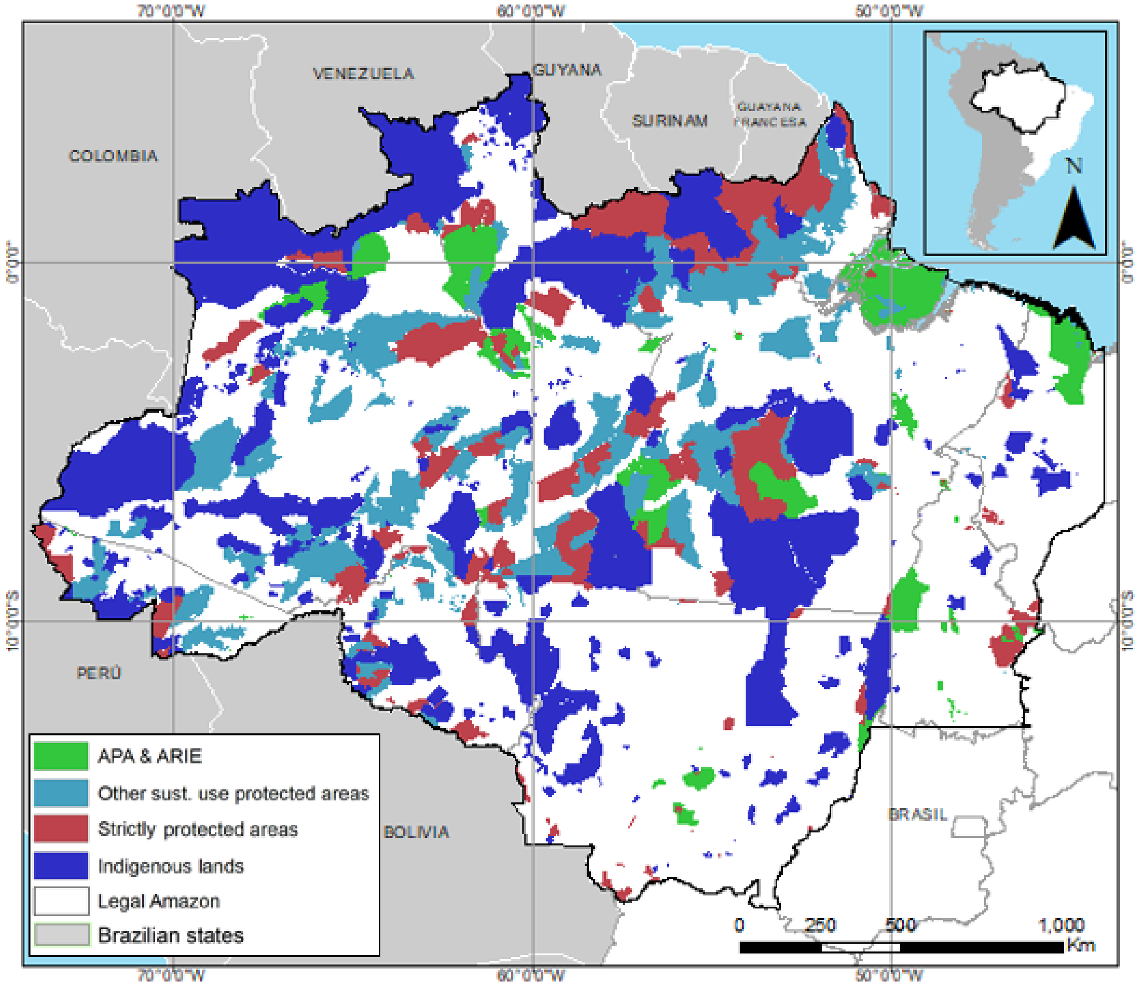


Figure SM3.1. Distribution of PAs whitin the Legal Amazon.

REFERENCES

Allouche, O., Tsoar, A., & Kadmon, R. (2006). Assessing the accuracy of species distribution models: prevalence, kappa and the true skill statistic (TSS). Journal of Applied Ecology, 43(6), 1223–1232. https://doi.org/10.1111/j.1365-2664.2006.01214.x

Boyce, M. S., Vernier, P. R., Nielsen, S. E., & Schmiegelow, F. K. . (2002). Evaluating resource selection functions. Ecological Modelling, 157(2–3), 281–300. https://doi.org/10.1016/S0304-3800(02)00200-4

De Marco, P., Nóbrega, C.C., 2018. Evaluating collinearity effects on species distribution models : An approach based on virtual species simulation. PLoS One 13, e0202403. https://doi.org/10.1371/journal.pone.0202403

De Marco, P., Nóbrega, C.C., 2018. Evaluating collinearity effects on species distribution models : An approach based on virtual species simulation. PLoS One 13, e0202403. https://doi.org/10.1371/journal.pone.0202403

De Marco, P., Villén, S., Mendes, P., Nóbrega, C., Cortes, L., Castro, T., Souza, R., 2018. Vulnerability of Cerrado threatened mammals: an integrative landscape and climate modeling approach. Biodivers. Conserv. https://doi.org/10.1007/s10531-018-1615-x. https://doi.org/10.1007/s10531-018-1615-x

De Marco, P., Villén, S., Mendes, P., Nóbrega, C., Cortes, L., Castro, T., Souza, R., 2018. Vulnerability of Cerrado threatened mammals: an integrative landscape and climate modeling approach. Biodivers. Conserv. https://doi.org/10.1007/s10531-018-1615-x. https://doi.org/10.1007/s10531-018-1615-x

Diniz-Filho, J. A. F., Mauricio Bini, L., Fernando Rangel, T., Loyola, R. D., Hof, C., Nogués-Bravo, D., & Araújo, M. B. (2009). Partitioning and mapping uncertainties in ensembles of forecasts of species turnover under climate change. Ecography, 32(6), 897–906. https://doi.org/10.1111/j.1600-0587.2009.06196.x

Fick, S.E. and R.J. Hijmans, 2017. Worldclim 2: New 1-km spatial resolution climate surfaces for global land areas. International Journal of Climatology.

Golding, N. (2017). GRaF: Species Distribution Modelling using Gaussian Processes.

Hijmans, R. J., Phillips, S., Leathwick, J., & Elith, J. (2017). dismo: Species Distribution Modeling.

Hirzel, A. H., Le Lay, G., Helfer, V., Randin, C., & Guisan, A. (2006). Evaluating the ability of habitat suitability models to predict species presences. Ecological Modelling, 199(2), 142–152. https://doi.org/10.1016/j.ecolmodel.2006.05.017

Karatzoglou, A., Smola, A., Hornik, K., & Zeileis, A. (2004) kernlab - An S4 Package for Kernel Methods in R. Journal of Statistical Software, 11, .

Karatzoglou, A., Smola, A., Hornik, K., & Zeileis, A. (2004) kernlab - An S4 Package for Kernel Methods in R. *Journal of Statistical Software*, 11, .

Karatzoglou, A., Smola, A., Hornik, K., & Zeileis, A. (2004). kernlab - An S4 Package for Kernel Methods in R. Journal of Statistical Software, 11(9). https://doi.org/10.18637/jss.v011.i09

Liaw, A., & Wiener, M. (2002). Classification and Regression by randomForest. R News, 2(3), 18–22.

Liu, C.R., White, M., Newell, G., 2011. Measuring and comparing the accuracy of species distribution models with presence-absence data. Ecography (Cop.). 34, 232–243.

Liu, C.R., White, M., Newell, G., 2011. Measuring and comparing the accuracy of species distribution models with presence-absence data. Ecography (Cop.). 34, 232–243.

Marmion, M., Parviainen, M., Luoto, M., Heikkinen, R.K., Thuiller, W., 2009. Evaluation of consensus methods in predictive species distribution modelling. Divers. Distrib. 15, 59–69.

Marmion, M., Parviainen, M., Luoto, M., Heikkinen, R.K., Thuiller, W., 2009. Evaluation of consensus methods in predictive species distribution modelling. Divers. Distrib. 15, 59–69.

MMA. Portaria No- 444, de 17 de dezembro de 2014. , (2014).

O. Allouche, O. Steinitz, D. Rotem, A. Rosenfeld, R. Kadmon, 2008. Incorporating distance constraints into species distribution models J. Appl. Ecol., 45, pp. 599-609. https://doi.org/10.1111/j.1365-2664.2007.01445.x

Pearson, R.G., Raxworthy, C.J., Nakamura, M., & Townsend Peterson, A. (2007) Predicting species distributions from small numbers of occurrence records: a test case using cryptic geckos in Madagascar. Journal of Biogeography, 34, 102–117.

Pearson, R.G., Raxworthy, C.J., Nakamura, M., & Townsend Peterson, A. (2007) Predicting species distributions from small numbers of occurrence records: a test case using cryptic geckos in Madagascar. Journal of Biogeography, 34, 102–117.

Phillips, S. (2017). maxnet: Fitting “Maxent” Species Distribution Models with “glmnet.”

R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/.

R Core Team. (2018). R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria.

Roberts, D. R., Bahn, V., Ciuti, S., Boyce, M. S., Elith, J., Guillera-Arroita, G., … Dormann, C. F. (2017). Cross-validation strategies for data with temporal, spatial, hierarchical, or phylogenetic structure. Ecography, (7491), 1–17. https://doi.org/10.1111/ecog.02881

Royle, J. A., Chandler, R. B., Yackulic, C., & Nichols, J. D. (2012). Likelihood analysis of species occurrence probability from presence-only data for modelling species distributions. Methods in Ecology and Evolution, 3(3), 545–554. https://doi.org/10.1111/j.2041-210X.2011.00182.x

Zhu, G. P., & Peterson, A. T. (2017). Do consensus models outperform individual models? Transferability evaluations of diverse modeling approaches for an invasive moth. Biological Invasions, (September), 1–14. https://doi.org/10.1007/s10530-017-1460-y