

## Supplementary information

Implementing Brazil's Forest Code: A vital contribution to securing forests and conserving biodiversity

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### Modelling of the environmental reserve quota mechanism (CRA)

The tradeable debt and surplus within the environmental reserve quota mechanism (CRA) was estimated in the model. The amount of land that the law requires to be protected, the legal reserve (LR), was calculated by multiplying the amount of land in a pixel by the percentage of the LR requirement in that pixel. The LR surplus for each gridcell was calculated as the amount of native vegetation that exceeds the legal reserve. Environmental debts, downscaled to 50 km x 50 km pixels were based on CAR data (Guidotti et al., 2017) downloaded in December 2016. Given the uncertainties regarding the future use of public areas in the state of Amazonas, we assume that only 20% of the unclaimed public lands in this state will be designated as private property. Hence, only 20% of forest surpluses in this region are considered in the CRA stock estimates. Without this assumption, the amount of forest surpluses in the Amazonas state alone would be more than enough to compensate all the LR debts within the whole Amazon biome. In terms of the debt offset mechanism we assume that: (1) environmental debts will be compensated by the quota system only in cells with deficits overlapping soybean and sugarcane production, (2) cells with larger deficits are compensated first, and (3) cells with larger surpluses are used first to offset the debts within the same biome. See Soterroni et al. (2018) for more details.

Table S1: List of species included in the analysis. The list includes all mammals, amphibians and birds that had been identified by the Brazilian government as threatened, and for which extent of occurrence data was available from the IUCN Red List. The 311 species are listed alphabetically by genus.

<i>Acrobatornis fonsecai</i>	<i>Campylorhamphus</i>	<i>Dendrocincla merula</i>
<i>Adelophryne maranguapensis</i>	<i>procurvoides</i>	<i>Dendrocolaptes certhia</i>
<i>Akodon mystax</i>	<i>Campylorhamphus</i>	<i>Dendrocolaptes picumnus</i>
<i>Alectrurus tricolor</i>	<i>trochilirostris</i>	<i>Diomedea dabbenena</i>
<i>Allobates goianus</i>	<i>Capito dayi</i>	<i>Diomedea exulans</i>
<i>Allobates olfersioides</i>	<i>Carduelis yarrellii</i>	<i>Discosura langsdorffi</i>
<i>Alouatta belzebul</i>	<i>Carpornis melanocephala</i>	<i>Dysithamnus plumbeus</i>
<i>Alouatta discolor</i>	<i>Caryothraustes canadensis</i>	<i>Eleoscytalopus psychopomus</i>
<i>Alouatta guariba</i>	<i>Cebus cay</i>	<i>Eleothreptus candicans</i>
<i>Alouatta ululata</i>	<i>Cebus flavius</i>	<i>Euryoryzomys lamia</i>
<i>Amazona pretrei</i>	<i>Cebus kaapori</i>	<i>Formicivora erythronotos</i>
<i>Amazona rhodocorytha</i>	<i>Cebus robustus</i>	<i>Formicivora grantsaui</i>
<i>Amazona vinacea</i>	<i>Cebus xanthosternus</i>	<i>Formicivora littoralis</i>
<i>Anodorhynchus leari</i>	<i>Celeus flavus</i>	<i>Fregata ariel</i>
<i>Anthus nattereri</i>	<i>Celeus obrieni</i>	<i>Furipterus horrens</i>
<i>Antilophia bokermanni</i>	<i>Celeus torquatus</i>	<i>Geositta poeciloptera</i>
<i>Aratinga solstitialis</i>	<i>Cercomacra ferdinandi</i>	<i>Glaucis dohrnii</i>
<i>Arremonops conirostris</i>	<i>Chaetomys subspinosus</i>	<i>Glyphonycteris behnii</i>
<i>Ateles belzebuth</i>	<i>Chamaeza nobilis</i>	<i>Grallaria varia</i>
<i>Ateles chamek</i>	<i>Chiasmocleis alagoanus</i>	<i>Guaruba guarouba</i>
<i>Ateles marginatus</i>	<i>Chiropotes satanas</i>	<i>Gubernatrix cristata</i>
<i>Atelocynus microtis</i>	<i>Chiropotes utahickae</i>	<i>Harpia harpyja</i>
<i>Attila spadiceus</i>	<i>Chrysocyon brachyurus</i>	<i>Hemitriccus furcatus</i>
<i>Augastes lumachella</i>	<i>Ciccaba huhula</i>	<i>Hemitriccus griseipectus</i>
<i>Automolus lammi</i>	<i>Cichlopsis leucogenys</i>	<i>Hemitriccus kaempferi</i>
<i>Blastocercus dichotomus</i>	<i>Circus cinereus</i>	<i>Hemitriccus mirandae</i>
<i>Bokermannohyla vulcaniae</i>	<i>Claravis geoffroyi</i>	<i>Herpailurus yagouaroundi</i>
<i>Bolitoglossa paraensis</i>	<i>Columbina cyanopsis</i>	<i>Herpsilochmus pileatus</i>
<i>Brachycephalus pernix</i>	<i>Conopophaga lineata</i>	<i>Holoaden bradei</i>
<i>Brachyteles arachnoides</i>	<i>Conopophaga melanops</i>	<i>Holoaden luederwaldti</i>
<i>Brachyteles hypoxanthus</i>	<i>Conothraupis mesoleuca</i>	<i>Hylatomus galeatus</i>
<i>Bradypus torquatus</i>	<i>Coryphas piza melanotis</i>	<i>Hylexetastes brigidai</i>
<i>Buteogallus coronatus</i>	<i>Coryphistera alaudina</i>	<i>Hylomantis granulosa</i>
<i>Buteogallus lacernulatus</i>	<i>Cotinga maculata</i>	<i>Hylopezus macularius</i>
<i>Cacajao hosomi</i>	<i>Cranioleuca muelleri</i>	<i>Hylophilus ochraceiceps</i>
<i>Calidris canutus</i>	<i>Crax blumenbachii</i>	<i>Hypocnemis ochrogyna</i>
<i>Calidris pusilla</i>	<i>Crax fasciolata</i>	<i>Hypsiboas cymbalum</i>
<i>Calidris subruficollis</i>	<i>Crax globulosa</i>	<i>Hypsiboas semiguttatus</i>
<i>Callicebus barbarabrownae</i>	<i>Crossodactylus dantei</i>	<i>Inia geoffrensis</i>
<i>Callicebus coimbrai</i>	<i>Crossodactylus lutzorum</i>	<i>Iodopleura pipra</i>
<i>Callicebus melanochir</i>	<i>Crypturellus noctivagus</i>	<i>Ischnocnema manezinho</i>
<i>Callicebus personatus</i>	<i>Ctenomys minutus</i>	<i>Kerodon acrobata</i>
<i>Callistomys pictus</i>	<i>Curaeus forbesi</i>	<i>Kerodon rupestris</i>
<i>Callithrix aurita</i>	<i>Cycloramphus diringshofeni</i>	<i>Kunsia fronto</i>
<i>Callithrix flaviceps</i>	<i>Cycloramphus faustoi</i>	<i>Lagothrix cana</i>
<i>Caluromysiops irrupta</i>	<i>Cycloramphus ohausi</i>	<i>Lagothrix lagotricha</i>
<i>Calyptura cristata</i>	<i>Dendrexetastes rufigula</i>	<i>Lagothrix poeppigii</i>

Leontopithecus caissara	Penelope ochrogaster	Saimiri vanzolinii
Leontopithecus chrysomelas	Penelope pileata	Schiffornis turdina
Leontopithecus chrysopygus	Penelope superciliaris	Scinax duartei
Leontopithecus rosalia	Phaethornis aethopygus	Sclerurus caudacutus
Leopardus colocolo	Phaethornis bourcieri	Sclerurus mexicanus
Leopardus geoffroyi	Phaethornis malaris	Sclerurus scansor
Leopardus tigrinus	Phlegopsis nigromaculata	Scytalopus diamantinensis
Leopardus wiedii	Phyllodytes gyrinaethes	Scytalopus iraiensis
Lepidocolaptes squamatus	Phyllomys lundii	Scytalopus novacapitalis
Lepidothrix iris	Phyllomys thomasi	Selenidera gouldii
Lepidothrix vilasboasi	Phyllomys unicolor	Serpophaga hypoleuca
Leptasthenura platensis	Phylloscartes beckeri	Speothos venaticus
Leptodon forbesi	Phylloscartes ceciliae	Sporophila falcirostris
Limnodromus griseus	Phylloscartes roquettei	Sporophila frontalis
Lonchophylla dekeyseri	Physalaemus caete	Sporophila hypoxantha
Lonchorhina aurita	Physalaemus maximus	Sporophila melanogaster
Lophornis gouldii	Physalaemus soaresi	Sporophila nigrorufa
Marmosops paulensis	Picus chrysochloros	Sporophila palustris
Mazama bororo	Picumnus varzeae	Sporophila ruficollis
Mazama nana	Pionus reichenowi	Stigmatura napensis
Melanophryniscus admirabilis	Pipile jacutinga	Stymphalornis acutirostris
Melanophryniscus	Piprites chloris	Synallaxis infuscata
cambaraensis	Platyrinchus mystaceus	Synallaxis kollari
Melanophryniscus dorsalis	Porzana spiloptera	Tangara cyanocephala
Mergus octosetaceus	Priodontes maximus	Tangara fastuosa
Merulaxis stresemanni	Procellaria aequinoctialis	Tangara peruviana
Mico rondoni	Procellaria conspicillata	Tangara velia
Microakodontomys	Proceratophrys moratoi	Taoniscus nanus
transitorius	Proceratophrys palustris	Tapirus terrestris
Momotus momota	Procnias albus	Tayassu pecari
Monasa morphoeus	Pseudalopex vetulus	Terenura sicki
Morphnus guianensis	Pseudoseisura lophotes	Thalassarche chlororhynchos
Myrmeciza ruficauda	Psophia dextralis	Thalpomys cerradensis
Myrmecophaga tridactyla	Psophia obscura	Thalpomys lasiotis
Myrmotherula fluminensis	Psophia viridis	Thalurania watertonii
Myrmotherula klagesi	Pterodroma deserta	Thamnomanes caesius
Myrmotherula minor	Pterodroma incerta	Thamnophilus aethiops
Myrmotherula snowi	Pteroglossus bitorquatus	Thamnophilus caeruleus
Myrmotherula urosticta	Pteronura brasiliensis	Thamnophilus nigrocinereus
Nemosia rourei	Pulsatrix perspicillata	Thoropa petropolitana
Neomorphus geoffroyi	Puma concolor	Thoropa saxatilis
Neopelma aurifrons	Pyriglena atra	Thripophaga macroura
Nothura minor	Pyrrhura vulturina	Thylamys macrurus
Nyctibius aethereus	Pyrrhura cruentata	Thylamys velutinus
Nyctibius leucopterus	Pyrrhura griseipectus	Tigrisoma fasciatum
Odontophorus capueira	Pyrrhura lepida	Tijuca condita
Oligoryzomys rupestris	Pyrrhura leucotis	Tinamus tao
Ortalis guttata	Pyrrhura pflimeri	Tolypeutes tricinctus
Oryzoborus maximiliani	Rhegmatorhina gymnops	Touit melanonotus
Ozotoceros bezoarticus	Rhipidomys cariri	Touit surdus
Panthera onca	Rhopornis ardesiacus	Trichechus inunguis
Paratelmatorhynchus lutzii	Saguinus bicolor	Trichechus manatus
Penelope jacucaca	Saguinus niger	Trinomys eliasi

Trinomys mirapitanga  
Trinomys moojeni  
Trinomys yonenagae  
Trogon collaris  
Wilfredomys oenax  
Xanthopsar flavus

Xenohyla truncata  
Xenops minutus  
Xeronycteris vieirai  
Xiphocolaptes falcirostris  
Xiphocolaptes  
promeropirhynchus

Xipholena atropurpurea  
Xiphorhynchus fuscus  
Xiphorhynchus guttatus  
Xolmis dominicanu

Table S2: Links between GLOBIOM-Brazil land use classes and IUCN species habitat classes. In order to assess how GLOBIOM-Brazil land use change projections affect species habitat availability, the GLOBIOM-Brazil land use classes were linked to IUCN species habitat classes. Species were assumed to survive within a GLOBIOM-Brazil land use if their IUCN habitat classes linked to this land use.

<b>GLOBIOM-Brazil land use class</b>	<b>Links to IUCN species classes in scenarios assuming forest species cannot recolonize reforested areas</b>	<b>Links to IUCN species classes in scenarios assuming forest species can recolonize reforested areas</b>
<b>Cropland</b>	Artificial/Terrestrial; Artificial/Terrestrial - Arable Land	Artificial/Terrestrial; Artificial/Terrestrial - Arable Land
<b>Grassland</b>	Artificial/Terrestrial; Artificial/Terrestrial - Pastureland	Artificial/Terrestrial; Artificial/Terrestrial - Pastureland
<b>Unmanaged Forest</b>	Forest; Forest; Forest – Boreal; Forest – Subantarctic; Forest – Subarctic; Forest - Subtropical/Tropical Dry; Forest - Subtropical/Tropical Mangrove Vegetation Above High Tide Level; Forest - Subtropical/Tropical Moist Lowland; Forest - Subtropical/Tropical Moist Montane; Forest - Subtropical/Tropical Swamp; Forest – Temperate; Savanna; Savanna – Dry; Savanna – Moist	Forest; Forest; Forest – Boreal; Forest – Subantarctic; Forest – Subarctic; Forest - Subtropical/Tropical Dry; Forest - Subtropical/Tropical Mangrove Vegetation Above High Tide Level; Forest - Subtropical/Tropical Moist Lowland; Forest - Subtropical/Tropical Moist Montane; Forest - Subtropical/Tropical Swamp; Forest – Temperate; Savanna; Savanna – Dry; Savanna – Moist
<b>Forest Regrowth</b>	Artificial/Terrestrial - Subtropical/Tropical Heavily Degraded Former Forest	Artificial/Terrestrial - Subtropical/Tropical Heavily Degraded Former Forest; Forest; Forest; Forest – Boreal; Forest – Subantarctic; Forest – Subarctic; Forest - Subtropical/Tropical Dry; Forest - Subtropical/Tropical Mangrove Vegetation Above High Tide Level; Forest - Subtropical/Tropical Moist Lowland; Forest - Subtropical/Tropical Moist Montane; Forest - Subtropical/Tropical Swamp; Forest – Temperate
<b>Other natural land</b>	Grassland; Grassland – Subantarctic; Grassland – Subarctic; Grassland - Subtropical/Tropical Dry; Grassland - Subtropical/Tropical High Altitude; Grassland - Subtropical/Tropical Seasonally Wet/Flooded; Grassland – Temperate; Grassland – Tundra; Savanna; Savanna – Dry; Savanna – Moist; Shrubland; Shrubland – Boreal; Shrubland - Mediterranean-type Shrubby Vegetation; Shrubland – Subantarctic; Shrubland – Subarctic; Shrubland - Subtropical/Tropical Dry; Shrubland - Subtropical/Tropical High Altitude; Shrubland - Subtropical/Tropical Moist; Shrubland - Temperate	Grassland; Grassland – Subantarctic; Grassland – Subarctic; Grassland - Subtropical/Tropical Dry; Grassland - Subtropical/Tropical High Altitude; Grassland - Subtropical/Tropical Seasonally Wet/Flooded; Grassland – Temperate; Grassland – Tundra; Savanna; Savanna – Dry; Savanna – Moist; Shrubland; Shrubland – Boreal; Shrubland - Mediterranean-type Shrubby Vegetation; Shrubland – Subantarctic; Shrubland – Subarctic; Shrubland - Subtropical/Tropical Dry; Shrubland - Subtropical/Tropical High Altitude; Shrubland - Subtropical/Tropical Moist; Shrubland - Temperate

Figure S1: Impacts of assumptions on species distribution relative to land use.

Since the resolution of the GLOBIOM-Brazil land use change projects is different to the information on species ranges and habitat requirements a number of assumptions needed to be made to link the datasets. The GLOBIOM-Brazil land use change projections are provided as the proportion of 6 different land use classes within a 0.5° grid (approximately 50x50km), while the species ranges are available as higher resolution vectors. Therefore an assumption needed to be made on where within a gridcell the land use change occurred in relation to the species ranges. Additionally, an assumption was needed on whether species could recolonize newly abandoned land. The minimum species habitat loss 2010 to 2050 would occur if in each gridcell habitat loss first occurs outside species ranges and species can maximise new habitat (A). The maximum species habitat loss 2010 to 2050 would occur if in each gridcell habitat loss first occurs inside species ranges and species cannot use newly abandoned land (B).

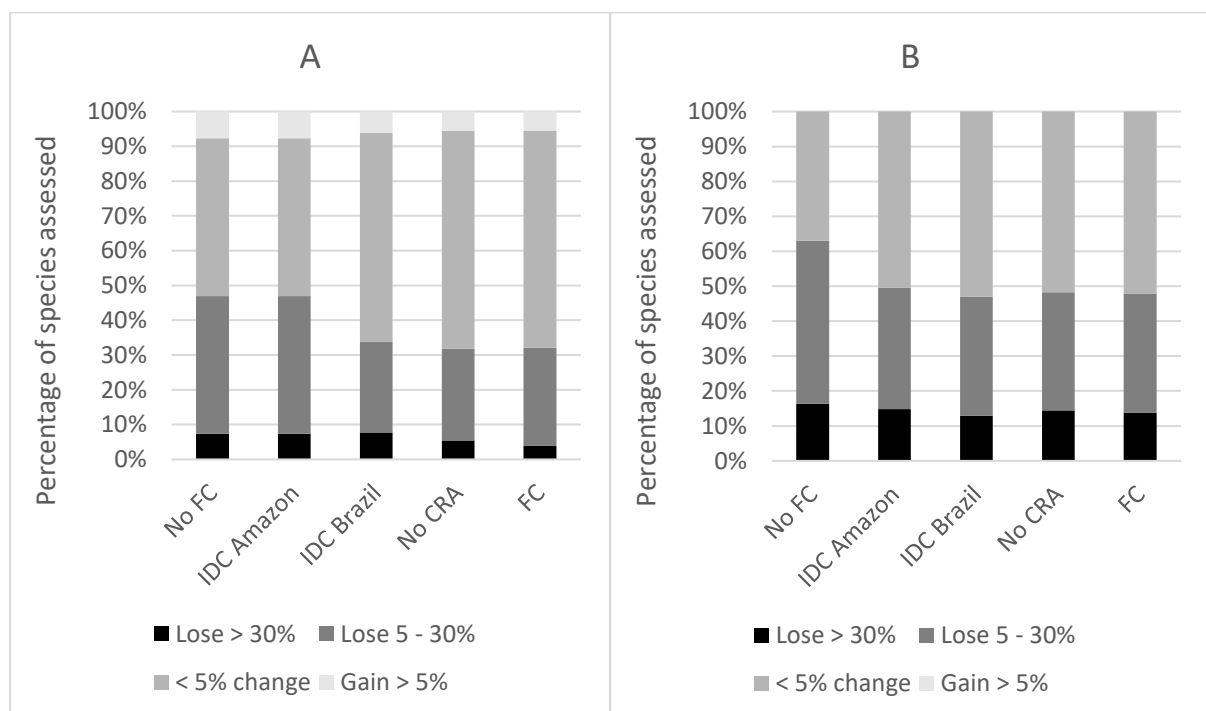
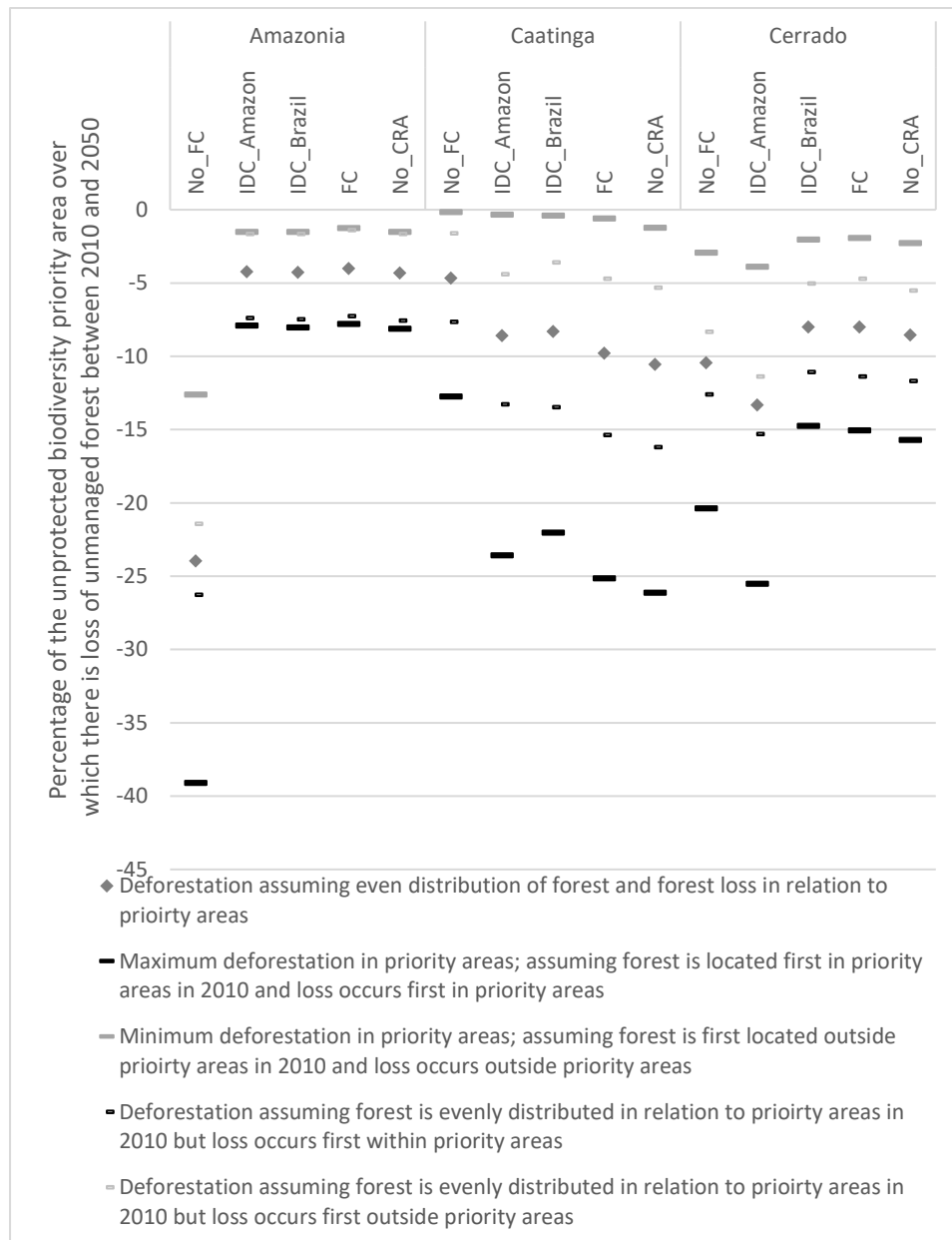


Figure S2: Impacts of assumptions on priority area distribution relative to land use. As with species ranges, the resolution of the GLOBIOM-Brazil land use change projections is also different to the information on biodiversity priority areas. Therefore, a number of assumptions needed to be made to link these datasets. The GLOBIOM-Brazil land use change projections are provided as the proportion of 6 different land use classes within a 0.5° grid (approximately 50x50km). The biodiversity priority areas are available as higher resolution vectors. The assumption regarding where forest is located in relation to priority areas in both relevant time periods (i.e. 2010 and where forest loss occurs in relation to priority areas) can have a large impact on the amount of deforestation projected to occur within priority areas. However, the pattern between scenarios remains the same.



## References – Supplementary Material

Guidotti, V., Freitas, F., Sparovek, G., Pinto, L., Hamamura, C., Carvalho, T., Cerignoni, F. (2017) *Números detalhados do novo código florestal e suas implicações para os PRAs*, Tech. Report, IMAFLORA. Available at:  
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