Supplementary material for **IS BRAZIL’S BIODIVERSITY OFFSET POLICY EFFECTIVE IN CONSERVING THE CERRADO?**

**This file contains an explanation of Brazilian Legal Reserve legislation, a list of the environmental variables used in climate niche modeling and the frequency of species losses in all scenarios analysed.**

**Appendix S1**

***Legal Reserve in Brazilian Legislation***

The obligation to maintain part of a privately owned property with native vegetation has existed since Decree-Law 29.793 of 1934. Over time, this legislation has changed regarding the concept of Legal Reserve (LR) and the percentage of property to be conserved.

One of the most important changes was the edition of Provisional Measure 1.605-30 in 1988, which allowed owners of rural properties that did not contain sufficient vegetation to compose the Legal Reserve to make compensation by acquiring a Legal Reserve in another property, thus establishing a biodiversity offset policy.

In 2012, new legislation brought about three changes that notably weakened the main rules of LR compensation. The elimination of two ecological criteria allowed ecologically distinct areas to be used for compensation, and changes in the admitted spatial scale (from watershed to biome) allowed compensation in very distant properties.

In 2018, the Brazilian Supreme Court decided that one of the Legal Reserve Compensation options should demonstrate the ‘ecological identity’ between the donor and impact sites. This decision still requires regulation defining what ‘ecological identity’ is. See van der Hoff & Rajao (2020) for more details.

**Table S1.** Changes in rules for Legal Reserve compensation. \*The term ‘biome’ in Brazilian legislation refers to large biogeographic regions (Amazon, Atlantic Forest, Caatinga, Cerrado, Pampa, and Pantanal).

|  |  |  |
| --- | --- | --- |
| Code version | Limit date for LR deforestation | Criteria for LR biodiversity offset |
| Law 4.771/65 'Old’ Forest Code | 14/12/1998 | - Same ecological importance - Same extension - Same ecosystem - Same watershed |
| Law 12.651/12 'New’ Forest Code | 22/07/2008 | - Same extension - Same biome\* - If in a different State, it must be in a priority area for conservation |

The Legal Reserve is established by Law 12.651/2021, as described below.

**Art. 3º. For the effect of this Law, understand:**

**III. Legal Reserve: an area located within the limits of a rural property or possession, delimited under the terms of Art. 12, with the function of maintaining sustainable economic use of the rural property’s natural resources, assisting the conservation and rehabilitation of ecological processes, and promoting the conservation of biodiversity as well as the shelter and protection of wild fauna e native vegetation.**

Minimum percentages of rural properties that must be conserved:

**Art. 12. Every rural property must maintain an area covered by native vegetation as a Legal Reserve, without prejudice to the rules concerning Areas of Permanent Protection, observing the following minimum percentages in relation to the property area, except in the cases stipulated in Art. 68 of this Law**

* 1. **Located in areas in the Legal Amazon region of Brazil**
  2. **80% (eighty percent) of the property if in forested area**
  3. **35% (thirty-five percent) of the property if in a cerrado area**
  4. **20% (twenty percent) of the property if in an open area of herbaceous vegetation**
  5. **Located in other all regions of the country: 20% (twenty percent)**

**Table S2**. Environmental variables used in climate niche modeling. The first two were obtained on CGIAR-CSI (Zomer et al., 2007, 2008, Jarvis, A et al., 2008) and others in CliMond (Kriticos et al., 2012).

|  |  |
| --- | --- |
| **Name** | **Description** |
| AI | Global Aridity Index |
| SRTM Digital Elevation Data | Elevation |
| Bio02 | Mean diurnal temperature range |
| Bio03 | Isothermality |
| Bio05 | Max temperature of the warmest week |
| Bio13 | Precipitation of wettest week |
| Bio14 | Precipitation of the driest week |
| Bio15 | Precipitation seasonality |
| Bio18 | Precipitation of the warmest quarter |
| Bio19 | Precipitation of the coldest quarter |
| Bio20 | Annual mean radiation |
| Bio22 | Lowest weekly radiation |
| Bio24 | Radiation of wettest quarter |
| Bio25 | Radiation of driest quarter |
| Bio26 | Radiation of warmest quarter |
| Bio31 | Moisture index seasonality |

**Table S3**. List of the 119 tree species used in Climate Niche Modelling.

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| **Anacardiaceae** |
| *Anacardium occidentale L.* |
| *Astronium fraxinifolium* Schott |
| **Annonaceae** |
| *Annona crassiflora* Mart. |
| *Cardiopetalum calophyllum* Schltdl. |
| *Xylopia aromatica* (Lam.) Mart. |
| **Apocynaceae** |
| *Aspidosperma macrocarpon* Mart. |
| *Aspidosperma multiflorum* A.DC. |
| *Aspidosperma nobile* Müll.Arg. |
| *Aspidosperma tomentosum* Mart. |
| *Hancornia speciosa* Gomes |
| **Araliaceae** |
| *Schefflera macrocarpa* (Cham. & Schltdl.) Frodin |
| **Asteraceae** |
| *Eremanthus arboreus* (Gardner) MacLeish |
| *Eremanthus glomeratus* Less. |
| *Eremanthus glomerulatus* Less. |
| *Eremanthus incanus* (Less.) Less. |
| *Wunderlichia mirabilis* Riedel ex Baker |
| **Bignoniaceae** |
| *Cybistax antisyphilitica* (Mart.) Mart. |
| *Handroanthus ochraceus* (Cham.) Mattos |
| *Jacaranda brasiliana* (Lam.) Pers. |
| *Tabebuia aurea* (Silva Manso) Benth. & Hook.f. ex S.Moore |
| **Boraginaceae** |
| *Cordia glabrata* (Mart.) A.DC. |
| **Burseraceae** |
| *Protium heptaphyllum* (Aubl.) Marchand |
| **Caryocaceae** |
| *Caryocar brasiliense* Cambess. |
| *Caryocar coriaceum* Wittm. |
| *Caryocar cuneatum* Wittm. |
| **Celastraceae** |
| *Plenckia populnea* Reissek |
| **Chrysobalanaceae** |
| *Couepia grandiflora* (Mart. & Zucc.) Benth. |
| *Hirtella ciliata* Mart. & Zucc. |
| *Hirtella glandulosa* Spreng. |
| *Licania sclerophylla* (Hook.f.) Fritsch |
| **Clusiaceae** |
| *Kielmeyera coriacea* Mart. & Zucc. |
| *Kielmeyera grandiflora* (Wawra) Saddi |
| *Kielmeyera lathrophyton* Saddi |
| *Platonia insignis* Mart. |
| **Combretaceae** |
| *Combretum mellifluum* Eichler |
| *Terminalia argentea* Mart. |
| *Terminalia fagifolia* Mart. |
| **Dilleniaceae** |
| *Curatella americana L.* |
| **Ebenaceae** |
| *Diospyros hispida* A.DC. |
| *Diospyros sericea* A.DC. |
| **Erythroxylaceae** |
| *Erythroxylum deciduum* A.St.Hil. |
| **Euphorbiaceae** |
| *Mabea fistulifera* Mart. |
| *Sapium haematospermum* Müll.Arg. |
| **Fabaceae** |
| *Andira cordata* Arroyo ex R.T.Penn. & H.C.Lima |
| *Andira cujabensis*Benth. |
| *Andira vermifuga* (Mart.) Benth. |
| *Bowdichia virgilioides Kunth* |
| *Cenostigma macrophyllum Tul.* |
| *Copaifera langsdorffii* Desf. |
| *Dalbergia miscolobium* Benth. |
| *Dimorphandra gardneriana Tul.* |
| *Dimorphandra mollis* Benth. |
| *Dipteryx alata* Vogel |
| *Enterolobium gummiferum* (Mart.) J.F.Macbr. |
| *Hymenaea stigonocarpa* Mart. ex Hayne |
| *Leptolobium dasycarpum* Vogel |
| *Leptolobium elegans* Vogel |
| *Luetzelburgia auriculata* (Allemão) Ducke |
| *Machaerium acutifolium* Vogel |
| *Parkia platycephala* Benth |
| *Peltogyne confertiflora* (Mart. ex Hayne) Benth. |
| *Plathymenia reticulata* Benth. |
| *Pterodon emarginatus* Vogel |
| *Pterodon pubescens* (Benth.) Benth. |
| *Senna silvestris* (Vell.) H.S.Irwin & Barneby |
| *Tachigali aurea Tul.* |
| *Tachigali subvelutina* (Benth.) Oliveira-Filho |
| *Tachigali vulgaris* L.G.Silva & H.C.Lima |
| *Vatairea macrocarpa* (Benth.) Ducke |
| **Icacinaceae** |
| *Emmotum nitens* (Benth) Miers |
| **Lecythidaceae** |
| *Eschweilera nana* (O.Berg) Miers |
| **Loganiaceae** |
| *Strychnos pseudoquina* A.St.-Hil. |
| **Lythraceae** |
| *Lafoensia pacari* A.St.-Hil. |
| **Malpighiaceae** |
| *Heteropterys campestris* A.Juss. |
| **Malvaceae** |
| *Eriotheca gracilipes* (K.Schum.) A.Robyns |
| *Eriotheca pubescens* (Mart. & Zucc.) Schott & Endl. |
| *Pseudobombax longiflorum* (Mart. & Zucc.) |
| *Pseudobombax tomentosum* (Mart. & Zucc.) |
| **Meliaceae** |
| *Cedrela fissilis* Vell. |
| **Moraceae** |
| *Ficus citrifolia* Mill. |
| **Myristicaceae** |
| *Virola sebifera Aubl.* |
| **Myrtaceae** |
| *Blepharocalyx salicifolius* (Kunth) O.Berg |
| *Eugenia dysenterica DC.* |
| *Myrcia multiflora* (Lam.) DC. |
| *Myrcia tomentosa* (Aubl.) DC. |
| *Psidium myrtoides* O.Berg |
| **Nyctaginaceae** |
| *Guapira graciliflora* (Mart. ex Schmidt) Lundell |
| *Guapira noxia* (Netto) Lundell. |
| **Opiliaceae** |
| *Agonandra brasiliensis* Miers ex Benth. & Hook. f. |
| **Primulaceae** |
| *Cybianthus detergens* Mart. |
| *Myrsine guianensis* (Aubl.) Kuntze |
| **Proteaceae** |
| *Roupala montana Aubl.* |
| **Rosaceae** |
| *Prunus myrtifolia* (L.) Urb. |
| **Rubiaceae** |
| *Alibertia edulis* (Rich.) A.Rich. |
| *Cordiera sessilis* (Vell.) Kuntze |
| **Rutaceae** |
| *Zanthoxylum rhoifolium* Lam. |
| *Zanthoxylum riedelianum* Engl. |
| **Salicaceae** |
| *Casearia grandiflora* Cambess. |
| *Casearia sylvestris* Sw. |
| **Sapindaceae** |
| *Cupania vernalis* Cambess. |
| *Magonia pubescens* A.St.-Hil. |
| **Sapotaceae** |
| *Pouteria ramiflora* (Mart.) Radlk. |
| *Pouteria torta* (Mart.) Radlk. |
| **Styracaceae** |
| *Styrax ferrugineus* Nees & Mart. |
| **Symplocaceae** |
| *Symplocos rhamnifolia* A.DC. |
| **Urticaceae** |
| *Cecropia pachystachya* Trécul |
| **Vochysiaceae** |
| *Callisthene fasciculata* Mart. |
| *Qualea cordata* (Mart.) Spreng. |
| *Qualea dichotoma* (Mart.) Warm. |
| *Qualea grandiflora* Mart. |
| *Qualea multiflora* Mart. |
| *Qualea parviflora* Mart. |
| *Salvertia convallariodora* A.St.Hil. |
| *Vochysia cinnamomea* Pohl |
| *Vochysia elliptica* Mart. |
| *Vochysia gardneri* Warm. |
| *Vochysia haenkeana* Mart. |
| *Vochysia rufa* Mart. |
| *Vochysia thyrsoidea* Pohl |

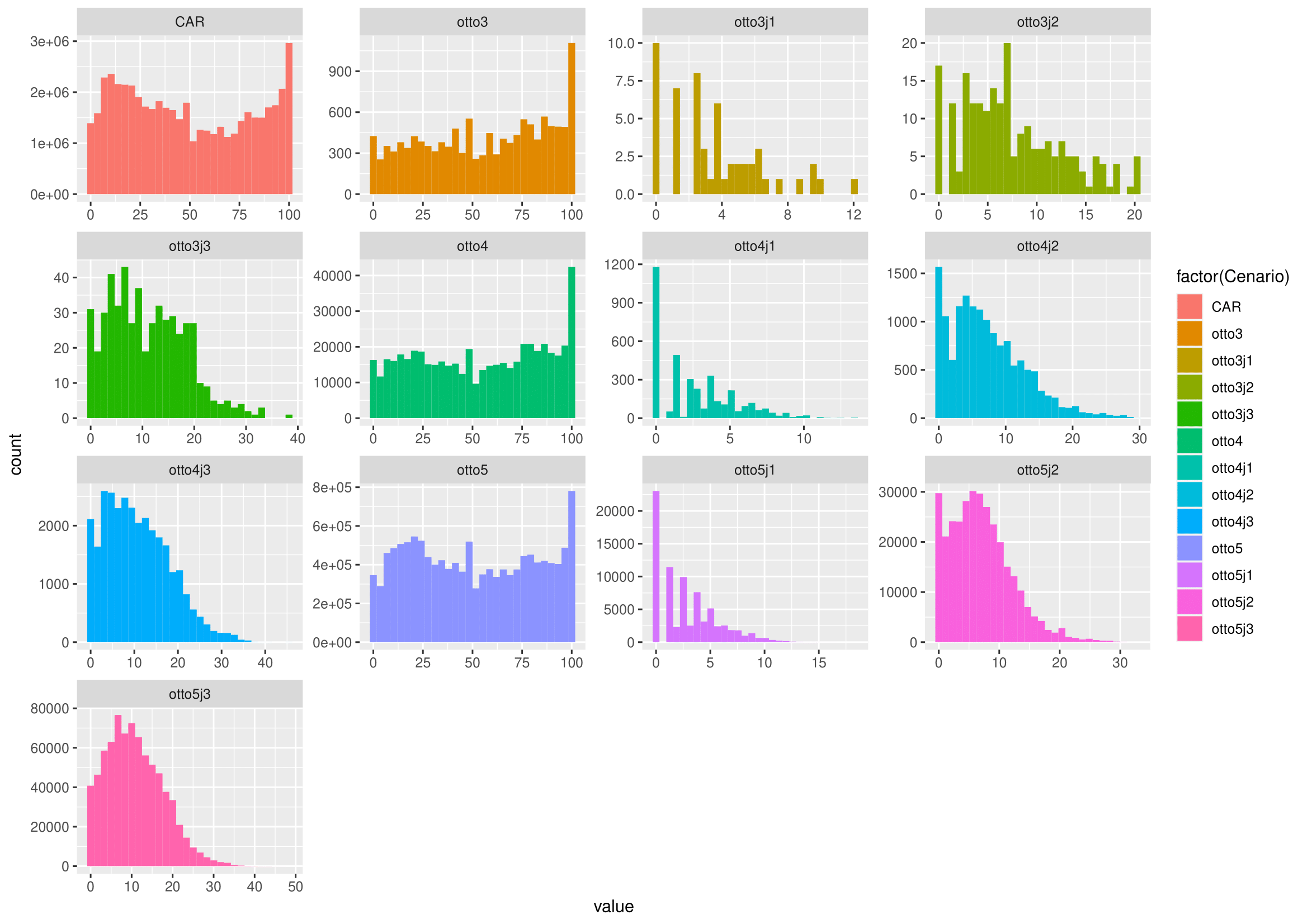


Figure S1. Frequency (y-axis) of % species losses (x-axis) in all scenarios. J1 = 90%, J2 = 80% and J3 = 70%.

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