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NEOTROPICAL WILD CATS SUSCEPTIBILITY TO CLIMATE CHANGE

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ABSTRACT

Ongoing climate change and the human role as dominant cause behind it are undeniable and already affecting living systems around the Globe. Nonetheless, the likely consequences of climate change to Neotropical biodiversity remains poorly understood. We used species distribution modeling to evaluate the likely effects of climate change to the eigth species of wild cats that are endemic to the Neotropics. We gathered (and provide) 424 species occurrence records from museum collections and the literature. We run the analysis on the ModEco software, using four modeling algorithms and projected models into 2050 using data from International Panel on Climate Change's last Assessment Report, under a business-as-usual emission scenario (RCP 8.5), according to four Global Circulation Models. We used an ensemble-forecasting approach to reach a consensus scenario, including only models with AUC > 0.70 for the present climate dataset. We created ensembles using the majority rule. After this procedure, we ended with two final suitability models per species, one for the present and another for the future. Model performance varied among species and was related to species' climatic suitability area (the smaller the area, the greater the model performance), and species with the smaller ranges were predicted to lose the highest percentage of their current distribution under climate change. The projections under climate change points to important contraction of climatically suitable areas for all Neotropical felids. Except for *Leopardus geoffroyii*, the remaining species show, in average, a 59.2% contraction of suitable areas. The three species that are already threatened under IUCN, *Leopardus jacobitus, Leopardus guigna, Leopardus tigrinus*, show more than 50% contraction. Among these species *Leopardus jacobitus*, found only in the higher elevations of the Andes, is of special concern because highland species are particularly susceptible to a warming climate.
Keywords: biodiversity; conservation; ecologic niche modeling; Felidae; species distribution modeling.

INTRODUCTION

Ongoing climate change is undeniable, with warming of the atmosphere and oceans, shrinking of glaciers and sea level rise (IPCC 2013). Since the 50's many of the observed changes are unprecedented over decades to millennia, and it is extremely likely that anthropogenic greenhouse gas emissions is the dominant cause of this observed changes (IPCC 2013).

Human-induced climate change is already affecting living systems around

the Globe (Parmensan and Yohe 2003). About two-thirds of all known species occur in the tropics (Pimm and Raven 2000), but studies on the likely effects of climate change on biodiversity focus overwhelmingly on temperate regions (Vale *et al.* 2009). Predictions for the Neotropics indicate with high confidence that climate change will promote the shrinkage of Andean glaciers, the increase in stream flow in sub-basins of the La Plata River, and the increase in coral bleaching in western Caribbean, and with medium confidence that it will promote changes in extreme flows in Amazon River and discharge patterns in rivers in the western Andes (IPCC 2014). With its current adaptation capacity, the regions has a high risk of shortage in water availability in semi-arid and glacier-melt-dependent regions, flooding and landslides in urban and rural areas due to extreme precipitation, and spread of vector-borne diseases (IPCC 2014).

The likely consequences of climate change to Neotropical biodiversity are still poorly understood (Vale *et al.* 2009). Studies, mostly based on species distribution modeling, generally predicts medium to severe contraction of species' geographic range (*e.g.* Anciães and Peterson 2006, Diniz *et al.* 2010, Souza *et al.* 2011, Loyola *et al*. 2014), as a consequence of disappearing of extant climates under climate change (Williams *et al.* 2007). Indeed, the first recorded extinction of species associated with climatic changes occurred with an endemic frog from Costa Rica (Pounds *et al.* 2006). There is a strong bias on the studies towards plants and vertebrates, especially birds in the literature in general (Siqueira *et al.* 2009, Nabout *et al.* 2012) and for studies with Neotropical species the bias remains (Vale and Lorini 2012). There is an important gap on the likely effects of climate change on carnivores, whose loss can cause top-down ecosystem forcing, leading to trophic downgrading and changes in ecosystems functioning (Estes *et al.* 2011). Here we evaluate the likely effects of climate change to the seven species of wild cats endemic to the Neotropics. We use endemic species to avoid modeling response curves that can be incomplete descriptions of species' responses to environmental predictors, because this may compromise the projection of species' distributions in different times than those used to calibrate the models (Thuiller *et al.* 2004). Neotropical endemic wild cats include wide-range and restricted-range species, which can differ in sensitivity to climate change. Often, species with restricted distribution also present a narrow niche breadth and tend to be more vulnerable to climate change (Broennimann *et al.* 2006). We hypothesize that species with larger current climatically suitable area would be less susceptible to future climate change, because they would be tolerant to a broader spectrum of climatic conditions.

MATERIAL AND METHODS

Species occurrence and environmental data

We gathered empirical occurrence records of Felidae species endemic

to South America from museum collections and the literature. Whenever the description of the record was precise enough, we determined the geographic coordinates of the location from four sources (in that order): (1) The literature source or museum tag, whenever available, (2) The Ornithological Gazetteers of the Neotropics (Paynter 1982, 1989a, 1989b, 1992, 1993, 1995, 1997, Stephens and Traylor 1983, 1985, Paynter and Traylor 1991, Vanzolini 1992), (3) The Directory of Cities and Towns in the World (DCTW 2008), and (4) paper or digital maps. We gathered 423 unique geo-referenced records for the eight endemic cat species (Carnivora, Felidae): 43 records of *Leopardus braccatus* (Cope, 1889), 21 of *L. colocolo* (Molina, 1782), 122 of *L. geoffroyi* (d'Orbigny and Gervais, 1844), 15 of *L. guigna* (Molina, 1782), 59 of *L. jacobitus* (Cornalia, 1865), 57 of *L. pajeros* (Desmarest, 1816), 40 of *L. tigrinus* (Schreber, 1775), and 66 of *L. guttulus* (Hensel, 1872) (Annex 1), following Wilson and Reeder (2005) for the first six species and Trigo *et al.* (2013) for *L. tigrinus* and *L. guttulus*.

Following Souza *et al.* (2011), we used a dataset of six bioclimatic variables to model species' distributions: maximum temperature of warmest month, temperature seasonality, precipitation of the driest month, precipitation of the wettest month, precipitation seasonality, and minimum temperature of coldest month. These six variables were selected from a set of 19 available variables (Hijmans *et al.* 2005), on the basis of their biological relevance, and the need to: 1) reduce the number of variables, given the relatively small number of occurrence records for some species; and 2) reduce, as much as possible, collinearity in the original set of variables.

We downloaded data for the current time and future projections under climate change from WorldClim (www.worldclim.org) at a resolution of 2.5 arc-minutes. Projected data for 2050 were based on IPCC's Fifth Assessment Report (IPCC 2013), using Representative Concentration Pathways (RCP) 8.5 (Riahi *et al.* 2001), according to four different Global Circulation Models (GCMs): CNRM-CM5, GFDL-CM3, GISS-E2 and MPI-ESM-LR. The RCP 8.5, the "business as usual" climate scenario, is a pessimistic projection, with green house gas emissions stabilization post-2100, and concentrations post-2200 (Meinshausen *et al.* 2011).

Analysis

We fit species climatic suitability models in the ModEco analytical package (http://gis.ucmerced.edu/ModEco), which integrates a range of modeling methods within a Geographical Information System (Guo and Liu 2010). Because different modeling algorithms can produce very different results (Diniz-Filho *et al.* 2009), we used four standard and distinct algorithms, combining their results into a final ensemble forecast (Araújo and New 2007): one based on environmental envelope (BIOCLIM), a statistical Generalized Linear Model (GLM) and two machine learning based, Maximum Entropy (MAXENT) and One-class

Support Vector Machine (SVM). BIOCLIM and SVM are presence-only models, GLM and MAXENT are presence versus background data models. To run GLM and MAXENT we used 10,000 background points. We randomly selected 25% of the original presence data for testing the predictions and evaluate the performance of all models.

The ModEco interface generates an estimate of the model's performance represented by the "Area Under the ROC curve" (AUC). The AUC varies between 0 and 1, and has an intuitive interpretation: an AUC of 0.5 characterizes a model that is as good as one generated at random, a value > 0.5 characterizes a better-than-random model prediction, and a value < 0.5 characterizes a worse-than-random model prediction. We considered models with AUC ≥ 0.70 to be fair to excellent (Swets 1988, but see Lobo *et al.* 2008). The AUC was generated only for the model of current distribution, which is the actual model that is later projected into the future.

We used an ensemble-forecasting approach to reach a consensus scenario, in order to produce more robust predictions and reduce the model variability owing to the SDM methods and GCM**s** used (Araújo and New 2007, Marmion *et al.* 2009, Diniz-Filho *et al.* 2009, 2010). At the end, 20 climatic suitability models were created for each species: four algorithms x five datasets (present plus four AOGCMs future projections). We excluded models with AUC < 0.70 for the present climate dataset from further analysis. Continuous suitability results were transformed in binary predictions using the threshold that maximizes the sum of sensitivity and specificity (Liu *et al.* 2013). Only binary predictions (suitable or unsuitable) were combined to generate the consensus model because continuous outputs can have different meanings for different models and cannot be simply summed together (Guo and Liu 2010). We created ensembles in ArcGIS 10.1 using the majority rule, i.e. selecting as suitable only the cells defined as suitable for at least half of the models used in the ensemble (Diniz-Filho *et al.* 2010). After this procedure, we ended with two final suitability models per species, one for the present and another for the future. In addition, to visualize the variability of the results, we created two sets of ensembles for each species: 1) ensemble of results from different algorithms for each dataset, and 2) ensemble of GCMs based on previous ensembles for the future projections). Final climatic suitability models were projected using Albers Equal Area Projection in ArcGIS, and the area (km^2) of current and future suitability calculated.

We also investigated the relationship of species range characteristics and model prediction accuracy. We run a regression analysis between current predicted suitable area and model AUC values in order to evaluate whether models fitted for species with larger climatically suitable areas would show better performance. If that is the case, then the distributions of the restricted-range species are likely more regulated by climate, and therefore they might be more susceptible to climate change.

RESULTS

Model performance, as measured by AUC values, varied greatly among algorithms, with BIOCLIM performing best, followed by SVM and GLM, and MAXENT showing very poor performance (Table 1). Model performance also varied among species (Table 1), and was negatively related to species' suitability area for BIOCLIM and SVM: the smaller the area, the greater the model performance (Figure 1). Disregarding MAXENT AUC values for it poor results, *L. colocolo*, *L. jacobitus L. guigna* had the best model performance (average AUC > 0.9), followed by *L. geoffroyi* and *L. guttulus* (average AUC > 0.8), and *L. braccatus*, *L. tigrinus* and *L. pajeros* (average AUC > 0.7). The projections under climate change points to important contraction of climatically suitable areas for all Neotropical felids, except for *L. geoffoyii*. The remaining species show, in average, a 59.2% contraction of suitable areas, with *L. tigrinus*, *L. braccatus*, *L. jacobitus, L. guttulus* and *L. guigna*, showing more than 50% contraction (Table 2, Figure 2).

DISCUSSION

Our study suggests that climate change could negatively affect Neotropical wild cats by eliminating a vast extent of climatically suitable areas. As expected, distribution models for species with larger climatically suitable areas showed lower predictive accuracy. This has been shown before (Thuiller *et al.* 2004, Hernandez *et al.* 2006, Syphard and Franklin 2010, but see Zank *et al.* 2014) and is likely because species with large geographic ranges should be tolerant to a broader spectrum of climatic conditions, and its distribution cannot be determined by climate alone. On the other hand, species with smaller geographic ranges should likely be more

Table 1. Number of occurrence records (N), and AUC value for models of current climatically suitability of the four different algorithms used (BIOCLIM, SVM, GLM, MAXENT). Only models with AUC ≥ 0.7 were included in final ensemble distribution models (shown in bold) and projected into the future. Species presented in decreasing order of average model performance.

Species	N	BIOCLIM	SVM	GLM	MAXENT
L. colocolo	21	**0.995**	**0.909**	**0.951**	0.678
L. jacobitus	59	**0.967**	**0.911**	**0.733**	**0.807**
L. guigna	15	**0.958**	**0.842**	**0.842**	0.502
L. geoffroyi	122	**0.906**	**0.871**	**0.721**	0.618
L. guttulus	66	**0.946**	**0.928**	0.498	0.491
L. braccatus	43	**0.896**	**0.800**	0.498	0.496
L. tigrinus	40	**0.793**	**0.701**	0.522	0.500
L. pajeros	57	**0.760**	**0.690**	0.538	0.503

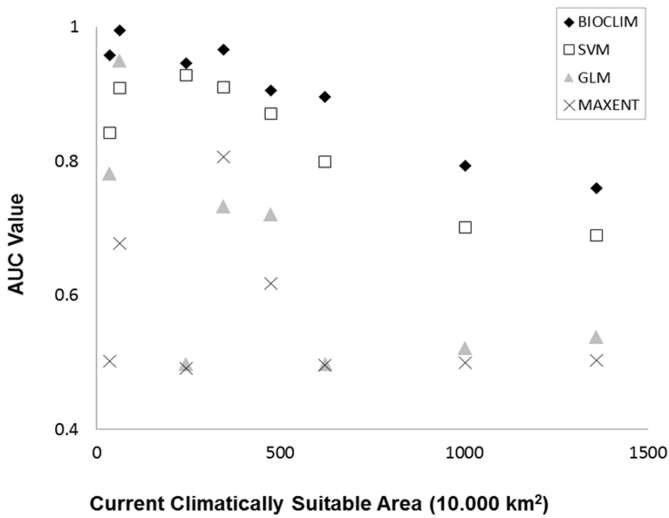

Figure 1. Relationship between AUC values and size of species' current climatically suitable areas for different distribution modeling algorithms: BIOCLIM ($r^2 = 0.941$), SVM ($r^2 = 0.779$), GLM ($r^2 = 0.416$) and MAXENT ($r^2 = 0.1283$).

Table 2. Modeled distribution range size of Neotropical felids under current climate and future (2050) climate change conditions. Species presented in decreasing order of range size contraction.

Species	Current Area Ensemble (km²)	Future Area Ensemble (km²)	Area Lost (%)	Area Gain (%)	Area Change (%)
Leopardus tigrinus	10,031,197.1	1,323,776.4	86.8	0.6	-86.2
Leopardus braccatus	6,224,047.9	4,794,244.6	77	2.5	-74.5
Leopardus jacobitus	3,453,507.3	1,414,818.0	62.1	0.3	-61.8
Leopardus guttulus	2,434,186.5	1,051,940.8	56.8	2.7	-54.1
Leopardus guigna	355,928.1	171,205.1	54.3	2.4	-51.9
Leopardus colocolo	624,735.0	333,780.3	47	0.5	-46.5
Leopardus pajeros	13,600,721.1	8,194,719.2	40.2	0.5	-39.7
Leopardus geoffroyi	4,740,710.6	4,636,930.3	21.7	19.5	-2.2

regulated by climate and, therefore, more susceptible to climate change. However, because all the Neotropical cat species have relatively large geographic ranges (> 1.000.000 km^2, except for *L. guigna* and *L. colocolo*), climate change alone is unlikely to reduce their extent of occurrence to the 20,000 km^2

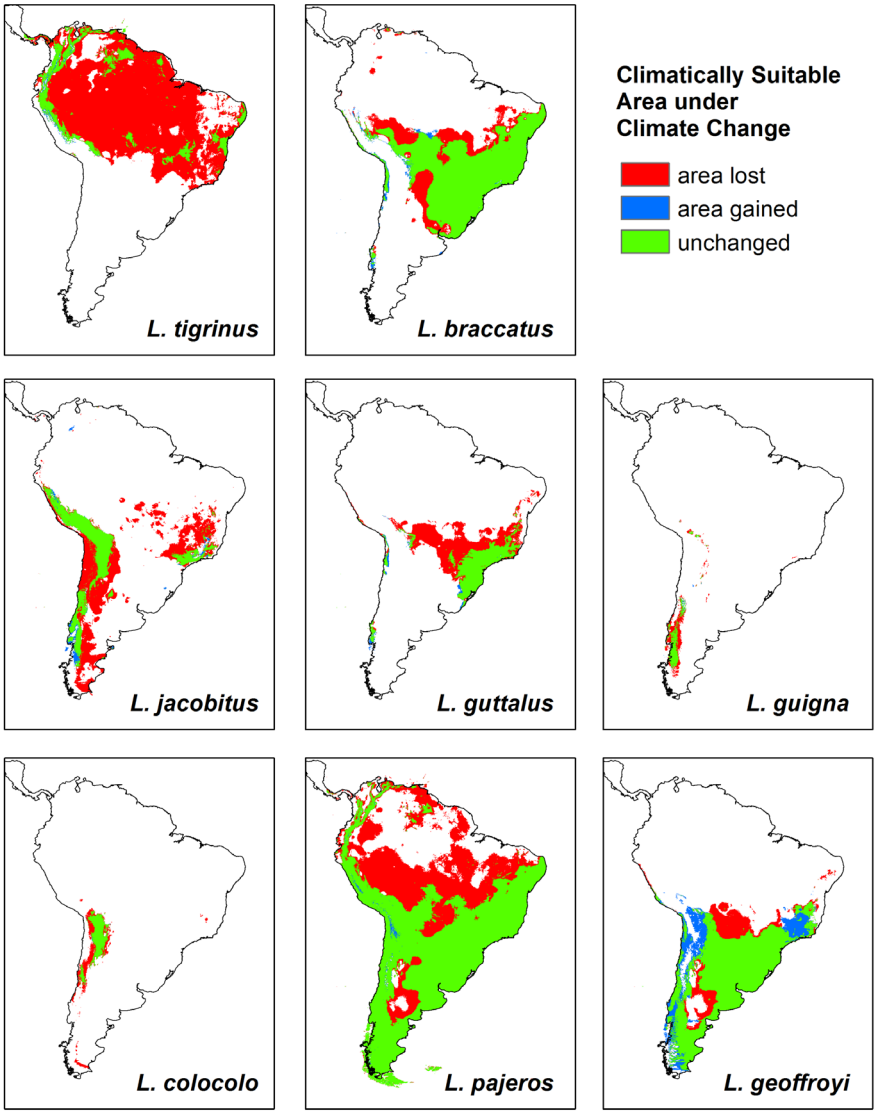

Figure 2. Projection of climatically suitable areas for Neotropical felids under a 2050 "business as usual" climate change scenario. Species presented in decreasing order of range size contraction.

threshold size that characterizes threat under the International Union for Nature Conservation criteria (IUCN 2001). It is important to note, however, that our estimates of climatically suitable areas does not equate to species' geographic range, being generally larger than the estimated extent of occurrence of the IUCN. For *L. guigna*, for example, we predicted 356,000 km^2 of climatically

suitable areas at present time, while its estimated extent of occurrence is just 177,000 km^2 (Acosta and Lucherini 2008). Future extent of occurrence, therefore, would likely be much smaller than the figures shown in Table 2.

Climate change can act in synergy with other stressors – habitat loss and fragmentation – which represent the main threat to the three already threatened species in our study: *L. jacobitus, L. guigna, L. tigrinus*, plus *L. guttulus* that in IUCN is still taxonomically within *L. tigrinus*. We considered *L. tigrinus* and *L. guttulus* as distinct species following Trigo *et al.* (2013). The authors found consistent evidence for genetic differentiation between NE and SSE populations of *L. tigrinus* that strongly indicate the absence of current or recent gene flow between these units, supporting the recognition of *L. tigrinus* (Schreber 1775) for NE Brazil and *L. guttulus* (Hensel 1872) for SSE Brazil as distinct biological species. Although much of the taxonomic confusion involving the genus *Leopardus* has been clarified in recent decades, some issues remain. One such issue is the taxonomic status of the *L. tigrinus* group, until now recognized as a single species (*L. tigrinus*), but for which contradictory data and hypotheses have been suggested in the past (Trigo *et al.* 2013). Besides the distinctiveness between *L. tigrinus* and *L. guttulus*, previous genetic studies (Johnson *et al.* 1999, Trigo *et al.* 2008) have indicated that populations from Central America (representing *L. t. oncilla*) were very distinct from those sampled in South America (now recognized as *L. guttulus*). Therefore, there is the possibility that populations of NE Brazil, Amazon and Central America actually comprise a species complex. This could be the reason for the poor performance of the *L. tigrinus* model, with mean AUC = 0.6 (Table 1) and a broad suitable area, likely overpredicted. Also, we predicted for *L. tigrinus* a contraction of 86.2% of suitable areas in the future, the highest value among the all species. We should be cautions with this result, considering that taxonomic uncertainties has a significant effect on spatial models (Elith *et al.* 2013). We agree with Trigo *et al.* (2013) that resolving the taxonomic uncertainty surrounding *L. tigrinus* group should be a priority that should involve compiling and synthesizing genetic, morphological and ecological information about these felids across their ranges in South and Central America.

Our study also shows that *L. jacobitus* and *L. guigna* are likely to lose more than 50% of currently suitable areas due to climate change. *Leopardus guigna* has already lost most of its native temperate forest habitat in Chile and Argentina due to extensive conversion to pine forest plantations, being considered Vulnerable to extinction by IUCN (Acosta and Lucherini 2008). *Leopardus jacobitus*, found only in the higher elevations of the Andes, is of special concern because highland species are particularly susceptible to a warming climate (Pounds *et al.* 1999, Williams *et al.* 2003, Pounds *et al.* 2006). The species preferred habitat is naturally fragmented by deep valleys and the patchy distribution of its preferred prey,

the mountain vizcachas (*Lagidium* spp.) (Acosta *et al*. 2008), and it is considered Endangered due to the loss of prey base and habitat and the persecution for traditional ceremonial purposes (Acosta *et al.* 2008).

Our findings are consonant with predictions of likely impacts of climate change on other wild cats. The Iberian Lynx (*Lynx pardinus*), the World's most endangered cat, may be extinct in the wild in the next 50 years, due to climate change induced range contraction and asynchrony with the redistribution of prey base, the European rabbit (*Oryctolagus cuniculus*) (Fordham *et al.* 2013). Similarly, the World's larger population of tigers (*Panthera tigris*), in India's Sundarban islands, may disappear in the next 50 years due to climate change induced sea level rise (Loucks *et al*. 2010).

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Annex 1: Gazetteer of 423 unique geo-referenced records used to model de climatically suitable areas for seven Felidae species endemic to the Neotropics. Geographic coordinates presented in decimal degrees. Complete dataset with record source available in spreadsheet format upon request.

Locality	Latitude	Longitude
Leopardus braccatus		
Aquidauana - Mato Grosso do Sul - Brazil	-20.467	-55.800
Arroyo Limetas - Conchillas - Colonia - Uruguay	-34.183	-58.100
Arroyo Perdido (rincón de Perdido y Curupí) - Soriano - Uruguay	-33.383	-57.367
Assunción - Paraguay	-25.267	-57.667
Asunción - Dpto. Central - Paraguay	-25.250	-57.667
banãdos Playa Pascual - San José - Uruguay	-34.750	-56.583
Bopicua - Río Negro - Uruguay	-33.100	-58.017
Boquerón - Porto Pinasco - Paraguay	-22.717	-57.833
Cachoeira - Piauí - Brazil	-7.333	-44.350
Cachoeira do Sul - Rio Grande do Sul - Brazil	-30.033	-52.883
Chamizo - Dpto. San José - Uruguay	-34.250	-55.933
Chapada dos Guimarães - MT - Brazil	-15.433	-55.750
Conchillas - Colonia - Uruguay	-34.250	-58.067
Córrego São Manuel - Goiás - Brazil	-16.400	-50.150
Cuiabá - Mato Grosso - Brazil	-15.583	-56.083
Descalvados - Mato Grosso - Brazil	-16.733	-55.717
Descalvados - Rio Paraguay (upper) - Mato Grosso - Brazil	-16.750	-57.700
Encruzilhada do Sul - Rio Grande do Sul - Brazil	-30.533	-52.517
Encruzilhada do Sul - Rio Grande do Sul - Brazil	-30.333	-52.000
Faz. Piquí - Aquidauana - Mato Grosso do Sul - Brazil	-20.467	-55.700
Fazenda Piquí - Aquidauana - Mato Grosso do Sul - Brazil	-20.467	-55.747
Fortín Juan de Zalazar - Dpto. Presidente Hayes - Paraguay	-23.100	-59.300
Hacienda Herminia - Parque San Gregorio - Dpto. San José - Uruguay	-34.683	-56.833
Júlio de Castilho - Rio Grande do Sul - Brazil	-29.217	-53.667
Maracajú - Mato Grosso do Sul - Brazil	-21.633	-55.167
Maracajú - Mato Grosso do Sul - Brazil	-21.633	-55.150
Martin Chico - Est Juan Escoto - Colonia - Uruguay	-34.167	-58.217

continued...

Miranda - Mato Grosso do Sul - Brazil	-19.850	-56.700
Palmas - Tocantins - Brazil	-10.167	-48.333
Parque Nacional das Emas - Goiás - Brazil	-18.264	-52.893
Paso del Pelado - Arroyo Miguelete - Colonia - Uruguay	-34.867	-56.217
Rio Paranã - Tocantins - Brazil	-12.667	-48.000
Rondonópolis - MT - Brazil	-16.467	-48.050
San Gregorio - San José - Uruguay	-33.950	-56.750
San Luis de la Sierra - Dpto. Concepción - Paraguay	-22.417	-57.450
São Desidério - BA - Brazil	-12.350	-44.967
São Lourenço - Rio Grande do Sul - Brazil	-31.367	-51.967
São Lourenço do Sul - Rio Grande do Sul - Brazil	-31.350	-51.967
Taguatinga - Distrito Federal - Brazil	-15.817	-44.350
Tarariras - Dpto. Cerro Largo - Uruguay	-32.467	-55.017
Três Lagoas - Mato Grosso do Sul - Brazil	-20.800	-51.717
Tupanciretã - Mato Grosso do Sul - Brazil	-19.483	-56.367
Zapicán - Dpto. Lavelleja - Uruguay	-33.517	-54.917
Leopardus colocolo		
Camarones river - Pcia. Tarapacá - Chile	-19.017	-69.867
Cauquenes - Pcia. Maule - Chile	-35.967	-72.350
Cerro de la Campana - Quillota - Pcia. Valparaíso - Chile	-32.950	-71.133
Cerro Llai-Llai - Pcia. Valparaíso - Chile	-32.833	-71.267
Colina - Chile	-33.200	-70.683
Hai-Llai - Chile	-33.833	-71.000
Limache - Pcia. Valparaíso - Chile	-33.000	-71.267
Malacará - Pcia. Valparaíso - Chile	-33.000	-71.083
Malacara opposite Quillota - Chile	-33.833	-71.833
Marquesa - Pcia. Cochimbo - Chile	-29.967	-71.000
montains above Catapilco lake - Pcia. Aconcagua - Chile	-32.567	-71.283
Lago Catapilco montains - Pcia. de Aconcagua - Patagonia - Argentina	-31.433	-70.717
Punta Caraumilla - Pcia. Valparaíso - Chile	-33.100	-71.733
Putre - Tacna - Pcia. Tarapacá - Chile	-18.200	-69.583
Santiago - Pcia. Santiago - Chile	-33.450	-70.667
Termas de Cauquenes - Chile	-34.250	-70.567
Termas de Cauquenes - Pcia. O'Miggins - Chile	-35.250	-70.567

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Tiltil - Chile	-33.083	-70.933
Vegas de Curacaví - Pcia. Santiago - Chile	-33.400	-71.150
Viña del Mar - Pcia. Valparaíso - Chile	-33.033	-71.583
Vina del Mar - Valparaiso - Chile	-33.033	-71.567
Leopardus geoffroyi		
Achiri - Dpto. La Paz - Bolivia	-17.200	-69.000
Aguaray - Salta - Argentina	-22.267	-63.733
Ajo - Buenos Aires - Argentina	-36.400	-56.967
vicinity of the city of Jujuy - Pcia. Jujuy - Argentina	-24.183	-65.300
Angostura - near river Caraparí - Pcia. Salta - Argentina	-22.133	-63.717
Arambaú - Camaquã - Rio Grande do Sul - Brazil	-30.850	-51.817
Arazatí - San José - Uruguay	-34.567	-57.000
Arroyo Cuaró - Paso Campameno Artigas Artigas - Uruguay	-30.767	-56.800
Arroyo Cuaró - paso Campamento - Artigas - Uruguay	-31.917	-55.217
Arroyo del Perdido - Soriano - Uruguay	-33.383	-57.367
Arroyo Limetas - Colonia - Uruguay	-34.183	-58.100
Arroyo Malo - Cortinas - Tacuarembó - Uruguay	-31.867	-58.200
Arroyo Mandiyú - Artigas - Uruguay	-30.483	-57.833
Arroyo Perdido (rincón de Perdido y Curupí) - Soriano - Uruguay	-33.383	-57.367
Arroyo Porongos - Flores - Uruguay	-33.533	-56.900
Arroyo Tigre - near Conchillas - Colonia - Uruguay	-34.250	-58.067
Arroyo Tres Cruces Chico - Artigas - Uruguay	-30.467	-56.750
Arroyo Tres Cruces Grande - Artigas - Uruguay	-30.283	-57.200
Asunción - Paraguay	-25.267	-57.667
Atahona - Dpto. Simoca - Tucumán - Argentina	-27.417	-65.283
Atlántida - Canelones - Uruguay	-34.767	-55.750
Bahia Blanca - Mar del Plata - Argentina	-38.717	-62.283
Balcarce (25 Km SE of) - Las Peditras - Buenos Aires Province - Argentina	-37.833	-58.250
Balneario Kiyú (sobre el Río de la Plata) - San José - Uruguay	-34.833	-56.667
Bañado Tropa Vieja - Canelones - Uruguay	-34.700	-56.450
banãdo Tropa Vieja (Arroyo Pando) - Canelones - Uruguay	-34.783	-55.867
Barra Arroyo Caracoles Grande (Rincón de las Gallinas, 17Km al S SW Fray Bentos) - Río Negro - Uruguay	-33.333	-58.333

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Barra de Los Arroyos Salsipuedes Grande y Salsipiedes Chico - Tacuarembó - Uruguay	-32.817	-56.683
Barra del Arroyo Caracoles Grande - 17Km SSW de Fray Bento - Uruguay	-33.267	-58.350
Barra del Arroyo Itapebi - Salto Grande - Salto - Uruguay	-31.233	-57.917
Barra del Infernillo - Tacuarembó - Uruguay	-31.383	-56.167
Barra del Río San Salvador - Soriano - Uruguay	-33.483	-58.383
Bialet Massé (oeste de) - Córdoba - Argentina	-31.300	-64.467
Bolsón de Pipanaco - Pcia. Catamarca - Argentina	-28.117	-66.417
Cabo Polonio - Rocha - Uruguay	-34.400	-53.783
Cabo Polonio - Rocha - Uruguay	-34.383	-53.767
Cajuata - Dpto. La Paz - Bolivia	-16.817	-67.250
Calanuechita - Córdoba - Argentina	-32.250	-64.583
Canada Honda - San Juan - Argentina	-31.583	-69.617
Cañadon de Las Vacas - Santa cruz - Argentina	-50.550	-69.250
Cerro Copetón - Florida - Uruguay	-33.800	-55.533
Cerro de las Aminas - Maldonado - Uruguay	-34.767	-55.317
Cerro do Jarau - Quaraí - Rio Grande do Sul - Brazil	-30.200	-56.500
Chalican - Pcia. Jujuy - Argentina	-24.067	-64.800
Chapada dos Guimarães (city) – Mato Grosso - Brazil	-15.433	-55.750
Colonia Alrear - Mendonza - Argentina	-34.967	-67.700
Colonia San Gregorio – coast of Río Uruguay - Artiga - Uruguay	-30.550	-57.867
Concepción - Dpto. Chincligasta - Tucumán - Argentina	-27.333	-65.583
Cortaderas - Pcia. de San Luis - Argentina	-32.500	-65.000
Cruz del Eje - Pcia. Córdoba - Argentina	-30.733	-64.800
Dpto. Burruyacú - Tucumán - Argentina	-26.500	-64.917
Dragones (vicinities of) - Salta - Argentina	-23.250	-63.350
El Mantial - Dpto. Lules - Tucumán - Argentina	-26.850	-65.283
Famatina - La Rioja - Argentina	-28.917	-67.517
Fazenda Timbaúva - Rosário do Sul - Rio Grande do Sul - Brazil	-30.450	-51.383
Gruta de Salamanca - Maldonado - Uruguay	-34.167	-54.667
Hualfín (14km S of) - Pcia. Catamarca - Argentina	-27.233	-66.833
Isla Mala - Florida - Uruguay	-34.189	-56.339
José Pedro Varela - Trienta y Tres - Uruguay	-33.450	-54.533

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Juan Zalazar - left bank to 4Km N Río Verde - Paraguay	-23.100	-59.300
Junta de Los Ríos - San Pedro de Colalao - Dpto. Trancas - Tucumán - Argentina	-26.233	-65.483
La Florencia - Junto el rio Tereco - Formosa - Argentina	-24.200	-62.017
La Ramada - Depto. Burruyacú - Tucumán - Argentina	-26.700	-64.950
Lago Martin - Río Negro - Argentina	-41.533	-71.700
Lago Nahuel Huapi - Argentina	-40.967	-71.500
Las Víboras - Dpto. de Anta - Salta - Argentina	-25.033	-64.650
Leales - Leales - Tucumán - Argentina	-27.200	-65.300
Lihue Calel National Park - Pcia. La Pampa - Argentina	-38.000	-65.583
Los Hoyos - Córdoba - Argentina	-29.867	-64.117
Los Palmares - Dpto. Santa Cruz - Bolivia	-15.750	-61.000
Los Yngleses - Ajo - Buenos Aires - Argentina	-36.517	-56.883
Loventuel - La Pampa - Argentina	-36.183	-65.300
Mar del Plata - Buenos Aires - Argentina	-38.000	-57.550
Monte Ombúes (Laguna de Castillos) - Rocha - Uruguay	-34.333	-53.900
Monteagudo (2Km SW of) - Dpto. Chuquisaca - Bolivia	-19.817	-63.967
Nahuel Huapi (frontier S of) - Patagonia - Argentina	-41.050	-71.150
Noetinger - FCCA - Pcia. de Córdoba - Argentina	-32.367	-62.317
Paraná - Entre Ríos - Argentina	-31.733	-60.533
Parque Nacional Torres del Paine - 142Km N Puerto Natales - Chile	-51.017	-72.900
Parque Santa Teresa - Rocha - Uruguay	-33.983	-53.533
Patquía - La Rioja - Argentina	-30.050	-66.883
Perforación - 50Km S of Cerro Colorado - Dpto. Santa Cruz - Bolivia	-19.917	-62.550
Pico Salamanca - Chubut - Argentina	-45.417	-67.417
Piedra Tendida - 12Km WNW Burruyacú - along Río Cajón - Dpto. Burruyacú - Tucumán - Argentina	-26.500	-64.867
Pirarajá Río Cebollati - Lavalleja - Uruguay	-33.733	-54.750
Pozo de Maza - Fortuna - Argentina	-23.567	-61.700
Pozo Hondo - Dpto. Graneros - Tucumán - Argentina	-27.817	-65.333
Puerto Ibanez, Coyhaique - Aysen Province - Chile	-46.300	-71.933
Pulque - Dpto. Chuquisaca - Bolivia	-19.233	-65.217
Punta del Arroyo Laureles - Tacuarembó - Uruguay	-31.367	-55.783
Punta San Gregório - San José - Uruguay	-34.683	-56.833

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Puntas del Río Olimar - Lavalleja - Uruguay	-33.267	-53.867
Quebrada de Los Matos - Dpto. Trancas - Tucumán - Argentina	-26.333	-65.367
Quebrada de la Angostura - Dpto. Trancas - Tucumán - Argentina	-26.200	-65.517
Río Arapey - 4Km SW de las Termas del Arapey - Salto - Uruguay	-30.967	-57.533
Río Cachimayo - Dpto. Potosí - Bolivia	-19.300	-66.200
Río de la Plata - 3Km al E de Martín Chico - Colonia - Uruguay	-34.167	-58.217
Río Negro - 7Km agua arriba de la barra com el Tacuarembó - Uruguay	-32.417	-55.483
Río Negro - frente a las islas Lobo y Del Vizcaino - Soriano - Uruguay	-33.383	-58.383
Río Negro - Uruguay	-33.400	-58.367
Río Olimar Chico - Trienta y Tres - Uruguay	-33.233	-54.517
Río Santa Lúcia Chico – 5 km from the city of Florida - Florida - Uruguay	-34.350	-56.333
San Lorenzo - Dpto. Tarija - Bolivia	-21.433	-64.783
San Rafael - Mendonza - Argentina	-34.600	-68.333
Santa Bárbara - Jujuy - Argentina	-23.600	-65.067
Santana do Livramento - Rio Grande do Sul - Brazil	-30.883	-55.517
São Lourenço - Rio Grande do Sul - Brazil	-31.367	-51.950
Sargento Rodriguez (bolivian border near) - Paraguay/Bolivia	-20.550	-62.283
Sierra de La Ventana - Pcia. Buenos Aires - Argentina	-38.050	-62.250
Soriano - Uruguay	-33.400	-58.317
Teniente Ochua - Paraguay	-21.700	-61.033
Tiraqui - Dpto. Cochabamba - Bolivia	-17.417	-65.717
Toay - La Pampa - Argentina	-36.667	-64.350
Trancas - Trancas - Tucumán - Argentina	-26.217	-65.283
Valle de Los Reartes - Córdoba - Argentina	-31.917	-64.583
Valle Edén - Tacuarembó - Uruguay	-31.833	-56.150
Victoria - La Pampa - Argentina	-36.217	-65.450
Villa Dolores - Córdoba - Argentina	-31.933	-56.200
Villa Hayes (Chaco Experimental Station, 295 km NW de) - Dpto. Presidente Hayes - Paraguay	-25.100	-57.567
Villa Unión - La Rioja - Argentina	-29.300	-68.200
Vipos - Dpto. Trancas - Tucumán - Argentina	-26.483	-65.367
Zapican - Lavalleja - Uruguay	-33.517	-54.917

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Leopardus guigna

Alto Río Simpson - near Loya de la Laguna Blanca - Chubut - Argentina	-45.400	-72.533
Angol - Chile	-37.800	-72.717
Ercilla - Pcia. Malleco - Chile	-38.050	-72.383
Lago Cayutuá - Pcia. Llanquihué - Chile	-41.267	-72.267
Lago Todos los Santos - Cayute - Chile	-41.100	-72.250
Limache - Valparaiso - Chile	-33.017	-71.267
Peninsula de Tumbes - Pcia. Concepción - Chile	-36.667	-73.133
Rinue - Valdivia - Chile	-39.850	-72.400
Río Inio - Ilha Chiloé - Chile	-43.350	-74.117
Sierra Nahuelbuta - Malleco - Angol - Chile	-37.800	-73.033
Talcahuano - Pcia. de Concepción - Chile	-36.717	-73.117
Temuco - Pcia. Cantía - Chile	-38.733	-72.600
Termas de Cauquenes - Pcia. O'Miggins - Chile	-35.250	-70.567
Valle del Lago Blanco - Chubut - Patagonia - Argentina	-45.900	-71.250
Vina del Mar - Valparaiso - Chile	-33.033	-71.567

Leopardus jacobitus

Abra del Acay - Salta - Argentina	-24.333	-66.083
Abra Iruya - Salta - Argentina	-22.867	-65.250
Acay - Salta - Argentina	-24.300	-66.067
Aguilar - Jujuy - Argentina	-23.767	-66.533
Arequipa (57Km ENE de) - Pcia. Arequipa - Dpto. Arequipa - Peru	-16.400	-71.550
Arica - Tarapaca Province - Chile	-18.483	-70.333
Auzangate - Canchis - Cuzco - Peru	-13.744	-71.204
Azul Pampa - Jujuy - Argentina	-22.950	-65.550
Camino a San Francisco - Pcia. Catamarca - Argentina	-26.600	-66.180
Canchayllo - Jauja - Junin - Peru	-11.824	-75.700
Catamarca - Pcia. Catamarca - Argentina	-28.467	-65.950
Challapata area - Dpto. Oruro - Bolivia	-18.900	-66.783
Chichillapi - Chucuito - Puno - Peru	-16.930	-69.806
Coyaguaima - Jujuy - Argentina	-22.833	-66.700
Cuesta Blanca - Jujuy - Argentina	-22.483	-66.533
Cumbres Calchaquíes - Dpto. Tafí Viejo - Tucumán - Argentina	-27.333	-65.583

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Cusi Cusi Limitayoc - Jujuy - Argentina	-22.233	-66.650
El Collao - Puno - Peru	-17.136	-69.699
El Collao - Puno - Peru	-16.710	-69.727
El Toro - Jujuy - Argentina	-22.167	-65.467
El Toro - Jujuy - Argentina	-23.000	-66.717
Huactapa - Arequipa - Peru	-14.989	-72.715
Huayhuash - Bolognesi - Ancash - Peru	-10.224	-76.954
Kallapuma - Tarata - Tacna - Peru	-17.318	-69.731
Khastor - Dpto. Potosí - Bolivia	-22.283	-67.017
Khastor (3Km NE of) - Dpto. Potosí - Bolivia	-22.200	-66.967
Koyajo - Arequipa - Peru	-15.434	-72.686
Laguna Blanca - Catamarca - Argentina	-26.583	-66.943
Laguna Blanca - Cerro Colorado - Catamarca - Argentina	-26.645	-66.971
Laguna Blanca - Quebrada Tranca - Catamarca - Argentina	-26.732	-67.020
Laguna Helada - NO of Corral Quemado - Pcia. Catamarca - Argentina	-27.083	-67.150
Laguna Huaca Huasi - Cumbres Calchaquíes - Dpto. Tafí Viejo - Tucumán - Argentina	-26.683	-65.733
Lampa - Puno - Peru	-15.258	-70.461
Laraos - Yauyos - Lima - Peru	-12.333	-75.783
Morro del Zarzo - Dpto. Tafí del Valle - Tucumán - Argentina	-27.000	-65.900
near Jijuaña - El Collao - Puno - Peru	-17.231	-69.894
near Kovire -El Collao - Puno - Peru	-17.183	-69.914
near Pisacoma - Chucuito-Puno - Peru	-16.917	-69.484
Ojo de Beltra´n - Catamarca - Argentina	-25.752	-67.357
Pachacpata - Abancay - Apurimac - Peru	-13.597	-72.969
Pillones - Arequipa - Arequipa - Peru	-15.935	-71.246
Pozuelos - Cerro Medano - Jujuy - Argentina	-22.333	-65.850
Pozuelos - Quera - Jujuy - Argentina	-22.283	-65.850
Pozuelos - Sta.Catalina - Jujuy - Argentina	-22.117	-65.767
Purmamarca Lipa´n - Jujuy - Argentina	-23.733	-65.533
S.A. de los Cobres - Salta - Argentina	-24.067	-66.067
Sajama (8 km ESE of the village of) - Pcia. Sajama - Dpto. Oruro - Bolivia	-18.150	-68.900
Sajama (8 km NW of the village of) - Pcia. Sajama - Dpto. Oruro - Bolivia	-18.083	-69.067

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Salinas Grandes - Jujuy/Salta - Argentina	-23.717	-66.700
Saya - Dpto. La Paz - Bolivia	-16.633	-67.450
Tacalaya - Candarave - Tacna - Peru	-17.102	-70.397
Tacjata - Tarata - Tacna - Peru	-17.174	-69.970
Tanta - Yauyos -Lima - Peru	-12.117	-76.017
Tanta - Yauyos - Lima - Peru	-12.069	-75.948
Tintay - Sucre - Ayacucho - Peru	-14.079	-73.865
Unión - Arequipa - Peru	-15.123	-72.666
Vilama, Cerro Tinte - Jujuy - Argentina	-22.483	-66.800
Vilama, Granada - Jujuy - Argentina	-22.700	-66.600
Vilama, Pululo - Jujuy - Argentina	-22.550	-66.783
Leopardus pajeros		
Aguaray - Pcia. Salta - Argentina	-22.267	-63.733
Ambo - Dpto. Huánuco - Perú	-10.083	-76.117
Andalgalá - Pcia Camarca - Argentina	-27.600	-66.333
Antofogasta de la Sierra - Pcia. Camarca - Argentina	-26.067	-67.417
between Catán - Lil and las Coloradas - Pcia. Neuquén - Argentina	-39.650	-70.600
Cabo Tres Puntas - Pcia. Santa Cruz - Argentina	-47.100	-65.550
Catamarca - Pcia. Catamarca - Argentina	-28.467	-65.783
Ccapana - Ocongate - Cuzco - Peru	-13.467	-71.417
Cerro Antisana - Oriente - Equador	-0.500	-78.133
Cerro Antisana E side - Pcia. Napo - Equador	-0.500	-78.133
Cerro Castillo - Pcia. Magallanes - Chile	-51.267	-72.350
Cerro Pichincha, NE side - Pcia. Pichincha - Equador	-0.167	-78.550
Chorrillos Mt. - Pcia. Salta - Argentina	-24.183	-66.350
Chorrilos (Alto de) - Pcia. de Salta - Argentina	-24.900	-65.483
Collón-Curá - Pcia. Neuquén - Argentina	-40.117	-70.733
Comanche - Dpto. La Paz - Bolivia	-16.967	-68.483
Concepción - Dpto. Chicligasta - Pcia. Tucumán - Argentina	-27.333	-65.583
Condechaca - Dpto. Amazonas - Peru	-5.500	-78.533
Depto. Cale-Caleu - Pcia. La Pampa - Argentina	-38.583	-64.000
Estancia El Retoño - General San Martin - Pcia. La Pampa - Argentina	-38.300	-63.650
Estancia Huanu-luan - Pcia. Río Negro - Argentina	-41.367	-69.867

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Estancia San José - Pcia. Buenos Aires - Argentina	-40.133	-62.917
Hacienda Calacala – 7mi SW Patina - Dpto. Puno - Peru	-15.233	-70.550
Hacienda Pairumani - Ilava (24MI S) - Dpto. Puno - Peru	-16.083	-69.667
Huariaca - Dpto. Pasco - Peru	-14.550	-69.800
Huariaca - Dpto. Puno - Peru	-10.450	-76.117
Khumo - Potosí - Bolivia	-22.290	-67.070
La Atrevesada - Dpto. de Audalgalá - Catamarca - Argentina	-24.367	-64.333
Lihue Calel National Park - Pcia. La Pampa - Argentina	-38.000	-65.583
Los Totumu - Dpto. Beni - Bolivia	-14.000	-63.833
Maquinchao - Pcia. Río Negro - Argentina	-41.250	-68.733
Ministro Ramos Mexía - Pcia. Río Negro - Argentina	-40.500	-67.283
Nahuel Huapí lake (southern border of) - Pcia. Río Negro - Argentina	-40.967	-71.500
Pampa - Central Argentina	-37.750	-65.000
Parque Nacional Torres del Paine - 142 km N Puerto Natales - Chile	-52.017	-73.917
Picotani - Dpto. Puno - Peru	-14.550	-69.800
Picotani - Peru	-0.217	-78.500
Puelches - Pcia. La Pampa - Argentina	-38.150	-65.917
Puerto Prat - Ultima Esperanza Inlet - Pcia. Magallanes - Chile	-51.633	-72.633
Putina - Dpto. Puno - Peru	-14.917	-69.867
Quito - Pcia. Pichincha - Equador	-0.217	-78.500
Río Abiseo Nationa Park - Dpto. San Martin - Peru	-7.083	-76.150
Río Gallegos - Pcia. Santa Cruz - Argentina	-51.633	-69.217
Río Senguerr - Pcia. Chubut - Argentina	-45.533	-68.900
Río Senyer (or “Senguer”) - Chubut - Argentina	-41.050	-71.150
Salinas de Serrezuela - Córdoba - Argentina	-30.633	-65.383
San Blas (20mi S of) - Pcia. Buenos Aires - Argentina	-40.550	-62.250
San Francisco de Las Pampas - Reserva La Otonga - Cotopaxi - Equador	-0.433	-78.967
San Pedro de Colalau - Dpto. Trancas - Tucumán - Argentina	-26.233	-65.483
Santa Ana Reserva Provincial - Río Chico y J. B. Alberti - Tucumán - Argentina	-27.500	-65.917
Sierra de Santa Victoria - Pcia. Jujuy - Argentina	-22.383	-65.283
Sierra Velasco - Pcia. La Rioja - Argentina	-29.083	-67.083
Tarata (10 mi S) - Pcia. Tarata - Dpto. Tacna - Peru	-17.467	-70.033

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Telén - La Pampa - Argentina	-36.267	-65.500
Tiraqui - Dpto. Cochabamba - Bolivia	-17.417	-65.717
Toay - La Pampa - Argentina	-36.667	-64.350
Toya - Pcia. La Pampa - Argentina	-36.667	-64.350
Victoria - Pcia. La Pampa - Argentina	-36.217	-65.450
Viedma - Río Negro (near) - Argentina	-40.800	-63.000
Villa Unión - La Rioja - Argentina	-29.300	-68.200
Leopardus tigrinus		
Acevedo - San Adolfo - Huila - Colombia	1.617	-75.983
Aldeia do Porto - Rio Mearim - Maranhão - Brazil	-6.117	-45.150
Andalucia - Huila - Colombia	1.900	-75.667
Barreiras - Bahia - Brazil	-12.133	-45.000
Caiena - French Guiana	4.933	-52.333
Carnaubeira - Pernambuco - Brazil	-8.317	-38.750
Chingaza - Colombia	4.517	-73.750
Crato - Serra do Araripe - Ceará - Brazil	-7.217	-39.400
Cuiaté - Paraíba - Brazil	-6.500	-36.167
Cundinamarca - Bogotá - Colombia	4.600	-74.083
Dadanawa (40 mi W) - Rupunani - Guyana	2.833	-59.500
E. Heller - Pozuzo - Peru	-10.067	-75.533
Engenho Riachão - Quebrangulo - Alagoas - Brazil	-9.333	-36.400
Estrada Campo Verde - Porto Platon - Amapá - Brazil	0.700	-51.450
Faz. São Miguel - Viçosa - Alagoas - Brazil	-9.367	-36.233
Hacienda paty NE Carpish Tunnel (trail to) - Dpto. Huánuco - Peru	-9.667	-76.083
Hato La Florida - Caicara (63 km SE) - Bolívar - Venezuela	7.417	-65.650
Ipú - Ceará - Brazil	-4.333	-40.700
Jalapão - Tocantins - Brazil	-10.471	-46.307
Jima - Pcia. de Azuay - Equador	-3.200	-78.950
Juazeirinho - Paraíba - Brazil	-7.070	-36.580
Los Patos - El Manteco (25Km SE) - Bolívar - Venezuela	7.183	-62.367
Malvata - Cauca - Colombia	2.483	-76.300
Mérida (near) - Venezuela	8.600	-71.133
Parque Ecológico Municipal Professor Vasconcelos Sobrinho - Brejo dos Cavalos - Caruaru - Pernambuco - Brazil	-8.3664	-36.0267

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Parque Nacional da Serra da Capivara - Piauí - Brasil	-8.433	-42.317
Pico Ávila - Caracas (6 km NNW) - Dpto. Federal - Venezuela	10.550	-66.867
Ponte Rio Oricó - BR 101 km 397 - Bahia - Brazil	-14.017	-39.450
Represa Guri (2 Km NO) - Alcabala Obra (1 Km E) - Bolívar - Venezuela	7.650	-62.833
Río Chili - S of Manzales - Colombia	4.117	-75.267
Río Chili - S of Manzales - Colombia	4.143	-75.546
Río Putumayo drainage - Puerto Leguizamo - Amazonas - Colombia	-0.200	-74.767
Rupunani - Rupunani - Guyana	3.000	-58.500
San Carlos de Río Negro (aprox. 3Km S) - Amazonas - Venezuela	1.917	-67.067
San Francisco de Las Pampas - Reserva La Otonga - Cotopaxi - Equador	-0.433	-78.967
San Gabriel - Rio Negro - AM - Brasil	-0.133	-67.083
San Juan - Tambopata - Dpto. Puno - Pcia. Sandia - Perú	-14.117	-71.667
São Benedito - Macapá - CE	-4.883	-40.883
Senhor do Bonfim - Bahia - Brasil	-10.450	-40.183
Villa Vecencia - Meta - Colombia	4.150	-73.617
Leopardus guttalus		
Águas Mornas - Santa Catarina - Brazil	-27.694	-48.824
Angostura - (near river) Caraparí - Pcia. Salta - Argentina	-22.133	-63.717
Angra dos Reis - Rio de Janeiro - Brazil	-23.000	-44.317
Anitápolis - Santa Catarina - Brazil	-27.902	-49.129
Arambaú - Mun. Camaquã - Rio Grande do Sul - Brazil	-30.850	-51.817
Araquari - Santa Catarina - Brazil	-26.370	-48.722
Bagé - Rio Grande do Sul - Brazil	-31.333	-54.100
Biguaçu - Santa Catarina - Brazil	-27.494	-48.656
Blumenau - Santa Catarina - Brazil	-26.919	-49.066
Camboriú - Santa Catarina - Brazil	-27.025	-48.654
Campestre - Lins - São Paulo - Brazil	-22.767	-47.717
Campos do Jordão - São Paulo - Brazil	-22.733	-45.583
Colatina - Espírito Santo - Brazil	-19.533	-40.617
Colonia Hansa - Santa Catarina - Brazil	-26.433	-49.233
Conchas - São Paulo - Brazil	-23.017	-48.000

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Corupá - Santa Catarina - Brazil	-26.425	-49.243
Dom Pedrito - Rio Grande do Sul - Brazil	-30.983	-54.667
Engenheiro - Espírito Santo - Brazil	-20.767	-41.467
Engenheiro Reever - Espírito Santo - Brazil	-20.767	-41.467
Estrada da Faxina - Itapuã - Viamão - Rio Grande do Sul - Brazil	-30.267	-51.017
Faz. Boa Fé - Teresópolis - Rio de Janeiro - Brazil	-22.383	-42.867
Fazenda Lapa, Mangaratiba - Rio de Janeiro - Brazil	-22.950	-44.033
Floresta da Capela - São Brás - Santa Tereza - Espírito Santo - Brazil	-19.933	-40.600
Franca - São Paulo - Brazil	-20.533	-47.400
Ilha Grande - Agra dos Reis - Rio de Janeiro - Brazil	-23.152	-44.229
Iporanga - Lajeado - São Paulo - Brazil	-24.583	-48.583
Itapoá - Santa Catarina - Brazil	-26.117	-48.616
Itararé - São Paulo - Brazil	-24.117	-49.333
Itatiba - São Paulo - Brazil	-23.000	-46.850
Ituverava - São Paulo - Brazil	-20.333	-47.783
Jaraguá do Sul - Santa Catarina - Brazil	-26.486	-49.067
Joinville (near) - Santa Catarina - Brazil	-26.000	-49.000
Lagoa Santa-Minas Gerais - Brazil	-19.633	-43.883
LinharEspírito Santo - Reserva Florestal da CVRD - Espírito Santo - Brazil	-19.500	-42.517
Lins - São Paulo - Brazil	-21.667	-49.750
Nova Friburgo - Rio de Janeiro - Brazil	-22.267	-42.533
Nova Teutonia - Rio Grande do Sul - Brazil	-27.050	-52.400
Nova Treanto - Santa Catarina - Brazil	-27.286	-48.930
Nova Wurtenberg - (near) Cruz Alta - N de Santa Maria da Boca do Monte - Rio Grande do Sul - Brazil	-28.650	-53.600
Núcleo Santa Virgínia - Parque Estadual da Serra do Mar - São Luís do Paraitinga - São Paulo - Brazil	-23.333	-45.117
Paranapiacaba - São Paulo - Brazil	-23.783	-46.317
Passo Fundo - Rio Grande do Sul - Brazil	-28.250	-52.400
Piedade - São Paulo - Brazil	-23.783	-47.417
Ponte Serrada - Santa Catarina - Brazil	-26.872	-52.016
Rancho Queimado - Santa Catarina - Brazil	-27.673	-49.022
Reserva Florestal da Compania do Vale do Rio Doce - Linhares - Espírito Santo - Brazil	-19.200	-40.033

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Ribeirão Fundo - São Paulo - Brazil	-24.250	-47.750
Rio Caparaó - Serra do Caparaó - Minas Gerais - Brazil	-20.633	-41.917
Rio de Janeiro - Rio de Janeiro - Brazil	-22.900	-43.233
Rio Grande - São Paulo - Brazil	-23.883	-46.417
Rio Ipiranga (Tamanduá) (near) Juquiá - São Paulo - Brazil	-24.367	-47.833
Río Yuqueri - Paraguay	-25.250	-55.650
Santa Isabel - São Lourenço do Sul - Rio Grande do Sul - Brazil	-32.117	-52.617
Santa Teresa - Bairro do Eco - Espírito Santo - Brazil	-19.917	-40.600
Santa Teresa - Espírito Santo - Brazil	-19.917	-40.600
Santo Amaro - São Paulo - Brazil	-23.550	-46.333
São Francisco - Jacarepaguá - Rio de Janeiro - Brazil	-22.950	-43.317
São Joaquim - Santa Catarina - Brazil	-28.294	-49.932
São Ludgero - Santa Catarina - Brazil	-28.317	-49.177
Sede do Parque Nacional de Itatiaia - Rio de Janeiro - Brazil	-22.383	-44.633
Serra de Macaé - Rio de Janeiro - Brazil	-22.317	-42.333
Serra do Itatins - Rio das Pedras - Iguape - São Paulo - Brazil	-24.367	-47.217
Sete Lagoas - Minas Gerais - Brazil	-19.450	-44.233
Teresópolis - Rio de Janeiro - Brazil	-22.417	-42.967
Ubatuba - São Paulo - Brazil	-23.433	-45.067
Valparaíso - São Paulo - Brazil	-21.217	-50.850
Viçosa - Minas Gerais - Brazil	-20.750	-42.883
Vidal Ramos - Santa Catarina - Brazil	-27.392	-49.353