EDSEL AMORIM MORAES JR[1]

The status of the jaguar in the Cerrado

The extent of occurence of jaguars *Panthera onca* in the Cerrado was estimated to be 157,500 km² and we identified 11 jaguar subpopulations in the biome by using jaguar presence points. Using data from several studies jaguar density was estimated at 0.67 mature individuals per 100 km² for all areas in the Brazilian Cerrado. A population of 323 adult jaguars is estimated to live throughout the biome. The Cerrado subpopulation is declining throughout the biome at an unknown rate. Jaguars have already disappeared from the areas where habitat has been converted. About half of the 2 million square kilometres of the original Cerrado were transformed into planted pastures, annual crops and other land use forms over the past 50 years. Principal jaguar threats are habitat loss, population declines, loss of prey base, jaguar killing, agribusiness, mining, roadkills and hydroelectric power.

Assessment

Endangered A2 b,c ; C2 a (i) – This subpopulation is considered Endangered due to a past reduction of more than 50% of the population in the past 3 generations (25 years) using citeria A2 b,c, and because all the subpopulations are less than 250 adult individuals (criteria C2 a(i); IUCN 2001). The subpopulation may experience some immigration from neighbouring biomes but it is expected to decrease in the next 25 years as some subpopulations may act as sinks.

Geographic range information

Extent of Occurrence EOO

The extent of occurence of jaguars in the Cerrado was estimated to be 157,500 km² using polygons drawn over maps of remaining Cerrado habitat (IBAMA/2009). The EOO included both the Conservation Units with known or inferred recent jaguar presence and points of jaguar presence reported by researchers, the literature and the Jaguar GIS Data compiled by the WCS "Jaguars in the new millenium" workshop. In order to calculate the EOO we included only the portions of jaguar range within Cerrado habitat (Fig. 1) while neighboring Amazon and Pantanal populations were treated separately (see other chapters of this issue).

Area of Occupancy AOO

We identified 11 jaguar subpopulations in the Cerrado biome by using jaguar presence points compiled by the Wildlife Conservation Society (Marieb 2006), Biotropicos Institute research field data and other publications (Silveira 2004, Torres 2006). These points of presence were obtained through interviews with researchers and local residents, work with camera traps, footprints, attacks on domestic animals and secondary data of the projects cited above. The area of occupancy of jaguars in the Cerrado was estimated as the sum of all occupied areas identified on the map totalling 48,000 km² with known or inferred recent jaguar presence (Supporting Online Material SOM Appendix I at www.catsg.org/catnews). It was presumed that jaguars use mainly good quality habitat (Fig. 2).

Ecology and population information

Population size

Using data from several studies (Silveira 2004, Astete et al. 2008, Sollmann et al. 2009, Edsel A. Moraes Jr., unpubl. data) overall jaguar density was estimated at 0.67 mature individuals/ 100 km² for all areas in the Brazilian Cerrado (Table 1). We opted to be conservative in all estimates. A population of 323 adult jaguars is estimated to live throughout the Brazilian Cerrado. Some jaguar subpopulations of the Cerrado may be regarded as sources or sinks.

Subpopulation 4 (Nascentes Parnaíba) indicates one of the most important populations of jaguars for the Cerrado region in the north/ northeast of Brazil. This is due to the size of the area which is well protected and because it covers two important conservation units in the National Park Nascentes do Rio Parnaíba which covers 7,350 km². The Cerrado transitions there into the semi-arid Caatinga biome where it is possible that this subpopulation is connected in the northern portion to the jaguar populations in the Caatinga.

Subpopulation 3 (Sertão Veredas Peruaçu) is located in an area of well preserved Cerrado in the states of Minas Gerais and Bahia. Within the area are the Conservation Units Mosaic of "Mosaico Sertão Veredas - Peruaçu", composed of 14 Conservation Units, six protected areas, two National Parks, Grande Sertão Veredas and Cavernas do Peruaçu, three State Parks (Veredas do Peruaçu, Serra das Araras and Mata Seca) and one Wildlife Refuge of Pandeiros, totaling an area of 3,465 km² (Funatura 2008). Although Moraes Jr (unpubl. data) has estimated a jaguar density of 2 individuals per 100 km² in the Grande Sertão Veredas National Park (with the presence of some melanistic individuals), the disturbed areas within the mosaic drop the

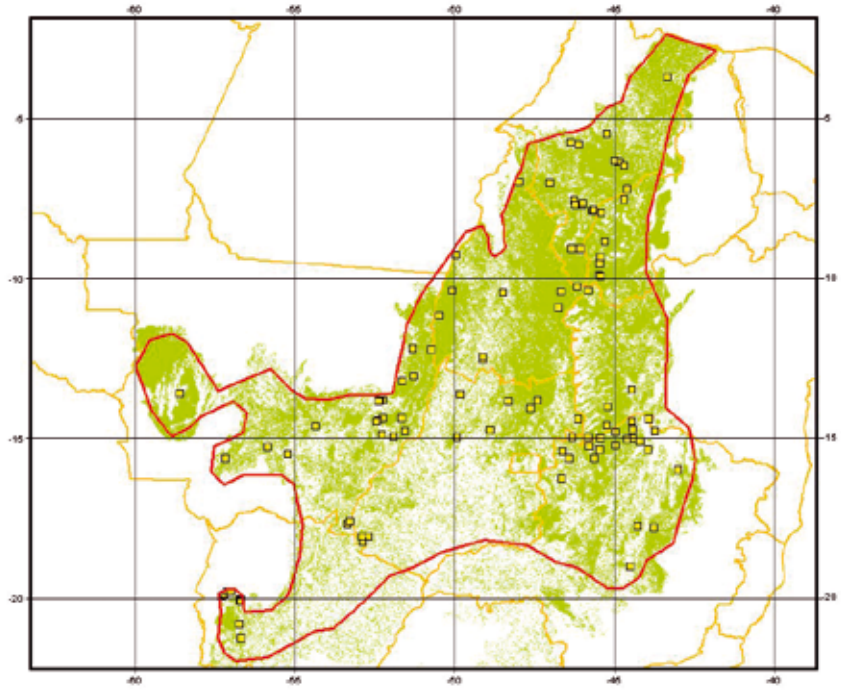

Fig. 1. Extent of occurrence EOO of jaguars in the Brazilian Cerrado (red polygon) with known or inferred presence of the species (yellow points).

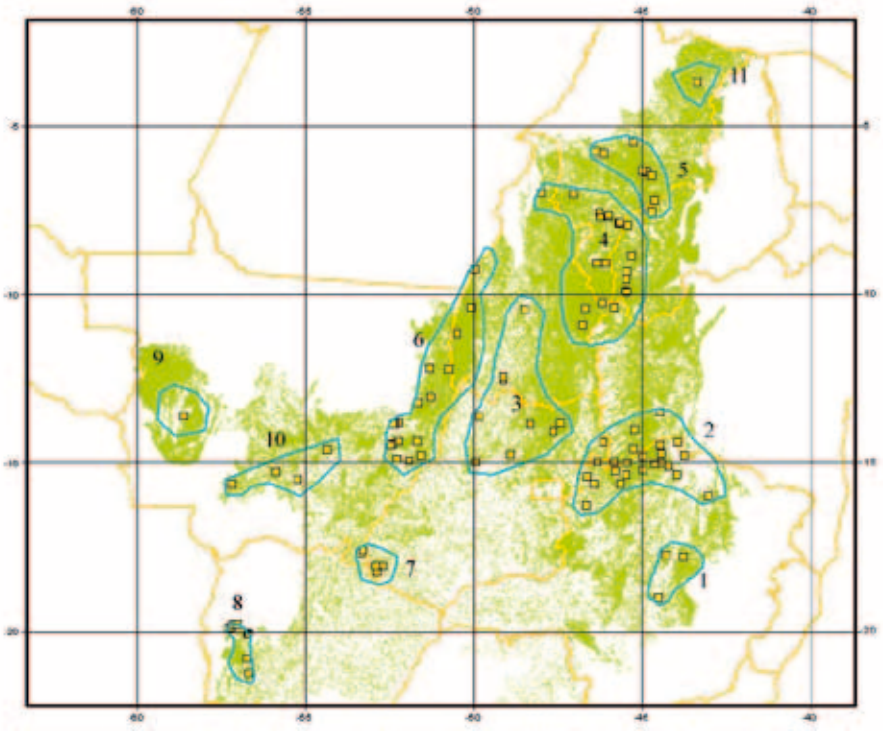

Fig. 2. Area of occupancy AOO of jaguars in the Brazilian Cerrado, inferred populations (blue polygons) with known or inferred presence of the species (yellow points) and respective numbers (Table 1).

overall density estimate to 0.67 individuals/100 km^2. This region is characterized by various Conservation Units protecting the Cerrado vegetation, wetlands on the river San Francisco and dry forest. It is situated very close to jaguar populations in the south Caatinga and also to the subpopulation 1 (Espinhaço de Minas Gerais), and there may be movements of animals between these populations.

The subpopulation 1 of Espinhaço in Minas Gerias, is located in the Espinhaço mountain range. Espinhaço is a priority conservation area in Brazil (Drummond et al. 2005, WWF 2001, BirdLife International 2003) and recognized as a UNESCO biosphere reserve (Candeias 2006). The Espinhaço Range divides two conservation hotspots, the Cerrado and the Atlantic Rain Forest. As a transitional area it holds high levels of species richness and presents high levels of plant endemism. Despite Espinhaço's great biological importance, its biodiversity is highly threatened: almost 70% of all plant species facing extinction in Minas Gerais state occur in this mountain range, especially in Rocky fields occurring above 1,000 meters, a typical Cerrado ecosystem. In Minas Gerais state, the Espinhaço mountain range mosaic of Conservation Units named "Mosaico do Espinhaço" will be created, "Alto Jequitinhonha – Serra do Cabral", aiming at integrated management and conservation of biodiversity in the region. Jaguar populations of northern Minas Gerais link to populations of the southern state in the Atlantic forest and therefore this region represents an important area for jaguar conservation.

Subpopulation 6 bordering the Brazilian Amazon (e.g. Araguaia region) also plays an important role for preserving jaguars. The Araguaia is Brazil's third largest river outside the Amazon basin. It originates in the Cerrado grasslands of Emas National Park and flows 1,800 kilometers to the Amazon. The 13 protected areas and five indigenous reserves along the Araguaia River strengthen its status as the most important biodiversity corridor in central Brazil. Among these protected areas are the Araguaia National Park with 1,319 km^2 of grassland floodplains in a transition zone between the Cerrado and the Amazon forest and the Cantão State Park. This park represents the largest block of forest along the Araguaia corridor as identified by the Jaguar Conservation Fund (Silveira 2004). Jaguars are present in the Cantão State Park and Araguaia National Park. The Araguaia gallery forest works as an important corridor for these animals (Silveira 2004).

In subpopulation 7 is the Emas National Park which encompasses 131 km^2 of area rich in heterogenity of the Cerrado ecosystem. Not only does it include several springs but also contains the largest grassland Conservation Unit.

Table 1. Jaguar subpopulations in the Brazilian Cerrado with the estimated area occupied by the species and number of adult jaguars in the Brazilian Cerrado. For all subpopulations we used a density of 0.67 adult jaguars/100 km^2. Numbers refer to polygons in Figure 2.

Number	Name	Area (km^2)	Number of adult jaguars
1	Espinhaço de Minas Gerais	1,841	12
2	Sertão Veredas Peruaçu	8,418	56
3	Goiás e Tocantins	9,056	61
4	Nascentes Parnaíba	10,250	69
5	Mirador	2,981	20
6	Araguaia	7,921	53
7	Emas	1,082	7
8	Bodoquena	964	6
9	Sapezal (MT)	1,693	11
10	Chapada dos Guimarães	2,888	19
11	Norte do Maranhão	1,075	7
	Total	**48,169**	**323**

Population trends

The Cerrado subpopulation is declining throughout the biome at an unknown rate. Jaguars have already disappeared from the areas where habitat has been converted. About half of the 2 million km^2 of the original Cerrado were transformed into planted pastures, annual crops and other land use forms over the past 50 years (Klink & Machado 2005). Planted pastures now cover an area of 500,000 km^2, an area the size of Spain. Monocultures, mainly soya, cover another 100,000 km^2 (Klink & Machado 2005). The total area left for conservation is only about 33,000 km^2, clearly insufficient when compared with the main land

use in the Cerrado (Klink & Machado 2005). Furthermore, Conservation Units are not large enough to maintain long-term viable jaguar populations (Silveira & Jácomo 2002). Great environmental impact such as hydroelectric dams and roads cause interruption of natural corridors used by jaguars (Silveira & Jácomo 2002), isolating subpopulations and decreasing their viability.

Subpopulations

There are at least eleven subpopulations within the biome, corresponding to the eleven polygons in Figure 2.

Threat information

Habitat loss

A recent study using satellite images from MODIS 2002 found that 55% of the Cerrado has been cleared or transformed by human action (Fig. 3; Machado et al. 2004), which is equivalent to an area of 880,000 km², or almost three times the area deforested in the Brazilian Amazon. The annual deforestation rates have also increased in the Cerrado: between 1970 and 1975 deforestation averaged 40,000 km² per year - 1.8 times the rate of Amazon deforestation during the period 1978-1988 (Klink & Moreira 2002). Current rates of deforestation vary between 22,000 and 30,000 km² per year (Machado et al. 2004), still higher than those of the Amazon.

Population declines

Population decline may be due to habitat loss, habitat degradation, loss of dispersing individuals, poaching, illegal predator control and other conflicts with humans and inbreeding. However, the rate of decline is unknown and can only be assumed. Based on known losses in some places, we think that the jaguar population in the Cerrado declined by 50% over the past 25 years.

Loss of prey base

Across much of the Cerrado biome, the potential prey base for the jaguar has been reduced due to poaching and habitat loss. In subpopulation 1 (Espinhaço de Minas Gerais) the different deer species *Mazama spp.* and white lipped peccaries *Tayassu pecari* have disappeared and collared peccaries *Pecari tajacu* are rare or absent in parts of the area. Tapirs *Tapirus terrestris*, capybaras *Hydrochoerus hydrochaeris* and giant anteaters *Myrmecophaga tridactyla* provide the main prey base to jaguars. Poaching occurs inside some Conservation Units.

Fig. 3. Agriculture and roads surrounding Grande Sertao Veredas National Park (Photo R. Araujo).

Jaguar killing

Jaguars are illegally hunted or shot throughout the Cerrado. Most of the killing is retaliation for depredation of domestic animals. Others killings are opportunistic or associated with sport hunting. In subpopulation 2 (Sertão Veredas Peruaçu) two jaguars were killed in one year (Biotrópicos Institute, unpubl. data) by poisoning or by poaching. The scarcity of jaguars in some areas of the Brazilian Cerrado may be due to persecution.

Agribusiness

The growth of agribusinesses (Fig. 4), sugar cane, cotton and particularly the soybean monocultures, makes it one of the most important threats to the Cerrado. Brazil is the second largest producer of soybeans in the world.

Mining

In the Espinhaço Mountain range the presence of large scale mining is the biggest threat to the conservation of the jaguar, causing habitat loss and degradation as well as indirect impacts such as large movement of heavy vehicles in areas surrounding Conservation Units.

Hydroelectric Power

Hydroelectric power plants cause irreversible environmental impacts. On a landscape scale the greatest impact resulting from the construction of these large reservoirs is the interruption of natural corridors for the movement of fauna which fragments populations and prevents gene flow (Carothers & Dolan 1982).

Conservation information

Conservation measures

1. Legal protection in the form of restrictive Conservation Units (CUs). More restrictive protected areas enhance jaguar conservation.
2. Effective protection of existing protected areas, performing the land regularization of the units and also in the form of intense patrolling inside the CU's. Along the regularization of protected areas went the withdrawal of all former residents of the area thus improving control and surveillance. Effective management practices in the existing protected areas: increase the number of rangers and more intense patrolling.
3. Creation of new protected areas in the biome large enough to accommodate a viable population of jaguars as well as CUs that function as corridors between populations and subpopulations.
4. Monitoring of animals for identification of ecological corridors between populations and subpopulations. Needs more research projects across the biome.
5. Implementation and maintenance of long-term research projects, thus increasing the basic data of ecology of the species in the Cerrado biome and subsidizing more conservation measures.
6. Translocations to increase depleted populations and to reduce inbreeding may be a necessity in some areas. Conducting a study to

Fig. 4. Large scale habitat distruction for the growing agrobusinesses, leaving no room for jaguar and its prey (Photo M. Ribeiro).

choose an area to carry out the translocation and implementation of a pilot project in the biome.

Research projects

1. *Grandes felinos como espécies focais para o planejamento da conservação do cerrado no Sertão dos estados de Minas Gerais e Bahia*. Localities: Parque Nacional Grande Sertão Veredas, Parque Estadual Serra das Araras, RPPN Porto Cajueiro, Refúgio de Vida Silvestre do Oeste Baiano, Parque Estadual Veredas do Peruaçu e Parque Nacional Cavernas do Peruaçu. Institution: Instituto Biotrópicos. Coordinator: Edsel Amorim Moraes Jr.

2. *Ecologia e conservação de grandes felinos do Espinhaço*. Localities: Parque Nacional das Sempre-vivas, Parque Estadual do Rio Preto, Parque Estadual do Biribiri e Parque Estadual do Pico do Itambé. Institution: Instituto Biotrópicos. Coordinator: Edsel Amorim Moraes Jr.

Parque Nacional das Emas. Institution: Instituto Onça-Pintada. Coordinator: Leandro Silveira. www.jaguar.org.br

4. *Corredor Araguaia*. Institution: Instituto Onça-Pintada. Coordinator: Leandro Silveira. www.jaguar.org.br

Parque Estadual Cantão. Institution: Instituto Onça-Pintada. Coordinator: Leandro Silveira. www.jaguar.org.br

Parque Nacional Nascente do Rio Parnaíba. Institution: Instituto Onça-Pintada. Coordinator: Leandro Silveira. www.jaguar.org.br

Estação Ecológica Uruçuí-una. Institution: Instituto Onça-Pintada. Coordinator: Leandro Silveira. www.jaguar.org.br

Contributors

Tadeu G. de Oliveira (UEMA & Instituto Pró-Carnívoros), Rogerio C. de Paula (CNAP/ICMBio & Instituto Pró-Carnívoros), Joaquim de Araújo Silva (Biotrópicos Institute), Rafael L. A. Freitas (Biotrópicos Institute).

References

Astete S., Sollmann R. & Silveira L. 2008. Comparative Ecology of Jaguars in Brazil. Cat News Special Issue 4, 9-14.

BirdLife International. 2003. BirdLife EBA Factsheet: Central Brazilian hills and tablelands. Version 2.0. Cambridge, UK: BirdLife International. <www.birdlife.org>, accessed on 13 april 2009.

Candeias H. 2006. Biosphere Reserve Information, Brasil, Espinaço Range, UNESCO, <www.unesco.org>, accessed on 13/04/2009.

Caso A., Lopez-Gonzalez C., Payan E., Eizirik E., de Oliveira T., Leite-Pitman R., Kelly M. & Valderrama C. 2008. *Panthera onca*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. <www.iucnredlist.org>. accessed on 05 October 2009.

Carothers S. W. & Dolan R. 1982. Dam changes on the Colorado River. Natural History 91, 74-84.

Drummond G. M., Martins C. S., Machado A. B. M., Sebaio F. A. & Antonini Y. 2005. Biodiversidade em Minas Gerais: um atlas para sua conservação. 2nd edition. Fundação Biodiversitas, Belo Horizonte.

FUNATURA – Fundação Pró-Natureza. 2008. Mosaico Sertão Veredas: Peruaçu: Plano de Desenvolvimento Territorial de Base Conservacionista - DTBC. Brasília: FUNATURA.

IBAMA. 2009. Relatório Técnico de Monitoramento do Desmatamento no Bioma Cerrado, 2002 a 2008: Dados revisados. Acordo de Cooperação Técnica Mma/Ibama/Pnud. Centro De Sensoriamento Remoto – CSR/IBAMA.

IUCN. 2001. IUCN Red List Categories and Criteria. Version 3.1. IUCN, Gland and Campridge.

Klink C. A. & Moreira A. G. 2002. Past and current human occupation and land-use. *In* The Cerrados of Brazil. Ecology and Natural History of a Neotropical Savanna. Oliveira P. S. & Marquis R. J. (Eds). Columbia University Press, New York, pp. 69-88.

Klink C. A. & Machado R. B. 2005. A conservação do Cerrado brasileiro. Megadiversidade 1, 147-155.

Machado R. B., Ramos Neto M. B., Pereira P., Caldas E., Gonçalves D., Santos N., Tabor K. & Steininger M. 2004. Estimativas de perda da área do Cerrado brasileiro. Conservation International do Brasil, Brasília.

Marieb K. 2006. Jaguars in the New Millennium Dataset Update: The State of the Jaguar in 2005. Wildlife Conservation Society, New York, USA.

Silveira L. & Jácomo A. T. A. 2002. Conservación del jaguar en el Centro del Cerrado de Brasil. *In* El jaguar en el Nuevo millenio. Una evaluacion de su estado, deteccion de prioridades y recomendaciones para la conservacion de los jaguares en America. *In* Medellín R. A., Equihua C., Chetkiewicz C. L. B., Crawshaw Jr. P. G., Rabinowitz A., Redford K. H., Robinson J. G., Sanderson E. W. & Taber A. (Eds). Fondo de Cultura Económica, Universidad Nacional Autónoma del México, WCS, Mexico, pp. 437-450.

Silveira L. 2004. Ecologia comparada de onça-pintada (*Panthera onca*) e onça-parda (*Puma concolor*) no cerrado do Brasil. Ph. D. Thesis, Universidade de Brasília, Brazil. 235 pp.

Sollmann R., Furtado M. M., Jácomo A. T. A., Tôrres N. M. & Silveira L. 2009. Population status of the jaguar in the Cerrado of Central Brazil. Program and book of abstracts of Defenders of Wildlife's Carnivores, November 15-18, Denver, Colorado. p. 304.

Tôrres N. M. 2006. Modelagem de nicho ecológico e análise de lacunas dos carnívoros (Carnivora, Mammalia) do Cerrado. Dissertação de Mestrado. Brasília: ICB/UnB. 66 pp.

WWF. 2001. Campos Rupestres montane savanna, WWF, <www.worldwildlife.org>, accessed on 13/04/2009.

Supporting Online Material SOM Appendix I is available at www.catsg.org/catnews

[1] **Agência de Correios Savassi, Caixa Postal 2469, Savassi, Belo Horizonte, Minas Gerais 30112-970 Brazil; <edsel@biotropicos.org.br>**