

Ecology of the ocelot (*Leopardus pardalis*) in the Atlantic Forest of Southern Brazil

Ecologia da jaguatirica (*Leopardus pardalis*) na Floresta Atlântica do sul do Brasil

Fernando Vilas Boas Goulart¹
fervbgoulart@yahoo.com.br

Maurício Eduardo Graipel²
graipel@ccb.ufsc.br

Marcos Adriano Tortato³
marcostortato@hotmail.com

Ivo Rohling Ghizoni-Jr²
ivoghizoni@yahoo.com.br

Luiz Gustavo Rodrigues
Oliveira-Santos⁴
gu_tapirus@hotmail.com

Nilton Carlos Cáceres⁵
niltoncaceres@gmail.com

Abstract

The ocelot *Leopardus pardalis* is a medium-sized Neotropical spotted cat with a wide geographic range. The present study was conducted in a reserve in an Atlantic Forest area in southern Brazil, and provided information on ocelot ecology through photographic records. Density estimated by the half of the mean maximum distance moved method resulted in 0.04 ocelots per km². The minimum home range sizes were obtained by the minimum convex polygon method and were in agreement with other studies for the males recorded. Our female's home range size was smaller than ranges reported elsewhere. The nocturnal pattern recorded is probably related with prey activity, since it is suggested that ocelots adjust their movements to the probabilities of encountering local prey, or with an evolutionary factor, aiming to avoid competition/predation with larger cats. The low density observed could be a consequence of the conditions of the study area, small and isolated, which indicates the necessity for larger reserves and mechanisms to connect isolated populations.

Key words: camera trap, Felidae, individual recognition, spot pattern, activity pattern.

Resumo

A jaguatirica *Leopardus pardalis* é um gato pintado neotropical de porte médio e com ampla distribuição geográfica. O presente estudo foi conduzido em uma reserva em área de Floresta Atlântica no sul do Brasil e forneceu informações a respeito da ecologia da espécie, por meio de registros fotográficos. A densidade estimada pelo método do HMMDM (metade da média das máximas distâncias percorridas) resultou em 0,04 jaguatiricas por km². As áreas de vida mínimas foram obtidas pelo método do mínimo polígono convexo e corroboraram com outros estudos quando se analisaram os registros dos indivíduos machos. Os registros para as áreas de vida das fêmeas foram menores do que as previamente reportadas. O padrão de atividade noturno está provavelmente relacionado com a atividade das presas, já que as jaguatiricas tendem a ajustar os padrões de movimento com a probabilidade de encontro com as mesmas, ou até mesmo com um fator evolutivo, objetivando evitar a competição/predação com felinos de maior porte. A baixa densidade observada pode ser consequência das condições da área de estudo, pequena e isolada, o que indica a necessidade por reservas maiores e por mecanismos visando conectar populações isoladas.

Palavras-chave: armadilhas fotográficas, Felidae, individualização, padrões de manchas, padrões de atividade.

¹ Departamento de Fiscalização e Monitoramento, Secretaria de Estado do Meio Ambiente (SP), Av. Prof. Frederico Hermann Junior, 345, Prédio 12, 3º andar, 05459-900, São Paulo, SP, Brazil.

² Departamento de Ecologia e Zoologia, Centro de Ciências Biológicas, Universidade Federal de Santa Catarina, Trindade, 88040-970, Florianópolis, SC, Brazil.

³ CAIPORA Cooperativa para Conservação da Natureza, Av. Desembargador Vitor Lima, 206, Ed. Madson Center, Sala 513, 88040-400, Florianópolis, SC, Brazil.

⁴ Departamento de Ecologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, 21941-901, Rio de Janeiro, RJ, Brazil.

⁵ Departamento de Biologia, CCNE, Universidade Federal de Santa Maria, Faixa de Camobi, Km 9, Prédio 17, Sala 1140 G, Camobi, 97105-900, Santa Maria, RS, Brazil.

* Author for correspondence

Introduction

The ocelot *Leopardus pardalis* is a medium-sized (adult weight range: 7-16 kg) neotropical cat with a geographic range from southern Texas in the USA to northern Argentina (Emmons and Feer, 1997; Murray and Gardner, 1997; Oliveira, 1994). Except for the jaguar (*Panthera onca*), the ocelot is the largest spotted cat of South America (Trolle and Kéry, 2003). Its opportunistic habits allow this cat to consume a great variety of small and medium-size prey (Murray and Gardner, 1997), hunting usually on the ground (Bisbal, 1986). Besides, ocelots are secretive, solitary, nocturnal, and prefer covered vegetation sites, which makes them difficult to study (Haines *et al.*, 2006). However, in comparison with other wild cats, ocelots are relatively easy to study because they are easily captured in live traps or camera traps (Di Bitetti *et al.*, 2006). Methodologies like radio-telemetry and camera-traps have been recently used for these aims. Radio-telemetry is constrained by the small number of animals that can be tagged simultaneously, the uncertainty about how many individuals are not tagged, and the high costs and efforts involved (Karanth, 1995; Trolle and Kéry, 2003). Camera-traps have been successfully employed in monitoring and analyzing capture-recapture data for felids such as the tiger *Panthera tigris* (Karanth and Nichols, 1998), leopard *Panthera pardus* (Henschel and Ray, 2003), bobcat *Lynx rufus* (Heilbrun *et al.*, 2006), jaguar *Panthera onca* (Maffei *et al.*, 2004; Soisalo and Cavalcanti, 2006) and ocelot (Di Bitetti *et al.*, 2006; Haines *et al.*, 2006; Maffei *et al.*, 2005; Trolle and Kéry, 2003; Trolle and Kéry, 2005).

Mostly field studies on ocelot ecology and behavior have focused on its abundance, diet, activity patterns, home range and habitat use, and these have just started to provide information on its degree of variability in response to the environment (Di Bitetti *et al.*, 2006).

Despite of this, the use of different methodologies has induced little consistence on data, and the knowledge on the species remains scarce (Maffei *et al.*, 2005; Trolle and Kéry, 2005), mainly in the Atlantic Ombrophyll Forest and in southern Brazil.

In this study, we used camera traps to assess the density, minimum home ranges and activity patterns of ocelots in the Atlantic Ombrophyll Forest of Santa Catarina, southern Brazil. This study presents an important contribution for ocelot ecology just because it is the most austral study comprising population and conservation aspects of this species.

Study area

The study was conducted in an Atlantic Forest area in Santa Catarina state, southern Brazil, in an ecological reserve, namely Reserva Ecológica do Caraguatá (4300 ha). It comprises five districts located on the hills of the Serra do Mar (headquarters at GPS position 27°25'51" S and 48°51'01" W) with altitudes ranging from 420 to 900 m asl. The main vegetation type of the area is the dense ombrophyll forest with montane and high-montane patches (Veloso *et al.*, 1991). There are few relicts of *Araucaria angustifolia* (the Brazilian pine tree), since the area comprises bordering patches of the mixed ombrophyll forest as well (Gaplan, 1986). The climate is subtropical with a high annual rainfall (1,800 mm). Mean annual temperature varies between 20 and 24°C in January and between 12 and 16°C in July (Gaplan, 1986).

Material and methods

Trapping procedures

Data were collected from camera-traps Tigrinus® installed all over the study area. The equipment consists of an infrared sensor programmed to shoot when an animal interrupt the beam. Twenty nine camera-trap stations were

placed during 14 months of study. Two models of camera-trap (conventional and digital) were distributed in ca. 30.54 km². Distances between capture stations ranged from 1.0 to 1.5 km among the nearest sites as possible, due to difficulties of the hilly and irregular relief, the access toward the dense coverage areas, and the availability of animal trails. This distance interval is recommended by Dillon and Kelly (2007) for ecological studies involving ocelots. The digital models were baited with cat food in order to correct the delay of this equipment for shooting. Information from the baited cameras were used as well, because we believe the bait did not influence the activity patterns and the size of the home ranges for three reasons: (i) the bait is not the original food of the species; (ii) the bait is not so scented, reaching small areas, and does not interfering in its long movements; (iii) the bait does not have a great validity, deteriorating in a few days. The effective sampled area was calculated including a circular radius (buffer area) around each trap station. This radius was the half of the mean maximum distance moved (HMMDM) for each individual of ocelot, according to Karanth and Nichols (1998), which resulted in a total surveyed area of ca. 70.62 km², with no "holes" within it (Figure 1). As the initial focus of our study was to evaluate the mammal community as a whole, the arrangement of the camera-traps was also adjusted for other larger mammal species than only for ocelots (see Figure 1).

Although the equipments were not used in pairs, it was able to unambiguously identify some frequent individuals, following Trolle and Kéry (2003) and Tortato and Oliveira (2005). In order to identify ocelots from the photographs obtained, it was used a combination of distinguishing characters including the patterns of rosettes, spots, stripes and sex (Figure 2). Photos of unidentified ocelots were excluded from the analysis. Ocelots' activity patterns were inferred from the time of the photo shoot. Nocturnal records were

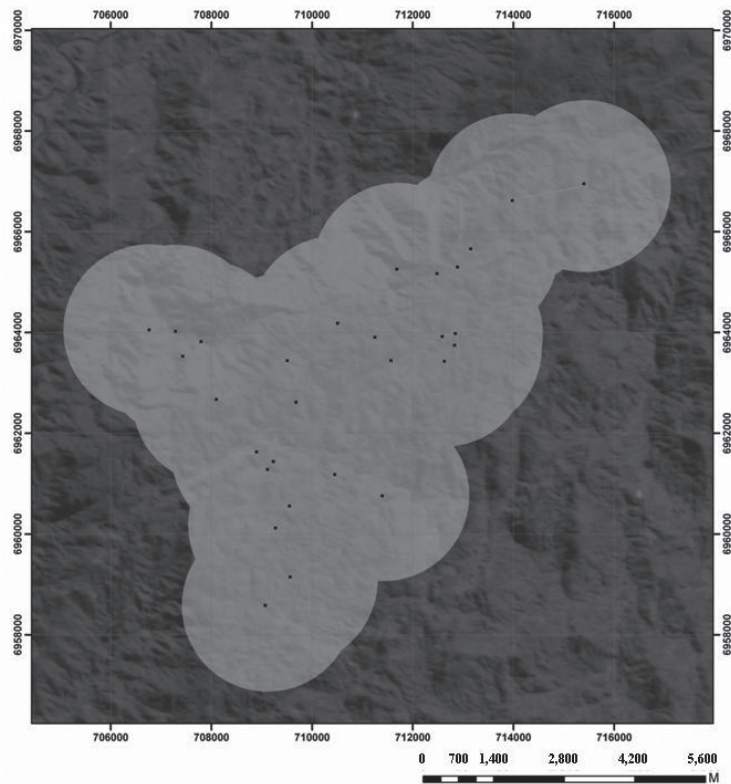


Figure 1. Effective sampled area (buffer area added around each trap station) in the study of ocelot ecology in the Atlantic Ombrophyll Forest of Santa Catarina State, southern Brazil. Points are the stations where the cameras were installed. Buffer area was obtained by the HMMDM method (Karanth and Nichols, 1998). Numbers outside the picture are the coordinates (in UTM) of the study area.

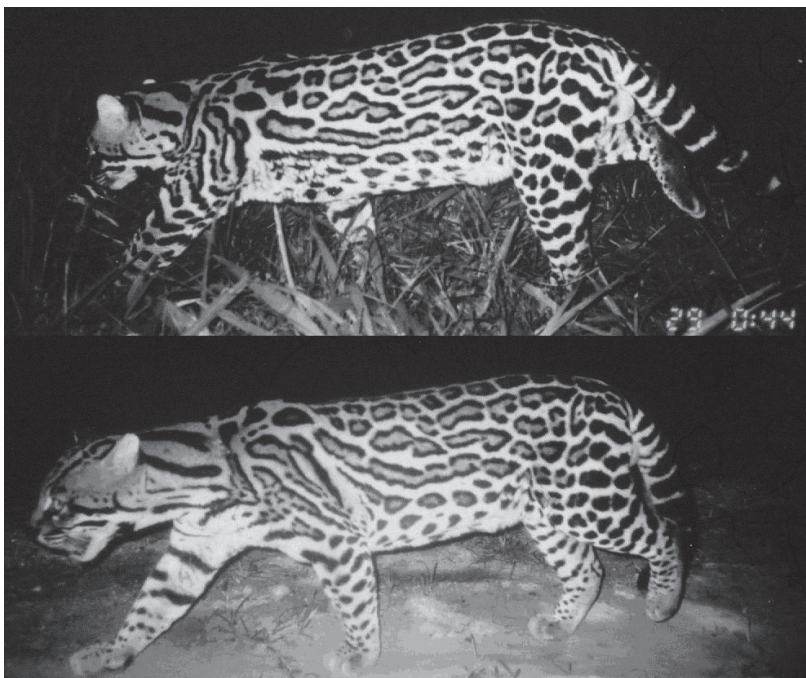


Figure 2. Records of the same individual of ocelot (*Leopardus pardalis*) in two distinct occasions in an Atlantic Ombrophyll Forest reserve in Southern Brazil, evidencing the capacity of identification by spot patterns.

considered as those occurred between sunset and sunrise while diurnal ones occurred between sunrise and sunset. Sunrise and sunset hours were determined by the software Moonrise 3.5 (Sidell, 2002), since the study was carried out for more than a year and the sunrise and sunset varies along the year in the area. For this analysis, we considered as the same capture (i.e., a valid record) records of the species in a given station during 1 hour interval and on the same day, in order to maximize the independence of the data.

Data analyses

Population estimation by the program CAPTURE was tested and rejected since there were just a few individuals in a large sampling period, contesting some and important premises. So we opted to estimate the ocelots' population size by the Jolly-Seber method. Ocelot's density was then obtained dividing the mean population size by the effective sampled area (areas of the cameras and respective buffers), according to Trolle and Kéry (2003).

The minimum convex polygon (MCP – 100%) method was used to calculate the minimum polygonal home ranges of three individuals of ocelot, two males and one female, by using the program ArcView 9.1. Data obtained with the two models of camera-trap (conventional and digital) were used for this analysis.

The chi-square test was used to examine differences in the ocelots' activity patterns by comparing the number of valid records of ocelots in each period (diurnal and nocturnal), following Dillon and Kelly (2007). The Spearman rank correlation was used in order to verify the activity pattern of ocelots along the night.

Results

During the 14 months of study, four individuals were recorded in the sampled area covered by a minimum convex polygon of ca. 30.54 km². The

total camera-trapping effort was about 4250 trap-nights. Forty two camera-trapping photographs of ocelots were obtained in 13 trap stations, becoming possible to identify the four individuals. In five photos we were not able to individualize ocelots and, therefore, these pictures were excluded from the analyses. The mean population size estimated by the Jolly-Seber method was 3.07 individuals, and the maximum number of estimated ocelots was five, between June and August 2006. Ten sample periods with 14.7 days in average (SD = 2.21) were considered. Intervals between sample periods were 20.2 days in average (SD = 2.33). Total sampled area was 70.62 km², resulting in a density of 0.04 ocelots per km² (Table 1).

Calculated minimum home ranges obtained by the MCP – 100% were 12.29 (# 1) and 2.69 km² (# 2) for

males and 0.38 km² for the female (# 1). The other individual was a female and was recorded in only two stations, becoming impossible to estimate its minimum home range (Figure 3). Maximum distances of movements observed during the survey periods were 4.75 and 7.54 km for males and 1.12 and 1.69 km for females. Ocelots showed a nocturnal activity pattern ($\chi^2 = 26.947$; $df = 1$; $p < 0.001$), being more recorded at night ($n = 35$) than during diurnal ($n = 3$) period, with two peaks of activity during the night, one near 21 h and the other near midnight. But in general, after the two initial peaks of activity, there was a trend to a decreasing activity pattern along the night (Figure 4) as confirmed by the Spearman rank correlation ($r_s = -0.817$; $n = 9$ hour classes; $p = 0.007$).

Discussion

Density estimate for ocelots was low in comparison with those of other studies in the neotropical (Di Bitetti *et al.*, 2006; Dillon and Kelly, 2008; Emmons, 1988; Jacob, 2002; Ludlow and Sunquist, 1987; Maffei *et al.*, 2002; Maffei *et al.*, 2005; Trolle and Kéry, 2003; Trolle and Kéry, 2005) and temperate regions (Haines *et al.*, 2006; López-Gonzalez *et al.*, 2003). However, most studies used different methods to estimate density, like the full MMDM (Jacob, 2002), radio-telemetry (Emmons, 1988; Ludlow and Sunquist, 1987) and records of ocelot observations (López-Gonzalez *et al.*, 2003). In comparison with studies that used the same method employed in the actual work (HMMDM) we still observed a low ocelot density. This fact can be related

Table 1. Mean population density and home range size (in km²) of ocelots (*Leopardus pardalis*) recorded with different methodologies in several studies carried out in the Americas. Abbreviations: RT, radio-telemetry; CT, camera-trap. Observations: 1, mean density (individuals per km²); 2, home range estimated by the minimum-area method; 3, home range estimated by the MCP – 100%; 4, home range estimated by the MCP – 95%; 5, home range estimated by the Fixed Kernel – 95%; 6, buffer derived independently from each survey grid.

Study	Method	Mean density ¹	Mean home range size	
			Male	Female
Ludlow and Sunquist (1987)	Radio-telemetry	0.4	10.0 ²	3.0 ²
Emmons (1988)	Radio-telemetry	0.8	7.0 ³	1.8 ³
Crawshaw and Quigley (1989)	Radio-telemetry	-	-	1.2
Jacob (2002)	MMDM - CT	0.31	11.7 ⁴	7.2 ⁴
Maffei <i>et al.</i> (2002)	HMMDM - CT	0.4	-	-
Trolle and Kéry (2003)	HMMDM - CT	0.56	-	-
López-Gonzalez <i>et al.</i> (2003)	Records	0.06	-	-
Maffei <i>et al.</i> (2005)	HMMDM - CT	0.3	-	-
Trolle and Kéry (2005)	HMMDM - CT	0.11	-	-
Di Bitetti <i>et al.</i> (2006)	HMMDM - CT	0.17	13.4 ³	6.0 ³
	MMDM - CT	0.10		
Haines <i>et al.</i> (2006)	HMMDM - CT	0.3	-	-
Dillon and Kelly (2007)	HMMDM - CT	0.25	-	-
Dillon and Kelly (2008)	Radio-telemetry ³	0.12	19.7	18.3
	Radio-telemetry ⁵	0.11	33.2	21.3
	HMMDM - RT	0.08		
	MMDM - CT	0.13		
	HMMDM - CT	0.3		
Maffei and Noss (2008)	CT ⁶	0.21	3.9 ⁴	2.9 ⁴
	HMMDM - RT	0.18	5.9 ⁵	3.2 ⁵
This study	HMMDM - CT	0.04	7.5 ³	0.4 ³

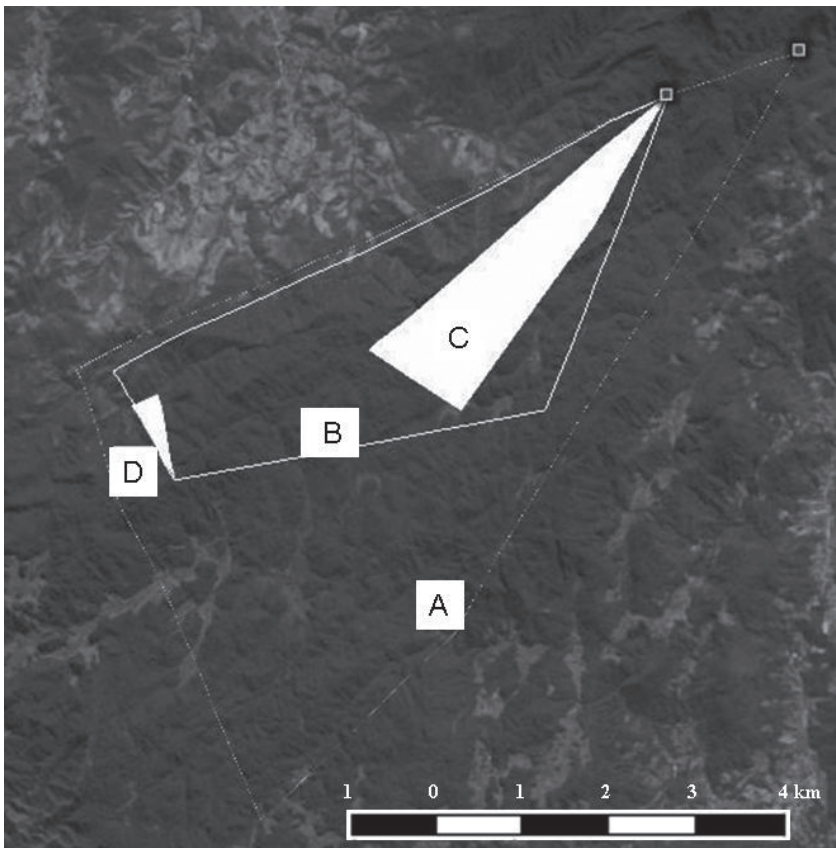


Figure 3. Home ranges of the three individuals of ocelot (*Leopardus pardalis*), calculated by the MCP, in an Atlantic Ombrophyll Forest reserve in southern Brazil. Figure shows the sampled area (A) and the home ranges of three individuals: the male 1 (B), the male 2 (C) and a female (D). The points in the top of the picture indicate the two stations where the other female was recorded. Central coordinates: 27°25'51" S and 48°51'01" W.

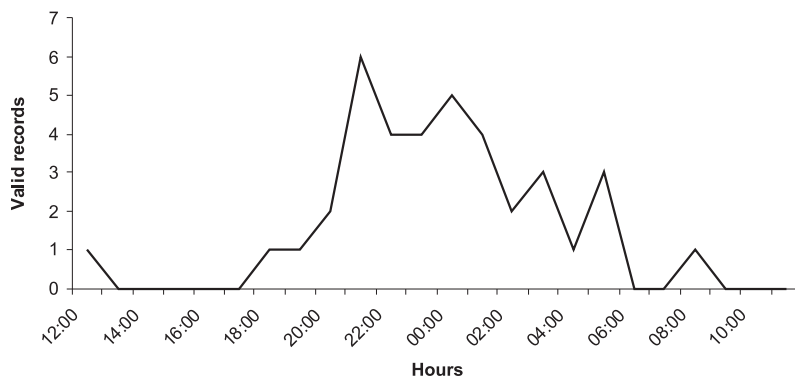


Figure 4. Activity patterns of ocelots (*Leopardus pardalis*) in an Atlantic Ombrophyll Forest reserve in southern Brazil, showing their nocturnal activity. Activity tends to decrease along the night.

to the conditions of the study area (a reserve) that would not provide a sufficient size for a large population. The reserve is small (ca. 43 km²) and it is surrounded by crop areas, where signs of illegal hunting are frequently

seen, limiting the ocelots to live in a small and partially isolated “island”. Besides, in almost half of the reserve, there were no records of ocelots, which indicate at least a low level of occupancy and a high heterogeneity in

the spatial occupation. Due to this last explanation, we believe that, rather than a result of failure of sampling (Maffei and Noss, 2008), the population of ocelots can be suffering problems of insulation in this small reserve, as observed by Dillon and Kelly (2008) elsewhere.

Independent of the density estimation, the determination of buffer width and its effect on estimates are subject of discussions and need further studies (Di Bitetti *et al.*, 2006; Dillon and Kelly, 2008; Trolle and Kéry, 2005). For instance, the suggestion of Karanth and Nichols (1998) to define the HMMDM method was based on small mammals, becoming unclear its use for large territorial carnivores. In the same way, some studies reported that the HMMDM method overestimates jaguars and ocelots population sizes in comparison with the GPS telemetry (Dillon and Kelly, 2008; Soisalo and Cavalcanti, 2006). In contrast to the results above, Maffei and Noss (2008) found that the camera trapping HMMDM accurately reflected ocelot home range in Bolivia. In the actual case in the Atlantic Forest, estimates appear to be underestimated, but we believe that population levels are really low, which would be explained by the insulation caused by the small-reserve factor, or even hunting pressure or other anthropogenic effect as observed for Di Bitetti *et al.* (2006). Given that traps sampled all extent of the reserve, this is another important factor assuring the low population level of ocelots here.

The recorded female home range size in our study area was lower than the ones reported elsewhere, even when considering the fact that home range size and density are negatively correlated in within-species comparisons of territorial carnivores (Di Bitetti *et al.*, 2006). Even other camera-trap studies have showed larger home ranges (see Di Bitetti *et al.*, 2006; Jacob, 2002) as well as those with radio-telemetry (Crawshaw and Quigley, 1989; Emmons, 1988; Lud-

low and Sunquist, 1987). Due to the fact that movement rates of females are lower than those of males (Oliveira, 1994), our mean distances between camera traps may not have been the best adjustment for females, being maybe and often longer than the expected female movements. If this has occurred, home range sizes of females in this study are quite underestimated, which is inferred by the comparative approach done with other studies. For example, female home range size in the Atlantic Forest of north-eastern Argentina was 6.0 km² (Di Bitetti *et al.*, 2006) whereas it was 0.4 km² in the present study.

For males, we observed the mean home range size in accordance with the range observed elsewhere, and larger than those of females. This uniformity suggests that this home range size maintained by ocelots is probably on the optimum limit that they could maintain, as prey density might vary considerably among sites (Oliveira, 1994). The knowledge that male's home ranges are generally larger than female's ones (Dillon and Kelly, 2008; Murray and Gardner, 1997; Oliveira, 1994), even 3-4 times (Ludlow and Sunquist, 1987), usually overlapping several territories (Emmons, 1988; Murray and Gardner, 1997) is probably due to the male's need to cover large distances for reproductive and energy requirements (Ludlow and Sunquist, 1987).

We could observe an overlapping between the home ranges of the three individuals monitored as well. The greater area belonged to a male and included the home ranges of the other two individuals (another male and a female). Overlaps in adult male home ranges are not common (Emmons, 1988), restricting the overlaps only to the boundaries of the areas (Jacob, 2002). Our records showed an overlapping during the same period (January and July 2006), suggesting that these two individuals are relative, since adult ocelots appear to tolerate

independent offspring in their natal ranges (Ludlow and Sunquist, 1987). The nocturnal habit of ocelots has already been recorded, but the degree of nocturnality varies from region to region (Di Bitetti *et al.*, 2006; Oliveira, 1994). We also recorded a bimodal activity pattern at night (like Emmons, 1988), but our peaks were recorded near 21 h (like Maffei *et al.*, 2005) and near midnight. It is quite possible that these peaks are just noise and the pattern tends to decrease during the night after a high peak in the evening. These nocturnal habits are probably a main consequence of the major prey activity (Ludlow and Sunquist, 1987), because ocelots' movements are probably locally fitted to probabilities of prey encounter (Emmons, 1988; Emmons *et al.*, 1989). Nocturnal pattern can be result of an evolutionary factor as well, in order to avoid the competition/predation of the ocelot with larger cats, like puma and jaguar, which display cathemeral, crepuscular or diurnal activity patterns (Gomez *et al.*, 2005; Maffei *et al.*, 2002). This strategy can act as a resource partitioning, similar to that observed for the microhabitat selection by mammal species in the same area (Goulart *et al.*, 2009).

Camera trapping is being used frequently to get estimates of home range size and ranging patterns of wild animals. However, it is important to obtain information on home range size in order to determine the appropriate camera spacing, buffer size and total grid size, in order to tailor the camera-traps to the local studied populations (Dillon and Kelly, 2008; Maffei and Noss, 2008). In our study, the effective sampled area covered all extent of the reserve and hence results showed a small population size of ocelots. If low population levels are a reality here, this would imply in the necessity for a larger reserve size for conservation of a minimum viable population size of ocelots, and an

efficient dispersal and immigration mechanism to connect isolated populations of this species (Mazzolli, 1993).

Acknowledgements

We are very grateful to Russel Wid Coffin to allow field research at Reserva Ecológica do Caraguatá. We also thank Conservation International/Brazil, Associação Reserva Ecológica do Caraguatá (in the person of Paulo Sérgio Schweitzer) and FUNPESQUISA/UFSC for logistical support. Appreciation is also due to Júlio César, Lenoir, Wanderlei, Adilson, Aranha and Joel (Caraguatá's forest rangers), for field support. C. H. Salvador de Oliveira, V. Piacentini, F. Souza, H. Mozerle and T. Maccarini helped us with field work in some expeditions. Sandra Costa and Diogo da Silva from Universidade do Vale do Paraíba (UNIVAP) supplied us with their indubitable help with the software ArcView 9.1.

References

- BISBAL, F.J. 1986. Food habits of some neotropical carnivores in Venezuela (Mammalia, Carnivora). *Mammalia*, **50**:329-339.
- CRAWSHAW, P.G. JR.; QUIGLEY, H.B. 1989. Notes on ocelot movement and activity in the Pantanal region, Brazil. *Biotropica*, **21**:377-379.
- DI BITETTI, M.S.; PAVIOLO, A.; DE ANGELO, C. 2006. Density, habitat use and activity patterns of ocelots (*Leopardus pardalis*) in the Atlantic Forest of Misiones, Argentina. *Journal of Zoology*, **270**:153-163.
- DILLON, A.; KELLY, M.J. 2007. Ocelot *Leopardus pardalis* in Belize: The impact of trap spacing and distance moved on density estimates. *Oryx*, **41**:469-477.
- DILLON, A.; KELLY, M.J. 2008. Ocelot home range, overlap and density: Comparing radio telemetry with camera trapping. *Journal of Zoology*, **275**:91-398.
- EMMONS, L.H. 1988. A field study of ocelots in Peru. *Revue d'Ecologie. (Terre et la Vie)*, **43**:133-157.
- EMMONS, L.H.; SHERMAN, P.; BOLSTER, D.; GOLDIZEN, A.; TERBORGH, J. 1989. Ocelot behavior in moonlight. In: K.H. REDFORD; J.F. EISENBERG (eds.), *Advances in Neotropical Mammalogy*. Gainesville, The Sandhill Crane Press, p. 233-242.

- EMMONS, L.H.; FEER, F. 1997. *Neotropical rain forest mammals. A field guide*. Chicago, University of Chicago Press, 307 p.
- GAPLAN. 1986. *Atlas de Santa Catarina*. Rio de Janeiro, Gabinete de Planejamento e Coordenação Geral, 173 p.
- GOMEZ, H.; WALLACE, R.B.; AYALA, G.; TEJADA, R. 2005. Dry season activity periods of some Amazonian mammals. *Studies on Neotropical Fauna and Environment*, **40**:91-95.
- GOULART, F.V.B.; CÁCERES, N.C.; GRAIPEL, M.E.; TORTATO, M.A.; GHIZONI-JR., I.R.; OLIVEIRA-SANTOS, L.G.R. 2009. Habitat selection by large mammals in a southern Brazilian Atlantic Forest. *Mammalian Biology*, **74**:182-190.
- HAINES, A.M.; JANECKA, J.E.; TEWES, M.E.; GRASSMAN JR, L.I.; MORTON, M. 2006. The importance of private lands for ocelot *Leopardus pardalis* conservation in the United States. *Oryx*, **40**:90-94.
- HEILBRUN, R.D.; SILVY, N.J.; PETERSON, N.J.; TEWES, M.E. 2006. Estimating bobcat abundance using automatically triggered câmeras. *Wildlife Society Bulletin*, **34**:69-73.
- HENSCHER, P.; RAY, J. 2003. *Leopards in African rainforests: Survey and monitoring techniques*. New York, Wildlife Conservation Society, 50 p.
- JACOB, A.A. 2002. *Ecologia e conservação da jaguatirica (Leopardus pardalis) no Parque Estadual Morro do Diabo, Pontal do Paranapanema, SP*. Brasília, Universidade de Brasília, Ph.D Thesis, 56 p.
- KARANTH, U.K. 1995. Estimating tiger *Panthera tigris* populations from camera-trap data using capture-recapture models. *Biological Conservation*, **71**:333-338.
- KARANTH, U.K.; NICHOLS, J.D. 1998. Estimation of tiger densities in India using photographic captures and recaptures. *Ecology*, **79**:2852-2862.
- LÓPEZ-GONZÁLEZ, C.A.; BROWN, D.E.; GALLO-REYNOSO, J.P. 2003. The ocelot *Leopardus pardalis* in north-western México: Ecology, distribution and conservation status. *Oryx*, **37**:358-364.
- LUDLOW, M.E.; SUNQUIST, M.E. 1987. Ecology and behavior of ocelots in Venezuela. *National Geographic Research*, **3**:447-461.
- MAFFEI, L.; CUÉLLAR, E.; NOSS, A.J. 2002. Uso de trampas cámara para la evaluación de mamíferos en el ecotono Chaco-Chiquitania. *Revista Boliviana de Ecología y Conservación Ambiental*, **11**:55-66.
- MAFFEI, L.; CUÉLLAR, E.; NOSS, A.J. 2004. One thousand jaguars (*Panthera onca*) in Bolivia's Chaco? Camera-trapping in the Kaa-Iya National Park. *Journal of Zoology*, **262**:295-304.
- MAFFEI, L.; NOSS, A.J. 2008. How small is too small? Camera trap survey areas and density estimates for ocelots in the Bolivian Chaco. *Biotropica*, **40**:71-75.
- MAFFEI, L.; NOSS, A.J.; CUÉLLAR, E.; RUMIZ, D. I. 2005. Ocelot (*Felis pardalis*) population densities, activity, and ranging behaviour in the dry forests of eastern Bolivia: Data from camera trapping. *Journal of Tropical Ecology*, **21**:1-6.
- MAZZOLLI, M. 1993. Ocorrência de *Puma concolor* (Linnaeus) (Felidae, Carnivora) em áreas de vegetação remanescente de Santa Catarina, Brasil. *Revista Brasileira de Zoologia*, **10**:581-587.
- MURRAY, J.L.; GARDNER, G.L. 1997. *Leopardus pardalis*. *Mammalian Species*, **548**:1-10.
- OLIVEIRA, T.G. 1994. *Neotropical cats: Ecology and conservation*. São Luís, Edufma, 220 p.
- SIDELL, B.P. 2002. *Moonrise 3.5* (32Bit) Software.
- SOISALO, M.K.; CAVALCANTI, S.M.C. 2006. Estimating the density of a jaguar population in the Brazilian Pantanal using camera-traps and capture-recapture sampling in combination with GPS radio-telemetry. *Biological Conservation*, **129**:487-496.
- TORTATO, M.A.; OLIVEIRA, T.G. 2005. Ecology of the oncilla (*Leopardus tigrinus*) at Serra do Tabuleiro State Park, Southern Brazil. *CATNews*, **42**:28-30.
- TROLLE, M.; KÉRY, M. 2003. Ocelot density estimation in the Pantanal using capture-recapture analysis of camera-trapping data. *Journal of Mammalogy*, **84**:607-614.
- TROLLE, M.; KÉRY, M. 2005. Camera-trap study of ocelot and other secretive mammals in the northern Pantanal. *Mammalia*, **69**:405-412.
- VELOSO, H.P.; RANGEL-FILHO, A.L.R.; LIMA, J.C.A. 1991. *Classificação da vegetação brasileira adaptada a um sistema universal*. Rio de Janeiro, IBGE, 124 p.

Submitted on June 22, 2009.

Accepted on July 27, 2009.