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# Rodent selection by Geoffroy's cats in a semi-arid scrubland of central Argentina

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A B S T R A C T

Small mammals usually constitute the main prey for *Leopardus geoffroyi* throughout its distribution. We studied the patterns of small rodent selection by this felid in a semi-arid scrubland of central Argentina, addressing whether prey choice may be related to the availability, morphology, and distribution of the different rodent species. Cat's diet was studied during 2005–2006 through the analysis of 182 scats, along with field estimates of rodent abundances from trapping. The cricetine rodents *Akodon molinae* and *Calomys musculinus* were predated according to the availability expected by trapping, indicating that their use was opportunistic. *Akodon azarae* and *Graomys griseoflavus*, on one hand, and *Eligmodontia typus*, on the other hand, were consumed in lower and higher proportion than their availabilities, respectively. Our results suggest that some cricetine rodent characteristics such as abundance, escape ability, microhabitat use, and activity period, appear to be potential factors contributing to differential vulnerability to predation by Geoffroy's cat in central Argentina.





## 1. Introduction

Predator-prey interactions are of particular interest in arid and semi-arid environments, where food resources are temporally fluctuant (Wiens, 1977). Prey may be captured in the same proportion as present in the environment by an opportunistic predator or in a different proportion by a selective one (Andersson and Erlinge, 1977; Futuyma and Moreno, 1988), and these patterns probably arises from the interaction between behavior and morphology of both predator and prey (Corley et al., 1995; Dickman et al., 1991; Kotler, 1984; Nishimura and Abe, 1988). Factors affecting prey choice by predators generally differ across landscapes, and this knowledge is essential to determine the ability of predators to deal with different prey compositions and habitat characteristics (Bekoff et al., 1984).

For several reasons, small mammals are a highly profitable prey for carnivores. First, small mammals are generally abundant in many ecosystems (Curtin et al., 2000; Pearson, 1964), which increase the encounter rate with predators. Second, they are usually easy to handle and digest by carnivores (Erlinge et al., 1974; Pearson, 1964). Third, small mammals typically contain a greater percentage of digestible matter respect to similar-sized birds or reptiles (Hume, 2005; Johnson and Hansen, 1979). In consequence, small mammals-and particularly small rodents-comprise the bulk of the diet of several small-sized felids (<7 kg of body weight) (Lozano et al., 2006; Sliwa, 2006; Walker et al., 2007). Moreover, Mukherjee et al. (2004) estimated that up to 70% of the daily metabolizable energy in the jungle cat (*Felis chaus*) and the caracal (*Caracal caracal*), is obtained from small rodents.

Different small mammal species have evolved different strategies to avoid predation and reduce vulnerability, including morphological features (e.g., size of the auditory bullae, length of the forelimbs) or behavioral traits (e.g., bipedal locomotion, use of dense cover) (Dickman, 1992; Kotler, 1984; Rosenzweig, 1973; Taraborelli et al., 2003). Ultimately, these antipredatory traits and the structure of the small mammal assemblage result in interspecific differences in vulnerability to predation (see Corley et al., 1995).

Geoffroy's cat (*Leopardus geoffroyi*) is a small felid (ca. 4 kg) distributed from southern Bolivia and Brazil to southern Argentina and Chile (Nowell and Jackson, 1996). This species appears to be a highly adaptive predator, inhabiting a wide variety of habitat types including wetlands, dry forests, grasslands, and scrublands (Perovic and Pereira, 2006). Although the introduced European hare (*Lepus europaeus*) or waterbirds were found to be important prey items for Geoffroy's cat in some localities, small mammals usually constitute the main prey for this felid throughout its

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distribution range (Bisceglia et al., 2008; Canepuccia et al., 2007; Johnson and Franklin, 1991; Manfredi et al., 2004; Novaro et al., 2000; Sousa and Bager, 2008; Vuillermoz, 2001). However, the selection pattern of rodents in relation to their morphological and behavioral traits remains unstudied, impeding the recognition of how those factors may predispose different rodent species to greater predation rates by these cats.

A previous study about diet composition of Geoffroy's cat carried out in the Monte desert of central Argentina (Bisceglia et al., 2008) showed that small mammals constituted up to 94% of its diet. Here, we studied the seasonal patterns of small rodent selection by the same Geoffroy's cat population, addressing whether prey choice may be related to the availability, morphology, and habitat use of the different rodent species.

## 2. Study area

The study was conducted in Lihue Calel National Park (37° 57′ S, 65° 33′ W; 9900 ha). This protected area is located in the endemic Monte Eco-region of central Argentina (Burkart et al., 1999). The landscape is composed of a flat terrain, except for a large set of bare rock hills. The vegetation is characterized by a mosaic of creosote bush flats of the genus *Larrea*, open grasslands and isolated patches of xeric forests with *Prosopis caldenia* and *Prosopis flexuosa* as dominant tree species. The area is characterized by hot summers (January mean temperature = 24 °C), cool winters (July mean temperature = 8 °C) and low annual rainfall (414 mm), concentrated mostly in spring and summer (September–April).

## 3. Materials and methods

### 3.1. Availability of small rodents

We studied prey selection patterns by Geoffroy's cats considering the seven small sigmodontine rodents (*Akodon azarae*, *Akodon molinae*, *Calomys musculinus*, *Eligmodontia typus*, *Graomys griseoflavus*, *Oligoryzomys longicaudatus*, and *Reithrodon auritus*) highly preyed by this felid species at Lihue Calel throughout the year (collectively, these set of species composed >50% of the seasonal diet composition in terms of percent occurrence; Bisceglia et al., 2008). Although other small rodent species (such as the caviomorphs *Galea leucoblephara*, *Microcavia australis* and *Ctenomys azarae*) inhabit the study area, they were infrequently preyed upon by this felid (Bisceglia et al., 2008) and they were not included in the present study.

Abundance of small sigmodontine rodents was surveyed seasonally from winter 2005 (mid-August) to fall 2006 (mid-May), using the multiple capture-recapture method (Lancia et al., 1994 [illegible] seasonally installed five grids of 7 × 8 live traps (7.6 × 8.9 × 22.8 cm; H. B. Sherman Traps, Inc., Tallahassee, Florida), with 10 m between traps, in the three habitat types highly represented in the study area: a) two grids in mixed scrublands of *Condalia microphylla*, *P. flexuosa*, *Lycium chilense* and *Larrea divaricata*, b) two grids in rocky slopes, and c) one grid in tall grasslands dominated by the thistle *Centaurea solstitialis*. Since Pereira (2009) pointed out that Geoffroy's cats showed a similar intensity of use of the three habitat types, we consider the current sampling design adequately represents rodents' availability for this predator. Grids were operated for 5–6 consecutive nights (overall trapping effort = 6468 trap-nights), using rolled oats and peanut butter as bait. Captured individuals were identified to species level, sexed, weighed, marked by toe clipping, and released at the capture site. Toe clip material was preserved for further genetic analyses. Due to the low capture and recapture rate of some species throughout the year, we were unable to estimate the abundance of rodent species using capture-recapture models. Thus, the seasonal abundance of each small rodent species was estimated using the minimum number of individuals known alive (MNKA). In each season, the proportion of each species in each habitat type was used as an index of its relative abundance.

### 3.2. Use and selection of small rodents by Geoffroy's cat

Diet composition of Geoffroy's cats was determined by analyzing fresh scats (see methods details and complete results in Bisceglia et al. (2008)). Scats were seasonally collected from winter 2005 to fall 2006, during a one-week period simultaneously with the small rodent surveys. Contribution of different small rodent species to the diet was reported as the number of times individuals of each species was found as percentage of all small rodents found (percent occurrence; PO). A goodness-of-fit chi-square test (Zar, 1996) was used to determine whether observed frequencies of each species in scats differed significantly from expected frequencies as estimated from trapping. Bonferroni confidence intervals were used to identify differences among species (Neu et al., 1974). When the expected proportion of consumption did not lie within the interval, we concluded that the expected and observed consumptions were significantly different at a level of significance of 0.05. Because the trapping protocol used during this study appeared to be not suitable to accurately assess the abundance of *R. auritus* (probably due to inadequate bait; see also Trejo and Guthmann (2003)), we did not consider this species for the selection analysis.

## 4. Results

### 4.1. Availability of small rodents

Globally, small rodents were more abundant during summer and fall than during spring or winter (Fig. 1). In each season, no significant differences were found in their abundance among habitats, except during summer ($\chi^2 = 11.51$, df = 3, $P = 0.003$) when the mixed scrubland showed the highest abundance and the rocky slopes the lowest one (Fig. 1). The grasslands showed a significant higher abundance of small rodents in summer and fall with respect to winter ($\chi^2 \geq 5.78$, $P \leq 0.016$), whereas the rocky slopes exhibit a significant higher abundance of small rodents in summer with respect to winter and spring ($\chi^2 \geq 7.76$, $P = 0.005$). The abundance of small rodents differed throughout the year in the mixed scrubland ($\chi^2 \geq 9.39$, $P \leq 0.002$), except between summer and fall ($\chi^2 = 0.19$, $P = 0.656$) when maximum abundances were reached (Fig. 1). *A. molinae* constituted >20% of the seasonal small rodent captures, with capture peaks in summer and fall (Fig. 2). *A. azarae* showed a similar pattern of captures of *A. molinae* throughout the year, but seasonal capture numbers were lower. *C. musculinus* was the most captured species in summer and fall. The remaining species were poorly represented in captures, except *G. griseoflavus* which showed a capture peak during fall (Fig. 2). *R. auritus* was not captured at all in spite of its presence in the study area was noticed from feces and burrows (Teta et al., 2009). Both *Akodon* species were more captured in the mixed scrubland than in the other hábitats; in contrast, *C. musculinus* was more captured in the grasslands and the rocky slopes (Table 1). *G. griseoflavus* and *A. molinae* were the heaviest of the studied species, whereas *C. musculinus* showed the lowest body mass (Table 1).

### 4.2. Use and selection of small rodents by Geoffroy's cat

*A. molinae* was the most consumed small rodent throughout the year, followed by *C. musculinus* and *E. typus* (Table 2). Other species reached relative high values in the cat's diet in a single season, such

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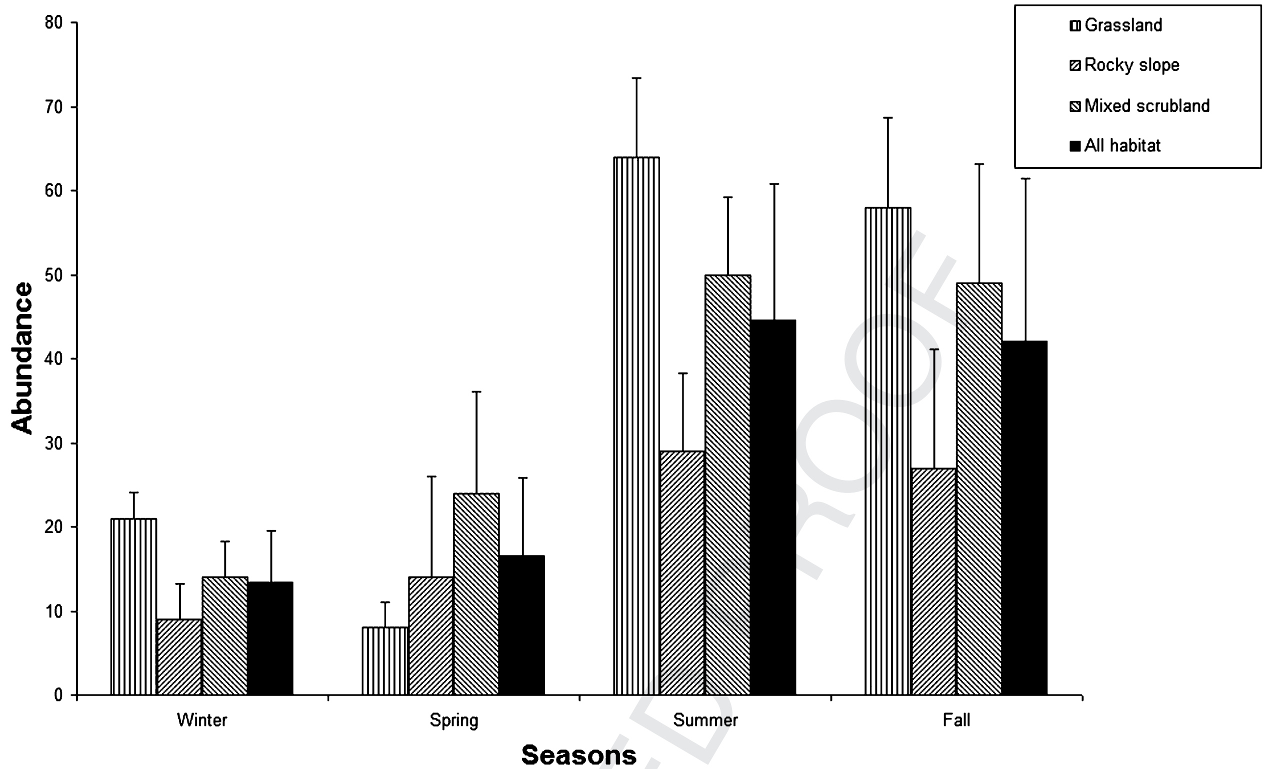


**Fig. 1.** Abundance of the small rodent assemblage (mean ± SE) in each habitat type and in all habitat types combined in Lihue Calel National Park, Argentina, during 2005–2006.

as *G. griseoflavus* in fall and *R. auritus* in summer (Table 2). The overall proportion of each species in the diet was significantly different ($P < 0.001$) to that expected as estimated from trapping in winter ($G = 32.36$; d.f. = 6), spring ($G = 61.73$; d.f. = 7), summer ($G = 64.41$; d.f. = 7), and fall ($G = 60.82$; d.f. = 4). *A. molinae* and *C. musculinus* were consumed in proportion to their availability throughout the year, whereas *G. griseoflavus* was negatively selected in summer and *E. typus* was positively selected in spring (Table 3). Finally, *A. azarae* (intervals not showed) was consistently "avoided" in all season.

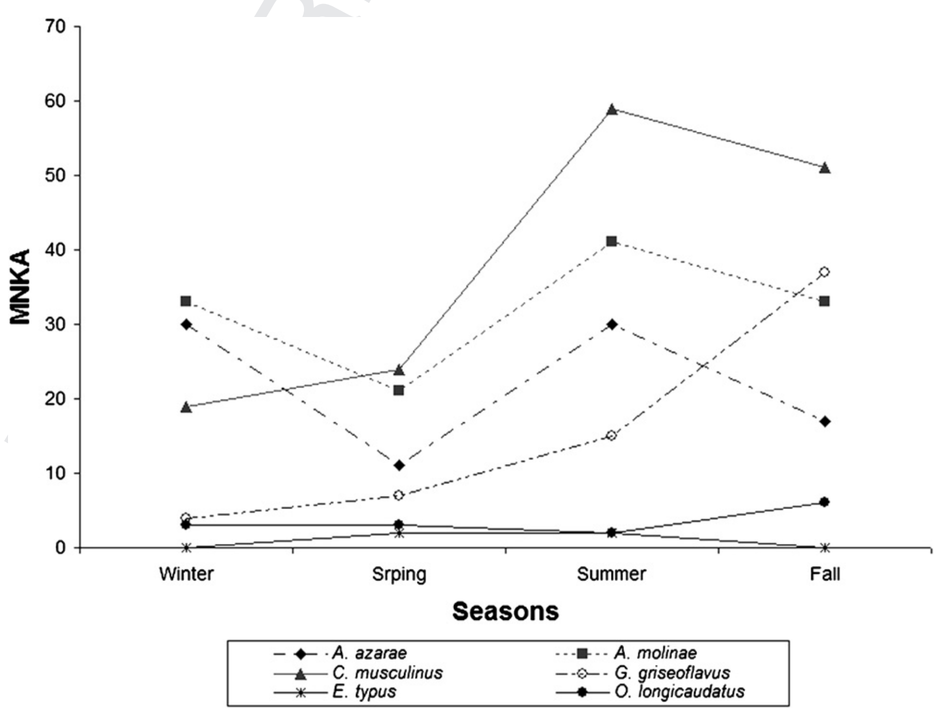


**Fig. 2.** Minimum number of individuals known alive (MNKA) of each small rodent species during each season in Lihue Calel National Park, Argentina, from winter 2005 to fall 2006.

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**Table 1**
Morphological and behavioral traits and number of individuals of small rodent species captured in different habitat types, estimated as the MNKA, in Lihue Calel National Park, Argentina. Values in rocky slopes and scrubland were averaged between both grids operated in these habitat types. Escape and Activity were compiled from several sources: Contreras 1979, Pearson 1995, Taraborelli et al., 2003 and Teta et al., 2009.

| Species | Body mass (mean ± SD) | Escape | Activity | Grassland | Rocky slopes | Mixed scrubland |
|---|---|---|---|---|---|---|
| *Akodon azarae* | 20.2 ± 5.4 | Quadrupedal | Diurnal/Nocturnal | 13 | 0.5 | 37 |
| *Akodon molinae* | 37.6 ± 10.5 | Quadrupedal | Nocturnal | 25 | 7.5 | 44 |
| *Calomys musculinus* | 14.7 ± 4.2 | Quadrupedal | Nocturnal | 50 | 30 | 21.5 |
| *Graomys griseoflavus* | 51.9 ± 15.7 | Quadrupedal saltation | Nocturnal | 4 | 13.5 | 16 |
| *Eligmodontia typus* | 19.2 ± 5.3 | Quadrupedal saltation | Nocturnal | 1 | 1 | 0.5 |
| *Oligoryzomys longicaudatus* | 25 ± 4.4 | Bipedal | Nocturnal | 0 | 0 | 7 |

## 5. Discussion

Our results showed that *A. molinae* and *C. musculinus* were the most abundant small rodent species in the field as well as the most consumed rodent species by Geoffroy's cats. In fact, both species were consumed according to their availability, indicating that their use was opportunistic. Thus, Geoffroy's cat would be considered as plastic predator, which feeds on the most abundant prey in order to maximize consumption (Griffiths, 1975). Both *A. molinae* and *C. musculinus* are short-legged rodents that have primarily a quadrupedal gait to escape from predators. This mode of locomotion is less effective than the bipedal one employed by other desert adapted species, which make them more vulnerable to predators and thus more dependent of plant cover (Taraborelli et al., 2003). Accordingly, both species reached high abundances in the more sheltered environments, such as the mixed scrubland and the grassland habitats. Several predation studies focused on raptor species have demonstrated that prey with low and predictable movements are often captured more frequently than those with rapid and erratic movements (e.g., Clarke, 1983; Glickman and Morrison, 1969; Kaufman, 1974; Spiegel et al., 1974; ). This is probably due to predators preferring prey with the greater certainty of capture (Stephens and Krebs, 1986). As a result, both the high abundance and the poor escape response of these species probably enhance their profitability as prey for Geoffroy's cats.

However, a different pattern was observed with *A. azarae.* Although this small rodent was abundant in Lihué Calel and it have also a quadrupedal gait to escape from predators, its presence in Geoffroy's cat feces was low. This species also reached its maximum abundance in the mixed scrubland, that was the more sheltered habitat of the three studied. Prey selection on *A. azarae* and its congeneric *A. molinae* probably did not result from differences in habitat use, morphology, or prey size, because both species are associated with relatively complex and closed habitat with high shrub cover, are morphologically similar and have body weights within the size range taken by cats (Teta et al., 2009). In this context, the "avoidance" of *A. azarae* is probably related with the mostly diurnal habits of this species in the study area (Teta et al., 2009). Thus, even when Geoffroy's cats use habitats with dense cover in Lihué Calel, such as scrublands and dense grassland (Pereira et al., 2006; Pereira, 2009), its activity time does not coincide with the main activity time of this mouse. In consequence, *A. molinae* may be actually more vulnerable to predation than *A. azarae*, because its activity period and habitat use pattern coincide with those of Geoffroy's cat.

Ease of capture and body size are two important factors affecting differential capture rates among prey types (Derting and Cranford, 1989). For example, both *G. griseoflavus* and *E. typus* have the ability to use quadrupedal saltation to avoid predators, including abrupt and quick changes of direction when escaping or erratic zigzagging movements (Taraborelli et al., 2003). Quadrupedal saltation may be more effective than quadrupedal gait in escaping attacks by predators because it allows for higher speed, a faster response to attack, and sudden changes of direction (Taraborelli et al., 2003). Taking into account its large size, long legs and climbing abilities, *G. griseoflavus* was able to escape predators using jumps longer than 10 cm and/or climbing up on shrubs and trees (Taraborelli et al., 2003). On the other hand, despite its low weight and jumping locomotion, *E. typus* is easy to catch because it inhabits sites with low vegetation cover or bare ground and it runs in the open for long periods (Trejo and Guthmann, 2003; Trejo et al., 2005). Use of open habitats is associated with higher risk of predation (Kotler, 1984), and this feature can increase its vulnerability to Geoffroy's cat predation.

Our results suggest that some features such as abundance, escape ability, microhabitat use, and activity period appear to be potential factors that contribute to differential vulnerability to predation by Geoffroy's cat in scrublands of Argentina. In a similar study carried out in a wetland landscape, Canepuccia et al. (2007) found that abundance, distance of prey before attack, and prey size were significant predictors of prey (mainly waterbird)

**Table 2**
Seasonal diet composition of *Leopardus geoffroyi* expressed in percent occurrence in Lihue Calel National Park, Argentina (see Bisceglia et al., 2008 for complete results).

| Prey item | Season | | | |
|---|---|---|---|---|
| | Winter | Spring | Summer | Fall |
| *Akodon molinae* | 55.1 | 27.3 | 34.7 | 24.4 |
| *Akodon azarae* | 7.1 | 7.6 | 2.7 | 5.4 |
| *Calomys musculinus* | 20.4 | 31.8 | 36.0 | 27.0 |
| *Graomys griseoflavus* | 4.1 | 9.1 | 6.7 | 13.5 |
| *Eligmodontia typus* | 13.3 | 18.2 | 9.3 | 27.0 |
| *Reithrodon auritus* | 0.0 | 3.0 | 10.6 | 0.0 |
| *Oligoryzomys longicaudatus* | 0.0 | 3.0 | 0.0 | 2.7 |

**Table 3**
Prey selection by Geoffroy's cat in Lihué Calel National Park, Argentina, based on the Bonferroni confidence intervals. Positive (prey species consumed more than expected) or negative (consumed less then expected) selection are considered at the 0.05 level of significance.

| | Season | Expected proportion | Bonferroni intervals | Selection |
|---|---|---|---|---|
| *Akodon molinae* | Winter | 0.37 | $0.31 \le p \le 0.69$ | = |
| | Spring | 0.30 | $0.12 \le p \le 0.42$ | = |
| | Summer | 0.24 | $0.19 \le p \le 0.49$ | = |
| | Fall | 0.23 | $0.05 \le p \le 0.42$ | = |
| *Calomys musculinus* | Winter | 0.25 | $0.09 \le p \le 0.31$ | = |
| | Spring | 0.32 | $0.16 \le p \le 0.47$ | = |
| | Summer | 0.35 | $0.21 \le p \le 0.51$ | = |
| | Fall | 0.35 | $0.07 \le p \le 0.45$ | = |
| *Graomys griseoflavus* | Winter | 0.03 | $0.00 \le p \le 0.09$ | = |
| | Spring | 0.10 | $0.00 \le p \le 0.19$ | = |
| | Summer | 0.35 | $0.00 \le p \le 0.14$ | Negative |
| | Fall | 0.25 | $0.00 \le p \le 0.28$ | = |
| *Eligmodontia typus* | Spring | 0.03 | $0.05 \le p \le 0.31$ | Positive |
| | Summer | 0.01 | $0.00 \le p \le 0.18$ | = |



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consumption by this predator. Geoffroy's cat appears to consume different prey species in an opportunistic manner, maximizing the use of the most abundant "profitable" species. In arid and semi-arid regions where water is a limiting resource, drought periods can have a strong effect on the abundance of main prey of Geoffroy's cats (Pereira et al., 2006). Thus, both the foraging flexibility and the opportunistic dietary strategy may help this felid to survive in these fluctuant environments.

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## References

Andersson, M., Erlinge, S., 1977. Influence of predation on rodent population. Oikos 29, 591–597.
Bekoff, M., Daniels, T.J., Gittleman, J.L., 1984. Life history patterns and the comparative social ecology of carnivores. Annual Review of Ecology and Systematics 15, 191–235.
Bisceglia, S.B.C., Pereira, J.A., Teta, P., Quintana, R.D., 2008. Food habits of Geoffroy's cat (*Leopardus geoffroyi*) in the central Monte desert of Argentina. Journal of Arid Environments 72, 1120–1126.
Burkart, R., Bárbaro, N.O., Sánchez, R.O., Gómez, D.A., 1999. Ecorregiones de la Argentina. Administración de Parques Nacionales, Buenos Aires.
Canepuccia, A.D., Martinez, M.M., Vassallo, A.I., 2007. Selection of waterbirds by Geoffroy's cat: effects of prey abundance, size, and distance. Mammalian Biology 72, 163–173.
Clarke, J.A., 1983. Moonlight's influence on predator/prey interactions between short-eared owls (*Asio flammeus*) and and deermice (*Peromyscus maniculatus*). Behavioral Ecology and Sociobiology 13, 205–209.
Corley, J.C., Fernandez, G.J., Capurro, A.F., Novaro, A.J., Funes, M.C., Travaini, A., 1995. Selection of cricetine prey by the Culpeo fox in Patagonia: a differential prey vulnerability hypothesis. Mammalia 59, 315–325.
Curtin, C., Kelt, D., Frey, T., Brown, J., 2000. On the role of small mammals in mediating climatically driven vegetation change. Ecology Letters 3, 309–317.
Derting, T.L., Cranford, J.A., 1989. Physical and behavioral correlates of prey vulnerability to barn owl (*Tyto alba*) predation. The American Midland Naturalist 121, 11–20.
Dickman, C.R., 1992. Predation and habitat shift in the house mouse, *Mus domesticus*. Ecology 73, 313–322.
Dickman, C.R., Predavec, M., Lynam, A.J., 1991. Differential predation of size and classes of mice by barn owl, *Tyto alba*. Oikos 62, 67–76.
Erlinge, S., Jonsson, B., Willstedt, H., 1974. Hunting behavior and the choice of prey of captive weasels. Fauna Och Flora (Stockholm) 69, 95–101.
Futuyma, D.J., Moreno, G., 1988. The evolution of ecological specialisation. Annual Review of Ecology and Systematics 19, 207–233.
Glickman, S.E., Morrison, B.J., 1969. Some behavioral and neural correlates of predation susceptibility in mice. Communications in Behavioral Biology 4, 261–267.
Griffiths, D., 1975. Prey availability and the food of predators. Ecology 56, 1209–1214.
Hume, I.D., 2005. Nutrition of marsupials in captivity. International Zoo Yearbook 39, 117–132.
Johnson, M.K., Hansen, R.M., 1979. Estimating coyote food intake from undigested residues in scats. The American Midland Naturalist 102, 363–367.
Johnson, W., Franklin, W., 1991. Feeding and spatial ecology of Geoffroy's cat in Southern Patagonia. Journal of Mammalogy 72, 815–820.
Kaufman, D.W., 1974. Differential predation on active and inactive prey by owls. Auk 91, 172–173.
Kotler, B.P., 1984. Risk of predation and the structure of desert rodent communities. Ecology 65, 689–701.
Lozano, J., Moleón, M., Virgós, E., 2006. Biogeographical patterns in the diet of the wildcat, *Felis silvestris* Schreber, in Eurasia: factors affecting the trophic diversity. Journal of Biogeography 33, 1076–1085.
Manfredi, C., Lucherini, M., Canepuccia, A.D., Casanave, E.B., 2004. Geographical variation in the diet of Geoffroy's cat (*Oncifelis geoffroyi*) in the Pampas grassland of Argentina. Journal of Mammalogy 85, 1111–1115.
Mukherjee, S., Goyal, S.P., Johnsingh, A.J.T., Leite-Pitman, M.R.P., 2004. The importance of rodents in the diet of jungle cat (*Felis chaus*), caracal (*Caracal caracal*) and golden jackal (*Canis aureus*) in Sariska Tiger Reserve, Rajasthan, India. Journal of Zoology (London) 262, 405–411.
Neu, C., Byers, C., Peek, J., 1974. A technique for analysis of utilization-availability data. Journal of Wildlife Management 38, 541–545.
Nishimura, K., Abe, M.T., 1988. Prey susceptibilities, prey utilization and variable attack efficiencies of Ural owls. Oecología 77, 414–422.
Novaro, A., Funes, M., Walker, S., 2000. Ecological extinction of native prey of a carnivore assemblage in Argentine Patagonia. Biological Conservation 92, 25–33.
Nowell, K., Jackson, P., 1996. Wild Cats. Status Survey and Conservation Action Plan. IUCN/SSC Cat Specialist Group. UICN, Gland, Switzerland, p. 382.
Pearson, O.P., 1964. Carnivore mouse predation: an example of its intensity and bioenergetics. Journal of Mammalogy 45, 177–188.
Pereira, J.A., 2009. Efectos del manejo ganadero y disturbios asociados sobre la ecología trófica y espacial y la demografía del gato montés (Leopardus geoffroyi) en el desierto del Monte, Argentina. PhD dissertation. Universidad de Buenos Aires, Argentina.
Pereira, J., Fracassi, N., Uhart, M., 2006. Numerical and spatial responses of Geoffroy's cat (*Oncifelis geoffroyi*) to prey decline in Argentina. Journal of Mammalogy 87, 1132–1139.
Perovic, P.G., Pereira, J.A., 2006. Familia Felidae (G. Fischer, 1817). In: Bárquez, R.M., Diaz, M., Ojeda, R.A. (Eds.), Mamíferos de Argentina. Sistemática y distribución. SAREM, Tucumán, pp. 93–100.
Rosenzweig, M.L., 1973. Habitat selection experiments with a pair coexisting heteromyid rodent species. Ecology 54, 111–117.
Sliwa, A., 2006. Seasonal and sex-specific prey composition of black-footed cats *Felis nigripes*. Acta Theriologica 51, 195–204.
Sousa, K.S., Bager, A., 2008. Feeding habits of Geoffroy's cat (*Leopardus geoffroyi*) in Southern Brazil. Mammalian Biology 73, 303–308.
Spiegel, R., Price, E., Huck, U.W., 1974. Differential vulnerability of wild, domestic, and hybrid Norway rats to predation by great-horned owls. Journal of Mammalogy 55, 386–392.
Stephens, D.W., Krebs, J.R., 1986. Foraging Theory. Princeton Univ Press, Princeton, New Jersey.
Taraborelli, P., Corbalán, V., Giannoni, S., 2003. Locomotion and escape modes in rodents of the Monte desert (Argentina). Ethology 109, 475–485.
Teta, P., Pereira, J.A., Fracassi, N.G., Bisceglia, S.B.C., Heinonen Fortabat, S., 2009. Micromamíferos (Didelphimorphia y Rodentia) del Parque Nacional Lihué Calel, La Pampa, Argentina. Mastozoología Neotropical 16, 183–198.
Trejo, A., Guthmann, N., 2003. Owl selection on size and sex classes of rodents: activity and microhabitat use of prey. Journal of Mammalogy 84, 652–658.
Trejo, A., Guthmann, N., Lozada, M., 2005. Seasonal selectivity of Magellanic horned owl (*Bubo magellanicus*) on rodents. European Journal of Wildlife Research 51, 185–190.
Vuillermoz, P.A., 2001. Dieta estacional y selección de presas del gato montés (Oncifelis geoffroyi) y zorro pampeano (Pseudalopex gymnocercus) en la Reserva de Vida Silvestre "Campos del Tuyú" (Bahía Samborombón). Dissertation thesis. Departamento de Ecología, Genética y Evolución, Facultad de Ciencias Exactas y Naturales. Universidad de Buenos Aires, Argentina.
Walker, R.S., Novaro, A.J., Perovic, P., Palacios, R., Donadio, E., Lucherini, M., Pia, M., López, M.S., 2007. Diets of three species of Andean carnivores in high-altitude deserts of Argentina. Journal of Mammalogy 88, 519–525.
Wiens, J.A., 1977. On competition and variable environments. American Scientist 65, 590–597.
Zar, J.H., 1996. Biostatistical Analysis, third ed. Prentice Hall.



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