

# What makes a mammal attractive to the public at the Zoological Park of Sapucaia do Sul in southern Brazil?

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Zoos can play an important role in biodiversity conservation by keeping well-managed populations of threatened species, producing scientific knowledge, helping to improve public awareness through environmental education (Reade & Waran, 1996) and promoting a feeling of connectedness to nature (Clayton & Myers, 2009). The efficiency of fulfilling these tasks is challenged by maintenance costs. Because maintenance costs can be high, species selection should take into account visitors' preference for reaching an optimal balance between income and expenses. Since most zoos in developing countries are public institutions with limited budgets, their potential for building and enriching exhibits to improve their inhabitants' welfare is limited. Therefore, finding mechanisms to raise income is critical.

Although several studies, especially in Europe and North America, have investigated the factors affecting zoo visitors' interest (Balmford, 2000; Balmford *et al.*, 1996; Bitgood *et al.*, 1988; Margulis *et al.*, 2003; Reade & Waran, 1996; Ward *et al.*, 1998), little is known about Latin American zoos. The variables often analyzed for accessing visitors' interest or species popularity include body mass, exhibit proximity to the zoo's main entrance, animal origin (native or exotic), level of activity, presence of infants, exhibit architecture and species' annual maintenance cost (Bitgood *et al.*, 1998; Davey 2006; Marcellini & Jessen, 1988; Margulis *et al.*, 2003; Mitchell *et al.*, 1990; Silva & Silva, 2007; Ward *et al.*, 1998). Popularity has been estimated via census by the mean number of visitors (Balmford *et al.*, 1996; Silva & Silva, 2007) or the time spent by them (Ward *et al.*, 1998) attending each exhibit. This difference in methodology has produced partially divergent results. Whereas Ward *et al.* (1998) found that body mass and maintenance cost influenced popularity, Balmford *et al.* (1996) and Silva & Silva (2007) found no relationship between these variables. On the other hand, both Balmford *et al.* (1996) and Ward *et al.* (1998) found a positive relationship between popularity and exhibit distance from the zoo's main entrance.

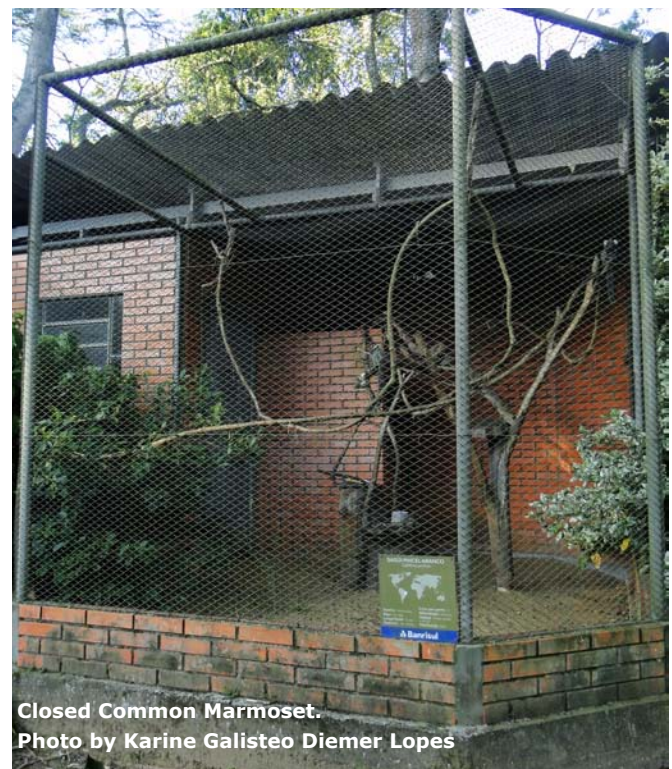
In this study we investigate the factors affecting mammal popularity at the Zoological Park of Sapucaia do Sul in southern Brazil. We aim to provide subsidies for future management decisions such as species pool and enclosure characteristics.

The Zoological Park of Sapucaia do Sul, state of Rio Grande do Sul, Brazil, occupies an area of 740 ha. Exhibits are distributed over 120 ha, with the remaining 620 ha representing a protected area covered mainly by forest. The zoo harbors nearly 1400 individuals distributed in about 120 mammal, bird and reptile species. Mammals are represented by 46 species.

Census of visitor attendance to mammal exhibits were conducted twice a day beginning at 10:00 am and 13:30 pm during 15 days in December 2008 and January 2009. Following the methodology of Balmford *et al.* (1998), the popularity of 40 mammal species was calculated using the mean percentage of visitors attending a particular exhibit (excluding those visitors that were only walking past it). Mammals in multi-species exhibits were not included in the census. *Tremarctos ornatus* and *Panthera onca* were represented by two individuals kept separately, but are analyzed together using the mean number of visitors. Individuals of *Cebus nigritus* and *Callithrix penicillata* were



Open Giraffe. Photo by Anamelia de Souza Jesus



Closed Common Marmoset. Photo by Karine Galisteo Diemer Lopes

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**Open Guanac.** Photo by Karine Galisteo Diemer Lopes.

**Table I. Descriptions of exhibit types**

Type	Description
Island	Exhibit surrounded by water. Island shoreline at approximately 10 m from observers, with no visual obstacles.
Pit	Pit-like exhibit in which animals are kept at a lower level. Visitors need to look down to see the animals
Closed (with fences)	Usually small exhibits, laterally closed with fences or brick walls. Upper and front sides closed with fences.
Open (with fences)	Exhibit totally surrounded by a fence and without an upper cover.
Semi-open (with windowpane)	Exhibit with upper side semi-open and front side closed with a glass windowpane. Laterals sides and bottom made of brick.

**Table II. Relationship between mammal popularity (dependent variable) and several independent variables using linear regression. Significant results are in bold**

Variable	Range	Median	r <sup>2</sup>	F	p	b
Distance from pedestrian entrance (m)	414-1,478	810	0.01	0.57	0.54	0.55
Distance from car parking lot (m)	50-691	317	0.01	0.23	0.63	0.17
Distance from bus parking lot (m)	194-918	357	0.03	2.56	0.11	0.69
<b>Distance from restaurant (m)</b>	<b>50-867</b>	<b>364</b>	<b>0.13</b>	<b>6.81</b>	<b>&lt;0.01</b>	<b>0.56</b>
<b>Exhibit size (m<sup>2</sup>)</b>	<b>12.6-11,490</b>	<b>121</b>	<b>0.25</b>	<b>14.99</b>	<b>&lt;0.01</b>	<b>0.36</b>
<b>Species weight (kg)</b>	<b>0.95-5,000</b>	<b>35</b>	<b>0.39</b>	<b>26.87</b>	<b>&lt;0.01</b>	<b>0.35</b>
Individuals in the exhibit	1-30	2	0.02	1.95	0.17	0.35

**Table III. Relationship between exotic mammal popularity (dependent variable) and several independent variables using linear regression**

Variable	Range	Median	r <sup>2</sup>	F	p	b
Distance from pedestrian entrance (m)	414-1,478	857	0.07	2.44	0.13	-0.93
Distance from car parking lot (m)	50-680	337	-0.02	0.56	0.53	0.21
Distance from bus parking lot (m)	194-961	400	0.05	2.06	0.16	-0.64
Distance from restaurant (m)	53-867	402	-0.005	0.84	0.64	-0.26
Exhibit size (m <sup>2</sup> )	13.5-11,490	478	-0.03	0.4	0.54	0.07
Species weight (kg)	6.55-5,000	142	-0.0015	1	0.66	0.26
Individuals in the exhibit	1-13	2	0.02	1.36	0.26	0.14

also kept at two exhibits, but because of exhibit differences they are analyzed separately. One *C. nigrurus* exhibit contained an albino individual and one *C. penicillata* group had twin infants.

We tested the relationship between species popularity and 11 variables: (1) distance from the pedestrian entrance to the exhibit, (2) distance from the zoo's restaurant to the exhibit, (3) distance from bus parking lot to the exhibit, (4) distance from car parking lot to the exhibit, (5) number of animals in the exhibit, (6) animal visibility (percentage of census' in which the animals were visible), (7) exhibit size (area), (8) species weight, (9) origin of species (native to Brazil or exotic), (10) presence or absence of infants and (11) exhibit type (Table 1). Weight data were obtained from the literature (Emmons & Feer, 1997; Walker, 1964). Data on (1) to (8) above were log transformed for reaching normality and allowing the comparison between measures with different scales (Sokal & Rohlf, 1998).

We used linear regression analysis to test the relationship between popularity and each variable. Because some variables can be interrelated we tested the level of correlation among all variables that predicted popularity in the linear regression analyses. Those correlated variables ( $r > 0.5$ ) were tested in a multiple regression (Sokal & Rolf, 1998). We used the chi-square test to determine whether popularity differed among exhibit types. The expected value was based on the assumption that the average popularity of each exhibit type is proportional to the number of sampled exhibits of each type. If the chi-square result was significant at the level of 0.05, a residual analysis was performed considering values outside the -2 to +2 range as significant. The influence of species origin and infant presence on popularity was addressed by the Mann-Whitney non-parametric test. All results were bilateral and considered a level of significance of 0.05.

### Results

A total of 2,296 visitors was counted during the study (mean±SD=107±84 visitors/census). Distance from the zoo's restaurant, exhibit size and species weight were good predictors of mammal popularity (Table 2), but were correlated (distance from restaurant vs. exhibit size:  $r = 0.68$ ,  $t = 5.80$ ,  $p < 0.01$ ; distance from restaurant vs. species weight:  $r = 0.70$ ,  $t = 6.18$ ,  $p < 0.01$ ; exhibit size vs. species weight:  $r = 0.81$ ,  $t = 6.18$ ,  $p < 0.01$ ). A multiple regression showed that species weight alone predicted

popularity ( $F_{3,41}=8.44$ ,  $p<0.01$ ; species weight:  $b=0.37$ ,  $t=2.97$ ,  $p<0.05$ ; distance from restaurant:  $b=-0.20$ ,  $t=-0.76$ ,  $p=0.45$ ; exhibit size:  $b=0.05$ ,  $t=0.35$ ,  $p=0.72$ ).

Popularity was also higher for exotic than for native species (exotic median=3.0; native median=0.97;  $U=98$ ,  $n_1=n_2=21$ ,  $p<0.05$ ). Because exotic species tended to be heavier than native ones (exotic: median=142.5 kg; native: median=6.4 kg;  $U=41$ ,  $n_1=n_2=21$ ,  $p<0.01$ ), we ran regression analyses on these two groups separately. Whereas none variable predicted popularity of exotic species (Table 3), five variables were good predictors of native species popularity (Table 4). However, these five variables were strongly correlated (Table 5) and a multiple regression analysis revealed that none variable alone predicted the popularity of native species ( $F_{5,15}=2.42$ ,  $p=0.08$ ; distance from pedestrian entrance:  $b=2.76$ ,  $t=0.36$ ,  $p=0.72$ ; distance from bus parking lot:  $b=-5.44$ ,  $t=-0.85$ ,  $p=0.41$ ; distance from restaurant:  $b=2.08$ ,  $t=0.82$ ,  $p=0.42$ ; exhibit size:  $b=0.039$ ,  $t=0.09$ ,  $p=0.92$ ; individuals in the exhibit:  $b=0.43$ ,  $t=1.63$ ,  $p=0.12$ ).

Exhibit type also influenced popularity ( $\chi^2=1,108.95$ ,  $d.f.=4$ ,  $p<0.05$ ). Visitors preferred mammals kept in "island", "pit" and "open with windowpane" exhibits and visited "closed exhibits with fences" less than expected (Figure 1). The presence of infants did not affect popularity (exhibits with infants: median=1.95; exhibits without infants: median=1.55;  $U=176$ ,  $n_1=14$ ,  $n_2=28$ ;  $p=0.30$ ).

### Discussion

Contrary to Balmford *et al.* (1996) and Silva & Silva (2007) who concluded that the choice for smaller mammals whose maintenance costs are lower would not compromise visitation, weight explained mammal popularity at the Zoological Park of Sapucaia do Sul, as also reported by Ward *et al.* (1998). This size effect is likely to be explained by the origin of the larger mammals exhibited at the zoo. Most larger mammals ranking top in popularity belonged to exotic, African, flagship species, such as lion, hippopotamus, giraffe, elephant and rhinoceros that are frequently targets of wildlife documentaries and conservation initiatives, therefore, stimulating the curiosity of visitors.

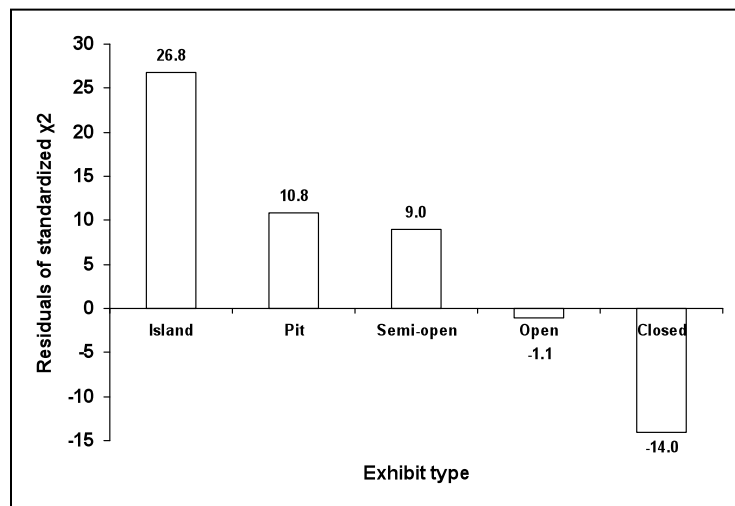
Exhibit type also had a significant influence on animal popularity. Mammals kept in open, and obstacle-free (without fences or other visual barriers) exhibits showed popularity

**Table IV. Relationship between native mammal popularity (dependent variable) and several independent variables using linear regression. Results in bold are significant.**

Variable	Range	Median	r <sup>2</sup>	F	p	b
<b>Distance to pedestrian entrance (m)</b>	<b>661-1435</b>	<b>712</b>	<b>0.16</b>	<b>4.87</b>	<b>&lt;0.05</b>	<b>2.61</b>
Distance to car parking lot (m)	150-691	312	0.39	1.82	0.19	1.12
<b>Distance to bus parking lot (m)</b>	<b>194-918</b>	<b>275</b>	<b>0.15</b>	<b>4.64</b>	<b>&lt;0.05</b>	<b>1.27</b>
<b>Distance to restaurant (m)</b>	<b>50-681</b>	<b>110</b>	<b>0.2</b>	<b>6.05</b>	<b>&lt;0.05</b>	<b>0.73</b>
<b>Exhibit size (m<sup>2</sup>)</b>	<b>12.6-353.1</b>	<b>65</b>	<b>0.25</b>	<b>7.81</b>	<b>&lt;0.05</b>	<b>0.53</b>
Species weight (kg)	0.95-225	6.35	0.03	1.71	0.204	0.45
<b>Individuals per exhibit</b>	<b>1-30</b>	<b>2</b>	<b>0.36</b>	<b>12.32</b>	<b>&lt;0.05</b>	<b>0.47</b>

**Table V. Correlation between the variables that influenced the popularity of native mammals.**

	Distance from pedestre entrance	Distance from bus parking lot	Distance from restaurant	Exhibit size
Distance from bus parking lot	$r=0.99$ , $t=25.45$ , $p<0.0001$	---	---	---
Distance from restaurant	$r=0.97$ , $t=18.85$ , $p<0.0001$	$r=0.99$ , $t=29.56$ , $p<0.0001$	---	---
Exhibit size (m <sup>2</sup> )	$r=0.78$ , $t=5.43$ , $p<0.0001$	$r=0.74$ , $t=4.86$ , $p<0.0001$	$r=0.79$ , $t= 5.61$ , $p<0.0001$	---
Species weight	$r=0.78$ , $t=5.41$ , $p<0.0001$	$r=0.79$ , $t=5.60$ , $p<0.0001$	$r=0.82$ , $t= 6.19$ , $p<0.0001$	$r=0.75$ , $t=4.92$ , $p<0.0001$



**Figure 1. Residuals of standardized chi-square for each type of exhibit.**



**Pit Lions. Photo by Anamelia de Souza Jesus.**



**Open Elephant. Photo by Karine Galisteo Diemer Lopes.**



**Semi Open Lutra. Photo by Anamelia de Souza Jesus.**



**Island Chimpanzee. Photo by Karine Galisteo Diemer Lopes.**

values significantly higher than those kept in closed, fenced exhibits. The otter, ranked seventh in popularity, is a good example. Despite being a <10 kg species, the otter is kept at an open exhibit, separated from the visitors only by a glass window. Furthermore, in light of the contention that the easiness to spot an animal and the exhibit level of naturalism can greatly influence the popularity of a species (see Clayton & Myers, 2009), the fact that the otter is a charismatic and quite active mammal might also have influenced its popularity (although we did not measure species activity levels). According to Davey (2005), zoo exhibit designers should identify and balance the best combination between the welfare of captive animals, the needs of visitors and the demands of investors. However, this task is particularly challenging given that these interests are rarely compatible.

The popularity of the chimpanzee shall also be highlighted. Despite being a middle-sized mammal compared to other African megafauna species exhibited at the zoo, the chimpanzee occupied the top of the popularity list. Several factors might help understand this result: (1) the chimpanzee is our closest living relative, (2) it is maintained in an enriched and obstacle-free island, (3) it is an active species, (4) there was an infant in the exhibit at the time of data collection (although this variable did not predict popularity, the child-like behavior of infant chimpanzees draws visitors' attention), and (5) it is a flagship popular species that is often target of television documentaries. Other authors have described a similar interest by zoo visitors for gorillas (Bodamer & Sankovic, 2001) and chimpanzees (Clayton *et al.*, 2009).

In sum, visitors tended to stop to watch exotic, larger species rather than native, smaller ones. Although this bias may represent a problem for zoo managers, since larger animals have higher maintenance costs, larger and charismatic animals can be the major motivators of zoo visitation. Contributing to the complexity of zoo management decisions are the perceptions of scientists, environmentalists, humane societies and the general public regarding the species pool that is (or should be) displayed. A strong debate occurred at the end of 2010 about the intention of the administration of the Zoological Park of Sapucaia do Sul of importing new giraffes from Africa after the death of both specimens in 2009 and 2010. This is a good example. Whereas most of these stakeholders opposed the

import, the perception of laypeople (the bulk of zoo visitors) varied from a naïve passionate support to an absolute disapproval.

Despite the bias towards exotic species, Latin American zoos should encourage conservation and outreach initiatives involving the less familiar native species to draw the population's attention to the equally important, and sometimes threatened, regional fauna to better fulfill their role in biodiversity conservation. Investments in educational materials, especially about the native species, are also mandatory for improving visitors' knowledge, awareness and interest in respecting and protecting wildlife.

### Conclusions

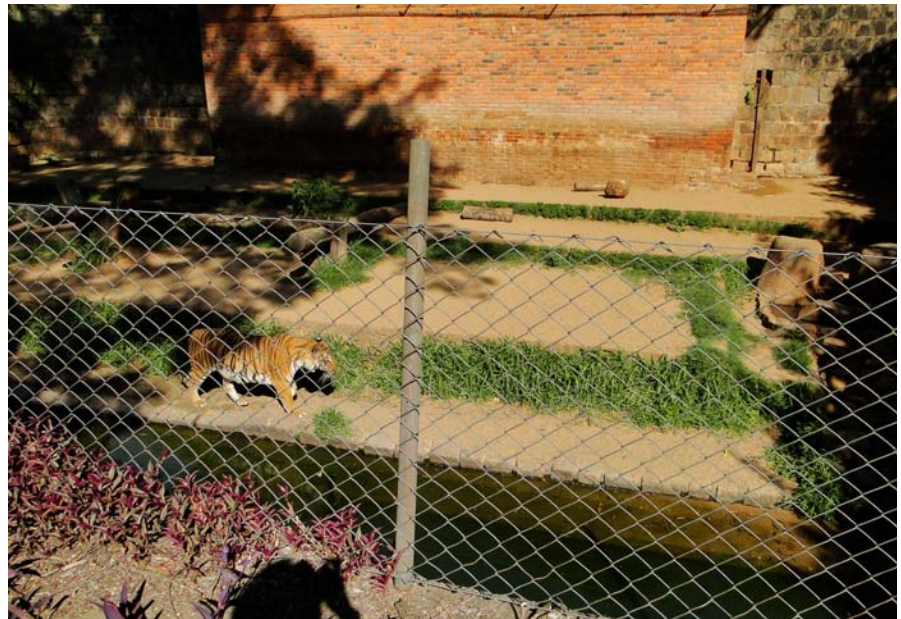
1. Species weight is the best predictor of mammal popularity at the Zoological Park of Sapucaia do Sul.
2. Exotic mammals were more attractive than native mammals, a likely effect of the presence of African megafauna species.
3. Mammals kept in open and obstacle-free (without fences or other visual barriers) exhibits were more popular than those kept in closed, fenced exhibits.

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Pit Tiger. Photo by Karine Galisteo Diemer Lopes.



Pit Hippo. Photo by Karine Galisteo Diemer Lopes.



Closed Brown Howler Monkey. Photo by Karine Galisteo Diemer Lopes.



Open Rhinoceros. Photo by Julio Cesar Bicca-Marques



Closed Spectacled Bear. Photo by Karine Galisteo Diemer Lopes.



Open llama. Photo by Karine Galisteo Diemer Lopes.

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