

# Environmental enrichment in species *Puma concolor* (Linnaeus, 1771) residing in the Lisbon Zoo

Crespo, A.P.M.<sup>1</sup>; Ferreira, J.D.<sup>2</sup>; Tibério, L.<sup>2</sup>; Pereira, A.P.S.<sup>1</sup>; Carolino, N.<sup>3</sup>

<sup>1</sup> - Escola Superior Agrária/Instituto Politécnico de Santarém, Quinta do Galinheiro - S. Pedro, 2001 - 904 Santarém, Portugal (kr3sp0@hotmail.com);

<sup>2</sup> - Jardim Zoológico de Lisboa, Estrada de Benfica, 158-160, 1549-004 Lisboa, Portugal;

<sup>3</sup> - Unidade de Investigação de Recursos Genéticos, Reprodução e Melhoramento Animal/Instituto Nacional dos Recursos Biológicos, I. P., Estação Zootécnica Nacional - Fonte Boa, 2005-048 Vale de Santarém, Portugal.

## INTRODUCTION

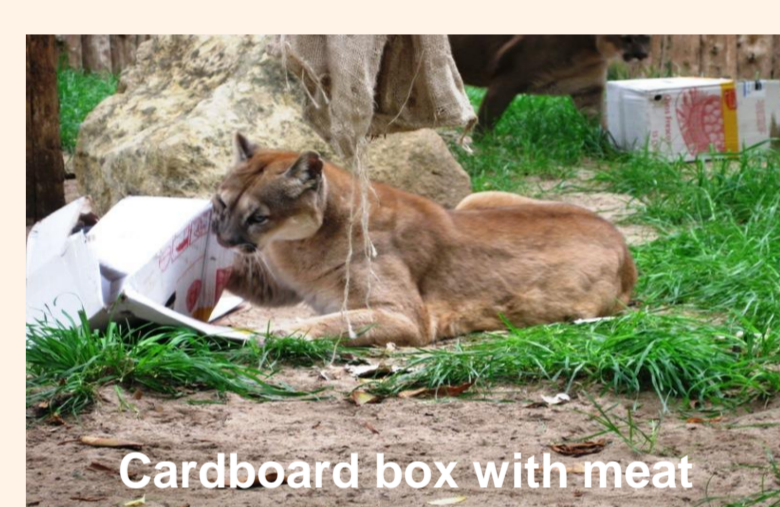
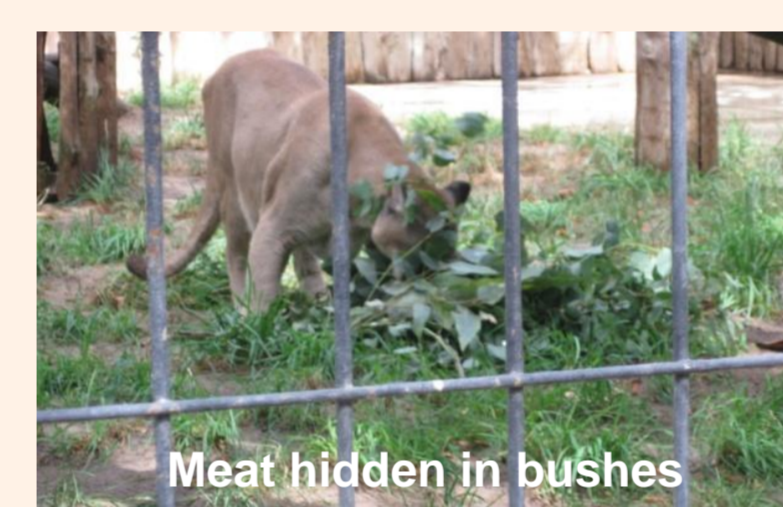
Animals in captivity often show less active behaviors than in nature, compromising their health. Environmental enrichment is a tool that can improve the life quality of captive animals by stimulating their senses, natural instincts, physical activity and domination of its habitat (Young, 2003).

## OBJECTIVES

In order to improve the psychological and physiological welfare of listless and overweighted male and female Cougars (*Puma concolor* Linnaeus, 1771), at the Lisbon Zoo a study of environmental enrichment (EE) was performed. The following hypotheses were studied: - if the animals after being subjected to the EE items will present more active and less agonistic behaviours; - if the sex and period of the day will influence the different behaviors; - if there's any preference for specific facility sites according to the study phase, sex, period and behaviors.

## METHODS

The study occurred during a four months period, from March to June 2009, including an overall of 100 hours of EE. This environmental enrichment trial consisted in preliminary observations (*ad libitum*), which were followed by three distinct phases for data collection (*focal sampling*): base line (BL), enrichment (E) and end line (EL). Several items of environmental enrichment were tested from which three were selected: two feeding enrichment's items (cardboard box with meat - E1, meat hidden in bushes or buried - E2) and a sensorial enrichment item (camel fur - E3). The sex of the animals, the period of the day and the area they attend to influenced the behaviors registered. Variance analysis was done using the *Wilcoxon/Kruskal-Wallis* test from the PROC GLM (SAS, 2004).



I N A C T I V I T Y

E N V I R O N M E N T A L E N R I C H M E N T

## RESULTS AND DISCUSSION

The stimulus of EE increased the behavioural diversity during the enrichment trials compared to the *base line*, with the persistence of this effect to the *end line* trials.

In general, they preferred to stay outside in the playground which was near the area where the EE was introduced regardless of the sex or the period of the day. The rest and alertness without enrichment of the animals was carried out preferably in the wooden support. This type of behaviour was also found in a study with cheetahs, in which they preferred the highest spots in their facilities to inspect their surroundings (Beekman *et al.*, 1990).

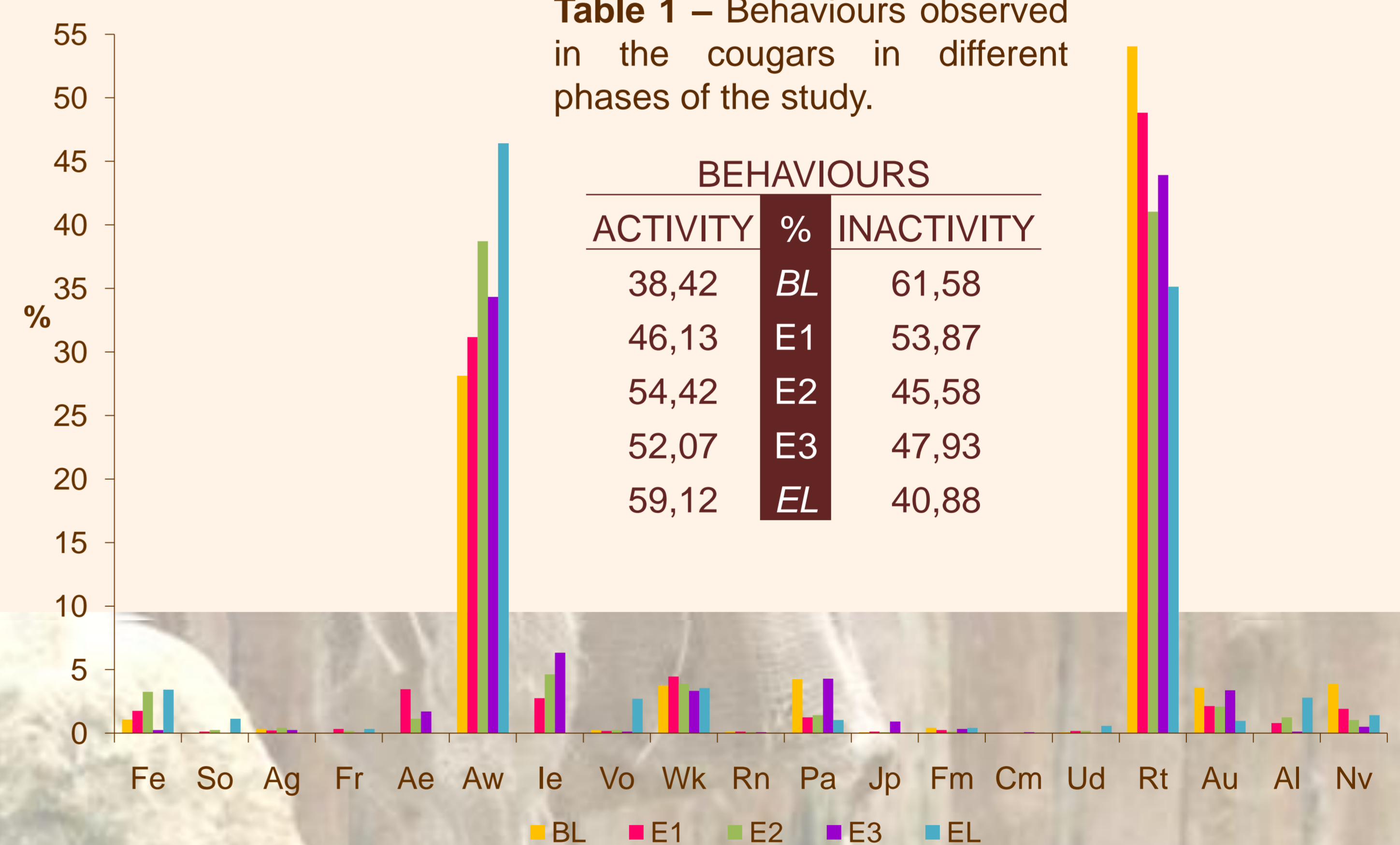
During the enrichment trials, they exhibited an increment in activity, such as alert state related and not related to the EE item, interaction with the EE item, allogrooming, forage, vocalization, and a decreased in sleeping and resting, pacing, autogrooming and repetitive behaviours ( $p < 0,01$ ) (Fig. 1; Table 1 and 2). The type of EE stimulus affected behavior as well, by increasing its diversity to one of the alimentary enrichment (meat hidden in bushes or buried - E2) (Fe, So, Ag, Vo and Al -  $p < 0,01$ ).

During the enrichment period the female showed more active behaviors than male and all the animals were more active in the morning (Table 3). The same results were found in a study with cheetahs in *Wassenaar Wildlife Breeding Centre*. (Beekman *et al.*, 1990).

In the overall, the cougars benefited from the enrichment by improving behaviour diversity and social interactions and by decreasing frustration, boredom, stress and aggressiveness.

**Table 3** – Behaviours types in the cougars along the study, according to sex and period of the day.

ACTIVITY					INACTIVITY			
Morning	Evening	Male	Female	%	Morning	Evening	Male	Female
32,84	44,09	31,59	45,26	BL	67,16	55,91	68,41	54,74
52,75	39,59	49,09	43,26	E1	47,25	60,41	50,91	56,74
65,56	42,75	52,59	56,25	E2	34,44	57,25	47,41	43,75
61,92	42,25	50,58	53,59	E3	38,08	57,75	49,42	46,41
68,25	50,00	55,84	62,42	EL	31,75	50,00	44,16	37,58



**Figure 1** – Behaviour observed in the Lisbon Zoo Cougars by phases of the environmental enrichment.

Fe - Feed; So - Social; Ag - Agonistic; Fr - Forage; Ae - Alertness with enrichment; Aw - Alertness without the enrichment; Ie - Interaction with the EE; Vo - Vocalization; Wk - Walk; Rn - Run; Pa - Pacing; Jp - Jump; Fm - Fical marking; Cm - Chemical marking; Ud - Urinate/defecate; Rt - Rest; Au - Autogrooming; Al - Allogrooming; Nv - Not visible.

**Table 2** – The effect of different study phase in the animals behaviour.

	BL vs E1	BL vs E2	BL vs E3	BL vs EL	EL vs E1	EL vs E2	EL vs E3
Fe	94,91**	3,81ns	12,58**	59,40**	13,24**	0,10ns	66,84**
So	71,70**	3,00ns	0,00ns	54,29**	19,31**	13,45**	27,14**
Ag	9,816*	0,69ns	0,28ns	16,02**	5,00*	10,01**	6,00*
Fr	13,54**	8,01**	1,00ns	16,02**	0,00ns	1,33ns	5,45*
Ae	158,90**	84,44**	21,34**	0,00ns	84,44**	29,14**	41,34**
Aw	212,80**	5,32*	41,53**	343,42**	117,51**	27,16**	72,76**
Ie	283,31**	66,90**	156,93**	0,00ns	66,90**	113,60**	156,93**
Vo	174,46**	0,40ns	1,00ns	99,51**	54,70**	49,75**	57,32**
Wk	4,77ns	1,52ns	0,60ns	0,29ns	2,62ns	0,37ns	0,15ns
Rn	1,27ns	0,00ns	0,20ns	2,00ns	1,00ns	0,33ns	0,33ns
Pa	111,68**	40,37**	0,00ns	95,89**	0,45ns	1,38ns	48,82**
Jp	53,79**	0,20ns	16,74**	0,66ns	1,00ns	0,33ns	19,26**
Fm	4,77ns	1,00ns	0,22ns	0,00ns	1,00ns	3,77ns	0,22ns
Cm	3,50ns	0,00ns	2,00ns	2,00ns	1,00ns	0,00ns	0,33ns
Ud	24,38**	0,66ns	2,00ns	18,05**	5,57*	5,57*	14,03**
Rt	203,94**	13,02**	49,21**	347,57**	92,56**	17,81**	38,79**
Au	46,67**	9,20**	0,15ns	74,51**	10,75**	10,13**	33,05**
Al	124,19**	19,07**	3,00ns	135,88**	20,27**	14,40**	59,36**
Nv	93,77**	16,36**	63,8**	56,30**	1,83nd	1,38ns	10,62**

\*\* Significance  $P < 0,01$ ; \* Significance  $P < 0,05$ ; ns - not significant or  $P > 0,05$

### Acknowledgments

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Beekman, S. P. A.; Wit, M.; Louwman, J.; Louwman, H. (1990) - *Criação e observações sobre o comportamento das Chitas (Acinonyx jubatus) no Centro de Criação de Animais Selvagens de Wassenaar*. Centro de Criação de Animais Selvagens de Wassenaar. Holanda, ciclostilado, 7 pp.

SAS (2004) - SAS® 9.1.2. for Microsoft Windows. SAS International, Heidelberg, Germany

Young, R. J. (2003) - *Environmental enrichment for captive animals*. Blackwell Publishing, Oxford, 228 pp.