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Puma Concolor (Linnaeus, 1771) Andean Puma Behaviour in Captivity Using an Environmental Enrichment Programme in "Taraccasa" Zoo (Apurímac, Peru)

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Abstract

An environmental enrichment programme was applied to pumas (*Pumas concolor*) at Taraccasa Zoological Park in Abancay (Apurímac, Peru) to monitor behavioural changes. Four Andean pumas (three females and one male) 3 to 9 years old were observed. Four types of environmental enrichment were used: physical (wooden stools, tree trunks), nutritional (equine meat, balanced feed for cats), sensorial (sacks with aromatic essences and spices, urine of foxes and deer), and social (balls made with equine skin). This study had two stages. One before the environmental enrichment (24 days) and the other during environmental enrichment (24 days). The animal behaviour was recorded with a video camera from 09:00 to 12:00 hrs. And from 16:00 to 18:00 hrs. The individual behaviour increased significantly with grooming, locomotion, observation, exploration, search ($p < 0.001$) and a reduction of an abnormal behaviour such as pacing ($p < 0.001$) was also observed. Group behaviour increased with approximation and scratching ($p < 0.001$), and chasing decreased ($p < 0.001$). It is concluded that the environmental enrichment programme applied to Andean pumas had a positive effect increasing normal activity and social behaviour, and decreasing stereotypic behaviour.

Keywords: *Puma concolor; Environmental enrichment; Stereotypes; Animal welfare*

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Introduction

Wild animals have time and energy to hunt for food, build nests, defend their territory and look for a mate. In captivity, a careful management of animals and the easy access to food, shelters and mates significantly reduce the activities and the period of time doing so (Beresca, 2014). A captive environment usually gives conditions to which all species must adapt, as human presence, imposition of feeding regimes and a lack of food-seeking opportunities, as well as veterinary medical procedures, space limitations, social grouping imposed and the immutable environment (Broom, 1988, Morgan, 2006).

Environmental enrichment is an animal management principle that seeks to improve the quality of animal care in captivity, identifying and providing the necessary environmental stimuli for optimal psychological and physiological well-being (Newberry, 1995). *Puma concolor* is a nocturnal behavior animal in the wild (Rodríguez., *et al*. 2006). There have been numerous attempts to increase the welfare of pumas in captivity in Latin America, enriching the environments in which they are kept, obtaining an increase in normal activity behaviour of the species (Pacheco, 2005, Medrano, 2008, Villafuerte, 2012, Martinez., *et al*. 2014).

Normal behaviour (individual or social) corresponds to time to rest, walk, groom and climb. The most frequent stereotypies in felines are short and desperate walks, or pacing, as well as lethargy (Mason and Rushen, 2006, Villafuerte, 2012).

Taraccasa Zoological Park, in Abancay Peru, has 52 animals on display. One of the establishment areas has two zones for pumas (*Puma concolor*). These animals showed stereotypical behaviours of pacing and excessive grooming because the zoo did not have environmental enrichment programmes. The objective of this study was to evaluate the influence of environmental enrichment programme on behaviour in four Andean pumas at "Taraccasa" Zoological Park.

Materials and Methods

Animals and Facilities

Taraccasa Zoological Park is a state institution belonging to Abancay Provincial Municipality at Apurimac, Peru. It is located between the coordinates N8493141 - E731311, with an altitude of 2,828 meters above sea level with an average annual temperature of 25.9ºC.

The Andean Pumas are exhibited the whole day from Monday to Sunday because the zoo does not have a perimeter fence. Two pumas occupy one enclosure (Table 1). This enclosure has an area of 842.4 m^2 and the other one 828.0 m^2. These two enclosures have similar basic characteristics with mesh walls of stainless steel, grass and dirt floor with different levels of inclination (30% on average). The first one has a den and the second does not. The food consisted of about 2 kg of horse meat, 6 times a week with 1 day of fasting. On Tuesdays they got 200g of equine liver. This research was led from July to September 2014, during the dry season when there was no rain.

Enclosure	Name	Sex	Age(years)	Type of admittance
1	Princesa	Female	9[1]	Temporary custody[2]
1	Bryan	Male	9[1]	Temporary Custody
2	Bella	Female	3	Born
2	Yenni	Female	4	Born

Table 1: *Record and age of Andean Pumas.*

[1]Estimated age

[2]Temporary custody was granted by the National Institute of Natural Resources (INRENA)

Characteristics of the Study

This study lasted 48 days (240 observation hours), distributed in two phases: a) The first phase (before environmental enrichment) 24 days observation (120 hours), with 5 hours (300 minutes) the total observation time per day, and b) The second phase (during environmental enrichment) 24 days (120 hours), with 5 hours (300 minutes) total observation time per day. There was a time interval of 14 days between the two research phases in which the enclosures were conditioned and the animals had a period of accustoming to their enriched environment. A focal sampling technique was used for this study.

The animal's behaviour was registered during 48 days from 09:00 to 12:00 in the mornings and from 16:00 to 18:00 in the afternoons from Monday to Sunday. These schedules were considered based on previous observations where pumas remain inactive early in the morning and from 12:00 to 16:00h. To record the animal's behaviour performance four cameras were used without the investigator's intervention in the recording schedule to avoid influence on the behaviour of the pumas. The animal's behaviors were analyzed in the cabinet observing the videos.

Environmental enrichment

Four types of environmental enrichment were used

Physical

The grass was weeded, stones and bones were removed. A 2m high eucalyptus wooden stool was assembled with $3m^2$ platform in the first enclosure (Figure 1) and 2m high stool with a $6m^2$ metal platform was set in the second enclosure. In addition, eucalyptus sticks were placed vertically 2.5 m high in both enclosures. In the first enclosure a structure with a calamine roof was set to provide shade.

Nutritional

Meat and liver provisions were offered in several presentations:

- Inside paper bags, tied with cabuya rope to the vertical sticks
- Meat in paper bags with straw, hanging on the vertical sticks
- Paper bags with straw and mint smelling, filled with some meat. All the paper bags were poured with equine blood
- Meat dispersed throughout the enclosure, hidden with branches, leaves and wood
- Meat hidden on the stool, covered by straw
- Meat hanging on the trunks with cabuya rope
- Meat inside cardboard mannequins, shaped like a vicuña (Vicugna vicugna) and white-tailed deer (Odocoelius virginianus)
- Meat inside cardboard boxes, tied with cabuya rope and hanging on wooden poles
- Dry cat food with equine blood, given in visible places
- Dry cat food dispersed throughout the enclosure
- Liver scattered around the area
- blood Ice scattered in the enclosure and hanging on the wooden trunks

Sensory stimulation

Various stimuli were used to get the attention of smell, taste, touch, vision and hearing of the animals

- Olfactory: Aromatic essences such as mint and various spices were used. They were boiled and, once cold, they were spread in several parts of the enclosures. Likewise, urine of (Andean fox) Lycalopex culpaeus and (white-tailed deer) O. virginianus were used outside the enclosure spraying it.
- Taste: The type of food was varied, using equine meat, guts and cat croquettes.
- Touch: It has been worked with several soil textures. Sand was added in the places where they weren't, toy balls were made with horse skin and cooked with cabuya rope; as well as the paper bags with the offered food variants. In addition, the trunks that served to sharpen their claws as territorial marking.

Figure 1: *Andean Puma on the wooden stool in search of food.*

Social and cognitive stimulation

These three mentioned stimuli led to a social stimulus while the used enrichments helped to develop cognitive stimuli.

Abnormal behavior

Stereotyped movements were verified, such as: walking on the same place over and over again. This activity is known as Pacing (Estrada and Parra, 2007).

Statistic analysis

A one-factor additive model was used with repeated measures over time. The periods before and during the environmental enrichment were taken as a factor in the study.

Results

The observation analysis seems to suggest some changes in activity levels and stereotypical behaviour after environmental enrichment. There were 17 types of behaviours (8 individual and 9 in group). Two stereotyped behaviour were identified within individual behaviours: Pacing and excessive grooming.

A significant difference was found with classified behaviour proportion as normal activity (Table 1). The individual behaviour with the longest time of difference was the search between the stage without enrichment and the stage with environmental enrichment ((2.3 and 9.6 min), as well as the observation (4.8 and 10.2 min) and the exploration (0.8 and 5.1 min). They presented a highly significant difference between the two stages, increasing the execution time of these behaviours when the enriching elements were introduced.

Table 2. Time[1] dedicated to individual and group behavior of four pumas (*Puma concolor*) before and during the environmental enrichment on their enclosures in Taraccasa Zoological Park (Abancay, Peru)

Behavior	Before	During	Probability[2]
	Average ± s.d.	Average ± s.d.	Period
Individuals			
Body care	22.0 ± 7.7	28.2 ± 9.6	**
Resting	132.6 ± 24.2	128.3 ± 19.1	NS
Trophic	33.9 ± 4.8	34.1 ± 5.4	NS
Locomotion	16.3 ± 5.7	22.2 ± 6.4	**

Observation	4.8 ± 3.1	10.2 ± 4.5	**
Exploration	0.8 ± 0.8	5.1 ± 3.6	**
Search	2.3 ± 1.3	9.6 ± 7.7	**
Pacing	57.8 ± 7.8	47.8 ± 16.0	**
Group			
play	0.8 ± 1.7	1.1 ± 1.5	NS
Approximation	1.0 ± 1.2	1.9 ± 2.2	**
Grooming	2.8 ± 3.2	2.5 ± 2.9	NS
Persecution	4.0 ± 7.5	1.2 ± 1.5	**
Mating[3]	14.2 ± 16.4	0	
Scratching	0.8 ± 0.6	3.0 ± 3.3	**
Aggression	3.0 ± 2.0	3.3 ± 2.1	NS
Submission	1.0 ± 0	1.19 ± 0.38	
Vocalization	4.2 ± 5.2	2.8 ± 1.4	NS

[1]Time spent during 300 minutes of observation (5 hours per day)

[2]NS: not significant; **: $p < 0.001$

[3]In the second phase the heat disappears, since they are different periods, this significance is taken into account for the investigation.

Similarly, in group behaviour the behaviour with the longest difference before and after environmental enrichment was that of marking (0.8 and 3.0 min, respectively), followed by approximation behaviours (1.0 and 1.9 min), and behaviour of persuit (4.0 and 1.2 min), in the latter case with a decrease in activity (Table 2).

Stereotyped behaviour in which there was a decrease in activity due to environmental enrichment was pacing (47.8 ± 16.0 min vs 57.8 ± 7.8 min). Likewise, the time granted to the corporal care behaviour increased from 22.0 ± 7.7 min to 28.2 ± 9.6 min ($p < 0.001$).

Discussion

The results of this study showed us that by making it difficult to food access, either by hiding it or by hanging it, the pumas increased the search time, or in that way, they increased other natural behaviour such as walking, jumping, sniffing and observing. Scratching is a behaviour that increased significantly when sticks of wood were placed inside the enclosure, in addition, they had more places to sharpen their claws and they did it for a longer peroid of time. The smells of other animals also helped to increase this behaviour, as pumas left marks on the borders of their territories to defend them from other pumas.

In a similar way to the study by Villafuerte (2012), after introducing enriching elements, it was observed that the females spent more time walking, climbing, jumping and observing, while the male spent more time lying down. Díaz (2001) comments that when animals are provided with stimuli and their feeding methods are changed, the locomotion time is increased, as found in the cougars of this research.

One of the behaviors that did not have a significant decrease was the rest behaviour, in comparison to other researchers who found differences with the introduction of enriching elements in the environment of the felines (Broom, 1988, Medrano, 2008). The reason could be due to the fact that felines have more activity time at night (Pacheco, 2005, Rodríguez., *et al*. 2006, Harmsen., *et al*. 2010).

Cougars performed the pacing between 16 and 18 hrs, when the sun was no longer warm. When introducing enriching elements in the second stage of the study, the pumas were curious, giving them more time and, therefore, reducing the time dedicated to pacing.

Medrano (2008) points out that it should be taken into account that felines show a tendency to increase stereotypes after having spent time with the enriching ones, as a result of frustration when not finding new objects after finishing with the introduced objects. In the present study, when the second stage of research was already advanced, the elements introduced inside the enclosure were already a normal part of the environment, and only the enriching elements with food, smells and sounds were the only ones that distracted the pumas, losing little by little interest in them.

Bodily care was presented after the cougars finished consuming their food, as mentioned by Manteca (2003). This behavior participates in the mechanisms of thermoregulation, since the saliva deposited on the body surface contributes to the loss of heat (Medrano, 2008, Mills., *et al*. 2010). While it is true that body care is a normal and basic behavior in cats, a behavior that exceeds the normal time it is performed can become a stereotypy (Mason and Rushen, 2006, Skibiel., *et al*. 2007, Mills., *et al*. 2010). In this case, the adult female cougar of the second enclosure, "Yenni", performed this behavior twice as long as the other three cougars, which could indicate that this behavior was becoming excessive in her.

Conclusions

- The implementation of environmental enrichment in the cougars of the Taraccasa Zoological Park was positive. Increased desirable behaviours such as exploration, locomotion, search and play.
- Undesirable animal's behaviour such as pacing, excessive grooming and prolonged rest decreased significantly.

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