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Evidence based practice

A therapeutic environmental enrichment programme for managing pathological behaviour in the fossa (*Cryptoprocta ferox*)

Raffaele Grisa[1], Marina Bertelé[1], Stefano Vaglio[1,2,*] and Caterina Spiezio[1]

[1] *Research and Conservation Department, Parco Natura Viva - Garda Zoological Park; Località Figara 40, 37012 Bussolengo (VR), Italy.*
[2] *Laboratori di Antropologia, Dipartimento di Biologia; Università degli Studi di Firenze; Via del Proconsolo 12, 50122 Florence, Italy.*
**Corresponding author: stefano.vaglio@parconaturaviva.it*

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Abstract

This study is based on an adult male fossa (*Cryptoprocta ferox*) that arrived at Garda Zoological Park (Italy) exhibiting stereotyped and self-injuring behaviours and follows its subsequent rehabilitation through a long-term environmental enrichment programme. Data were collected over a period of six months. Continuous focal animal sampling was used to collect behavioural data during 90-minute sessions; 24 sessions took place over the first two months and two sessions took place six months after his arrival. Data were analysed using non-parametric tests. At the beginning of the study period, the predatory behaviour of the fossa was not species-specific since he was not able to find food items when they were hidden in the enclosure. It usually interacted with items for just a few minutes. Rubbing different scents on enclosure furniture promoted play only for a few minutes. After two months of behavioural observations, its behaviour only improved slightly and stereotyped and self-injuring behaviours were maintained. However, we continued the intense enrichment programme for a longer period. Six months after its arrival rare undesirable behaviours or noticeable side effects were observed whilst species-specific behaviours were recorded. Results showed that the environmental enrichment curtailed the aberrant behaviours. In conclusion, this case study provides evidence supporting the hypothesis that a suitable enrichment programme could have a therapeutic effect on pathological behaviour in captive animals.

Background

Studies on the effects of environmental enrichment are largely limited to zoo captive animals. Their findings confirm evidence deriving from researches on laboratory animals by showing that enrichment programmes are able to promote both brain plasticity and animal welfare (Stewart and Bayne 2004). In particular, zoo environmental enrichment can be used to improve the physical and psychological well-being of captive animals (Young 2003).

The assessment of an animal's psychological well-being is based on the response of the animal to its environment and on the animal's ability to cope effectively with day-to-day changes in its social and physical environment. Furthermore, the assessment must be based on the absence of maladaptive or pathological behaviour that results in self-injury or other undesirable consequences and on the ability to engage in beneficial species-typical activities (Mason *et al.* 2007). In captivity, zoo animals have been known to exhibit stereotyped behaviours, which are characterised as behavioural patterns that are repetitive, invariant, and with no obvious function (Mason 1991). These patterns are thought to be caused ultimately by artificial environments that do not allow animals to satisfy their typical behavioural needs and can actually cause harm to the animals (Clubb *et al.* 2006). Enrichment is one of the most common approaches to enhance the quality of captive animal care and, therefore, to improve the animal's physical and psychological welfare (Shepherdson *et al.* 1998).

In March 2009, a captive adult male fossa (*Cryptoprocta ferox*) arrived at Parco Natura Viva - Garda Zoological Park (Italy). In the wild the fossa is a solitary species active both during the day and at night. Its diet consists mostly of small mammals and birds, but also includes reptiles, frogs and insects. It is a powerful predator, and has keen senses of vision, hearing and smell (i.e. variable home range which they scent mark with secretions from their anal glands). Moreover, it is an excellent climber, and uses its long tail to provide balance when pursuing prey through the trees (MacDonald 2001). On arrival, his behaviour was not species-specific. Indeed, even if the enclosure was supplied with climbing apparatus, the fossa never exhibited climbing ability using branches and relatively fine ropes. Furthermore, he did not seem able to properly climb trees and leap from branch to branch, as his body did not appear heavily muscled and his tail did not act as a balancing organ. In addition, this individual showed serious behavioural problems such as agitation, high levels of repetitive pacing, and pathological behaviours that resulted in self-injury and self-mutilation. The behaviours of this individual resembled those of humans with post-traumatic stress disorder (e.g. Mallonée and Joslin 2004).

Action

The space available to the fossa was structured, usable, and complex and there was also structural enrichment. In addition, a very intensive enrichment programme was planned to improve the physical and psychological well-being of this animal. A variety of whole food items was presented to encourage usual food processing behaviours by the fossa. Chicken, rabbit,

quail, and eggs were hidden in the enclosure. Manipulative items (i.e. logs, plastic barrels, cardboard boxes, etc.) were provided and different scents (i.e. spices, herbs, etc.) were rubbed on the enclosure furniture. This type of enrichment programme was planned to enhance species-specific behaviours, such as exploration and olfactory behaviours, by providing different kinds of stimuli. In addition, the programme involved a positive reinforcement training (PRT) session, on the basis of positive rewards (i.e. pieces of meat), to train the fossa to discontinue the repetitive pacing behaviour by performing species-specific behaviours. Participating in appropriately designed training sessions can give animals some amount of control in their lives.

The 60-min PRT session was carried out once a day, in the morning (from 8:30 am to 9:30 am). Non-feeding (manipulative objects, different scents, exhibit changes, etc.) and feeding enrichments were alternately provided once a day in the mid-morning (11:00 am). The 90-min data collection started immediately after the enrichment session (from 11:00 am to 12:30 am).

Data collection started immediately after arrival of the fossa (March 19, 2009) and lasted over a period of six months. Since the fossa behaviour was not species-specific, a behavioural report was transmitted to the EEP coordination and the very intensive enrichment programme was planned. Statistical analysis involved those data collected from April 13 to September 9, 2009, parallel to the implementation of the programme. Over this period behavioural data were collected through 90-minute focal animal sessions (26 sessions in total). Twenty-four sessions took place over the first two months and two sessions took place six months after his arrival. Behaviours showed in the first (12 sessions) and the second month (12 sessions) and, on the other side, in the "first phase" (first two days of the first two months), "last phase" (last two days of the first two months), and "post phase" (six months after his arrival), were compared to analyse the behavioural progresses of the fossa over the period. Time duration of behaviours was sampled. Data were analysed using non-parametric tests and the single-case approach.

The single-case approach refers to researches in which the phenomena of interest are studied using a single subject (also referred to as N-of-1 designs or single-subject research). Single-case research designs have a long history in psychological science, which demonstrates the enduring value of such approaches (Barlow and Hersen, 1984). In single-case designs, data derive from a single case or small group of cases and there are multiple observations per individual per condition, so that the commonly used group design methods are not appropriate.

Non-parametric tests such as randomization tests are useful in single case studies and the magnitude (e.g. mean) of behavioural performance for each condition can be appropriately evaluated (Box *et al.* 1994). Over the last few years the statistical approach to single-case data analysis has increased in popularity and sophistication (Franklin *et al.* 1997).

In all tests, the significance level was set to 0.05 (Siegel and Castellan 1992). StatView for Windows and Macintosh (version 5.0) was used for all the analyses.

Consequences

Fossa behaviours over a two month period

Results suggested that stereotyped were the most common behaviours. There was a decrease in stereotyped behaviours between the first month (12 sessions) and the second month (12 sessions) of behavioural observations. Furthermore, there was a significant increase in enrichment interaction (Wilcoxon Test: Z = -1.988; P = 0.0469) and foraging (Wilcoxon Test: Z = -2.803; P = 0.0051) and a significant decrease in locomotion (Wilcoxon Test: Z = -2.275; P = 0.0229) in the two month period. Nevertheless, the stereotyped (STE) behaviour was always more common than other behaviours

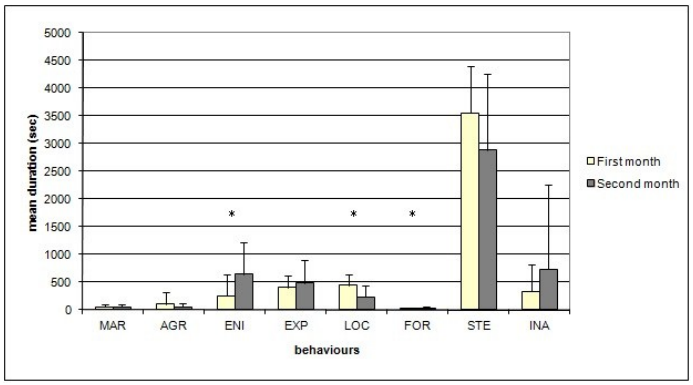

Figure 1. Comparison of different behaviours between the first (12 sessions) and the second month (12 sessions). MAR = Marking; AGR = Aggression; ENI = Envrichment Interaction; EXP = Exploration; LOC = Locomotion; FOR = Foraging; STE = Stereotype; INA = Inactivity. Behavioural mean duration was collected; error bars stand for the standard deviation; * P = 0.05.

such as scent-marking (MAR), exploration (EXP), inactivity (INA), locomotion (LOC), and foraging (FOR) (Figure 1).These results underline some beneficial effects on fossa behaviour, provided by the enrichment programme, even if the changes were very subtle.

"First phase" vs. "last phase" vs. "post phase" six months after arrival of the fossa

The use of the intense enrichment programme for six months, after the fossa's arrival, resulted in an improvement in natural behaviours and reduced maladaptive self-directed behaviours. Based on the analysis of behaviours performed during the "first phase", "last phase", and "post phase" (six months after his arrival), there was a significant change in the performance of abnormal and normal behaviours over six months (One-Sample Test: First Phase, P = 0.0156; Last Phase, P = 0.0156; Post Phase, P = 0.0078). In particular, the fossa showed less stereotypy in the "post phase" compared with the "last phase" and "first phase" (Figure 2). Indeed stereotypy was always more common than normal behaviours in both "first phase" and "last phase"; on the contrary normal behaviours became more common than stereotypy in "post phase".

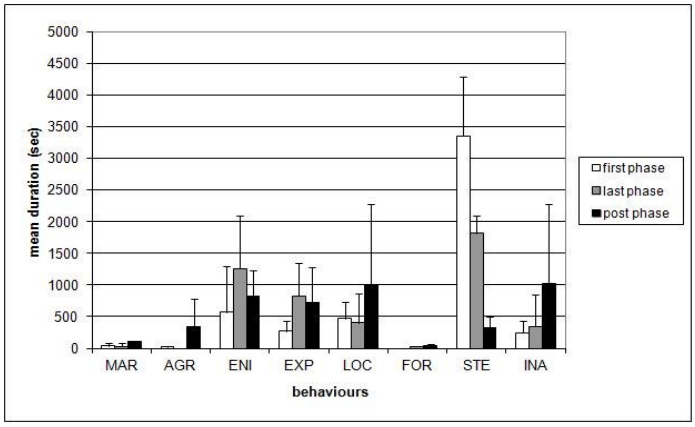

Figure 2. Comparison of different behaviours between the first and last phases (over 2-month period) and the post phase (6 months after his arrival). MAR = Marking; AGR = Aggression; ENI = Enrichment Interaction; EXP = Exploration; LOC = Locomotion; FOR = Foraging; STE = Stereotype; INA = Inactivity. Behavioural mean duration was collected; error bars stand for the standard deviation; * P = 0.05.

After two months of behavioural observations, the fossa's behaviour improved slightly; however, stereotyped and self-injuring behaviours were maintained, despite the intensive enrichment programme. The predatory behaviour of the fossa was not species-specific (Garbutt 2007) since the fossa was not able to find food items when they were hidden in the enclosure. He usually interacted with items for just a few minutes and rubbing different scents on enclosure furniture promoted play only for a few minutes. Howev-

er, we decided to continue the intense enrichment programme for a longer period (Abello *et al.* 1999).

Behavioural data recorded six months after his arrival showed rare undesirable behaviours or noticeable side effects. Results showed the environmental enrichment curtailed the aberrant behaviour. The fossa was rehabilitated due to an intense enrichment programme that was designed to stimulate all five senses of this carnivore (Allard *et al.* 2003; Kleiman *et al.* 2010). The design of the exhibit was also helpful because it allowed the fossa to perform many species appropriate behaviours.

This case study is an example of how good management of captive animals provide an invaluable support to reach an acceptable level of psychological and physical well-being (Hosey *et al.* 2009). In addition, the present study reports evidence that an appropriate environmental enrichment programme could be a therapeutic tool for managing pathological behaviour in captive animals (Carrasco *et al.* 2009).

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