

Stereotypical behaviour in captive West Indian manatee (*Trichechus manatus*)

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There is great difficulty in maintaining aquatic mammals in captivity, since the attempt to replicate the environment they live in poses an enormous challenge. Poor captivity facilities without environmental enrichment can lead to different consequences for animal health, including the appearance of stereotypical movements. The aim of this study was to identify these behaviours in three groups of animals, one group of manatees inhabiting a reintroduction oceanarium in Pernambuco (PE) state, and two other groups confined in corrals constructed in natural areas (estuaries), one located in Paraíba state and the other in Alagoas state, all in north-eastern Brazil. Observations were conducted using the focal animal sampling method. It was found that the animals inhabiting the reintroduction oceanarium with no environmental enrichment showed stereotypical behaviour such as 'Back-and-forth' movements, 'Hitting head against the limiting structure' and 'Hitting the muzzle', while animals constrained within estuaries did not. The 'circle swimming' behaviour was present in a higher percentage of the animals captive in the reintroduction oceanarium, although no significant difference between the sites was found. The number and frequency of occurrence of stereotypical behaviours was significantly higher in animals kept in the reintroduction oceanarium in PE than in those of other locations. Based on these results we recommend the use of appropriate environmental enrichment and the reduction of time manatees stay confined in the reintroduction oceanarium.

Keywords: animal welfare, behaviour, captivity, circle swimming, manatee, stereotypy

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INTRODUCTION

Aquatic mammals are kept in captivity all around the world. As a consequence of poor and predictable enclosures, animals can be induced to display negative behavioural responses such as apathy and stereotypical movements (Wemelsfelder, 1997). The term 'stereotypy' can be defined based on three characteristics: (i) they have a definite pattern; (ii) they are often repeated; and (iii) they do not have a known reason for their performance (Keiper, 1969; Mason, 1991; Marriner & Drickamer, 1994).

Stereotypy is of special importance because it can be a reliable behavioural indicator of deficient welfare (Mason, 1991; Mason & Latham, 2004), often regarded as a scar from unsuitable environments (Swaigood & Shepherdson, 2005). Some studies suggest a relationship between stereotypy and management techniques (Grandia *et al.*, 2001), time of day (Grandia *et al.*, 2001), seasonality (Carlstead *et al.*, 1991), frequency of social interaction (Fischbacher & Schmid, 1999) and size of natural habitat (Clubb & Mason, 2003). Most importantly, poor welfare is closely linked to a myriad of health problems, possibly because it involves a reduction in the immune system efficiency (e.g. Goldblatt, 1993). Thus, the study of stereotypy is of paramount importance for improving welfare and conservation.

Unfortunately, only a few studies have focused on the issue of stereotypy in aquatic mammals in captivity, and these include the polar bear, *Ursus maritimus* (Wechsler, 1991; Grittinger, 2004; Ross, 2006), the walrus *Odobenus rosmarus* (Kastelein & Wiepkema, 1988, 1989; Kastelein *et al.*, 2007; Mason, 2010), the Steller sea lion *Eumetopias jubatus* and the harbour seal *Phoca vitulina* (Grindrod & Cleaver, 2001). To our knowledge, no study has addressed this topic in manatees.

West Indian manatees (*Trichechus manatus*), herbivorous animals that belong to the order Sirenia, are distributed along estuaries on the coast of Florida, their northern boundary, down to the north-eastern coast of Brazil, the species' southern boundary (Lefebvre *et al.*, 2001). In relation to its conservation in the world, this animal is classified as 'vulnerable' (IUCN, 2010), and it is the aquatic mammal most threatened with extinction in Brazil (IBAMA, 2001).

In Brazil, the National Centre for Research and Conservation of Aquatic Mammals (CMA/ICMBio) and the Aquatic Mammals Foundation (FMA) lead a programme to rescue, rehabilitate and reintroduce sirenians through the Manatee Project. Animals rescued on the north-eastern coast of Brazil are transferred to the project's facilities, where they remain for a rehabilitation period in pools and reintroduction oceanaria. After nearly four years in this type of captivity, when they are deemed suitable in terms of size and health by the veterinary staff, animals are transferred and constrained within natural areas (estuaries). These enclosures under natural conditions seem suitable for the familiarization of the animals before their final release.

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This study aimed to investigate the presence of stereotypy in three groups of West Indian manatees (*T. manatus*) kept in two types of environments: reintroduction oceanaria and corrals within estuaries. Further, we also suggest management actions to improve the welfare and conservation of these aquatic mammals.

MATERIALS AND METHODS

Animals and captivity

We studied three groups of West Indian manatees (*T. manatus*). The first group, with seven animals, was kept in a reintroduction oceanarium in the headquarters facilities of the Manatee Project, at Itamaracá Island, state of Pernambuco (PE). The two other groups of four animals each inhabited the reintroduction oceanarium and were then taken to the corrals in the estuaries approximately six months before our observations began. These corrals are located in the states of Paraíba (PB) and Alagoas (AL). As a natural environment the corrals contain all typical characteristics of an estuary. The perimeter fence of the corral was made of wood in both locations. All manatees exhibited similar age and health conditions. Animals studied were part of the reintroduction programme, and were subject to constant veterinary monitoring, following ethical procedures established by Lima *et al.* (2007), and the study was approved by license 19019-2 from the Chico Mendes Biodiversity Conservation Institute (ICMBiO).

The monitoring of captive animals in the reintroduction oceanarium (Group 1) at Itamaracá Island (Pernambuco) was conducted in December 2009. The group consisted of four females and three males who had been in the project's facilities since they were rescued, about three years before. They were in the rehabilitation period and were maintained in the reintroduction oceanarium, which consisted of two interconnected tanks with total volumes of 67.84 m³ and 31.80 m³. The dimensions of the larger tank was 5.3 m long by 4 m wide by 3.2 m deep, and the smaller tank was 5.3 m long by 4 m wide by 1.5 m deep.

Group 2 was kept in a corral in a natural environment (estuary) in Paraíba, and was composed of three males and one female. The animals were monitored in March 2010, approximately six months after being transferred to this environment. The corral was built at 'Gamboa Caracabú', in the estuary of the Mamanguape River, state of Paraíba. The place is surrounded by an extensive mangrove area, and the corral had a width of 36 m at its posterior portion, 30 m of width at its anterior portion, and 63 m of length, resulting in an area of 2500 m².

Group 3 was composed of one female and three males which were also kept in a corral (estuary of the Tatuamunha River, in AL). The corral at this site had an area of approximately 1050 m², and the animals were monitored in September 2009, approximately three months after being transferred to this environment.

Procedures

FEEDING

Animals from Group 1 were fed seagrass and vegetables (carrot and beetroot) only once a day after 5 pm, through pipes submerged in three points of the reintroduction

oceanarium in an attempt to simulate the fixed vegetation they naturally feed on in the natural environment. Groups 2 and 3 (kept in corrals) were also provisioned with seagrass and the same vegetables through submerged pipes. However, they were fed two to three times a day.

OBSERVATIONS OF ANIMALS

For the ethological monitoring, the focal animal sampling method (Altmann, 1974) was used in sessions of three minutes for a period of 30 days of observation in each of the three groups. Eight hours of daily effort were performed (Table 1). The total observation effort was 549.45 hours, 188.2 hours for the monitoring of Group 1 (reintroduction oceanarium in PE) in December 2009, 159.05 hours for the monitoring of Group 2 (corrals in PB), in March 2010, and 202.2 hours for animals from Group 3 (corrals in AL) during the month of September 2009.

ETHOGRAM

Following the definition of stereotypical behaviours presented by Keiper (1969), Mason (1991) and Marriner & Drickamer (1994) four displays noted during the observation of animals fell into the category of stereotypical behaviours and were used for data analysis.

1. Hitting head against the limiting structure (HHALS)—the animal hits its head hard against the limiting structures (fibreglass wall or wooden fence) constantly.
2. Circle swimming (CS)—the animal moves in place around an axis in a continuous circular movement.
3. Back-and-forth movement (BF)—the animal performs the back-and-forth movement, swinging back and forth constantly.
4. Hitting the muzzle (HM)—the animal remains motionless near an object, making repeated movements with its muzzle (only the muscle part) rapidly up and down touching the object, or at the waterline. The head does not follow the movement.

Table 1. Presence of stereotyped behaviours in manatees monitored in the three studied environments, Pernambuco (PE), Paraíba (PB) and Alagoas (AL).

	Animals	Sex	Age	HHALS	CS	BF	HM
Group 1 (PE)	B6	Female	3	–	X	X	X
	Canoa	Female	4	X	–	–	X
	Maya	Female	3	–	X	–	X
	Noel	Male	4	–	X	X	X
	Telinha	Female	3	X	X	–	X
	Tupã	Male	6	–	X	–	X
	Zoé	Male	6	–	X	X	X
Group 2 (PB)	Guape	Male	15	–	X	–	–
	Mel	Female	9	–	–	–	–
	Tico	Male	9	–	–	–	–
	Puã	Male	6	–	X	–	–
Group 3 (AL)	Atol	Male	8	–	–	–	–
	Tinga	Male	8	–	–	–	–
	Arani	Male	8	–	X	–	–
	Cristal	Female	6	–	X	–	–

'X' indicates presence and '–' absence of behaviour. Age is expressed in years; HHALS: hitting head against the limiting structure; CS: circle swimming; BF: back-and-forth movement; HM: hitting the muzzle.

Data analysis

To investigate possible differences in the number of types of stereotypy among the three environments, the maximum number of stereotypical behaviours displayed by each animal was summed and a comparison between environments was performed. Stereotypy frequency ratio was calculated by the number of times the animal had stereotypical behaviours per session divided by the total number of sessions for the same animal. The results obtained for the animals monitored in each of the three environments were compared with one another. The Kruskal–Wallis test followed by Dunn's multiple comparison test was used for analysis (error alpha of 0.05), as the data were not normal (Kolmogorov–Smirnov test, $P < 0.05$). Sigmaplot software was used (Sigmaplot version 11.0, Jandel Scientific, Erkrath, Germany).

RESULTS

The median number of types of stereotypical behaviours (NSB) expressed by manatees in PE was 2.5, significantly higher than in those kept in AL and PB (Kruskal–Wallis test: $N = 15$, $H = 10.61$, $P = 0.005$; Dunn's test, $P < 0.05$, (Figure 1).

Similarly, the frequency of stereotypical behaviours per session (FSB) in PE was 0.08, a ratio significantly higher than in the two other locations, AL and PB (Kruskal–Wallis test: $n = 15$, $H = 10.81$, $p = 0.004$, Dunn's test, $p < 0.05$). There was no significant difference in FSB between AL and PB (Dunn's test: AL versus PB, non-significant) (Figure 2).

'Back-and-forth', 'hitting head against the limiting structure' (HHALS) and 'hitting the muzzle' (HM) behaviours were found only in animals inhabiting the reintroduction oceanarium in PE. Among these seven monitored animals from the reintroduction oceanarium in PE, two displayed HHALS and three 'back-and-forth'. 'Circle swimming' (CS) behaviour was found in all bases (Table 1). The occurrence of CS was 85% (6 out of 7 animals) in manatees from PE and 50% in animals from PB and AL.

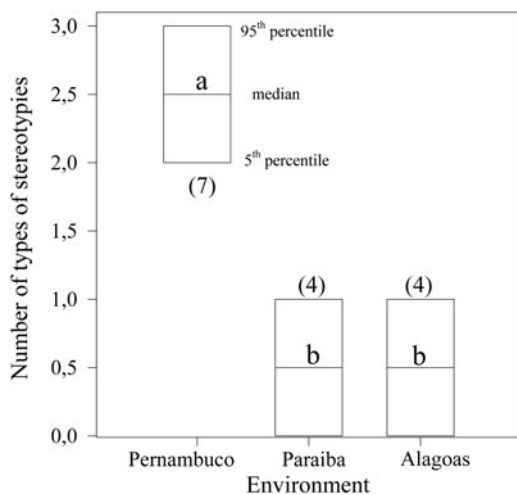


Fig. 1. Median number of types of stereotypies displayed by manatees according to the environment studied. Data are expressed as median (midline in boxes), 5th and 95th percentiles. Different letters indicate statistically significant difference based on Kruskal–Wallis followed by Dunn's test ($P < 0.005$). (N): number of samples per treatment.

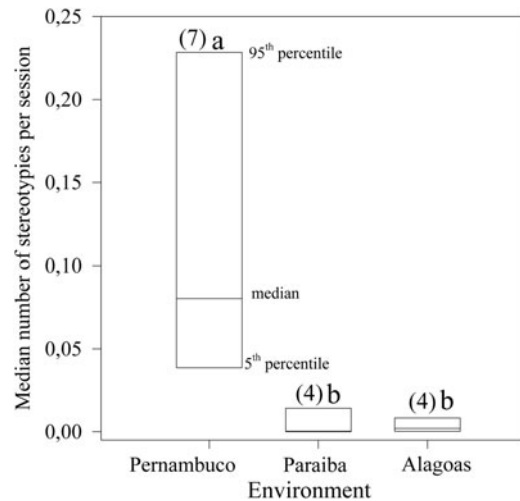


Fig. 2. Median number of stereotypies per session presented by manatees according to the environment studied. Data are expressed as median (midline in boxes), 5th and 95th percentiles. Different letters indicate statistically significant difference based on Kruskal–Wallis followed by Dunn's test ($P < 0.005$). (N): number of samples per treatment.

DISCUSSION

The results showed a significantly higher level of stereotypical behaviour in West Indian manatees inhabiting the reintroduction oceanarium (Group 1) than in those groups confined in corrals constructed in natural areas (estuaries). Moreover, animals inhabiting the reintroduction oceanarium displayed all four types of stereotypical behaviours observed in the study, while those of the corrals displayed only one. The reduced presence of stereotypical behaviour in both corrals constructed in natural environments is a clear indicator of the better quality of this type of captivity over the reintroduction oceanarium.

The differences between the reintroduction oceanarium and the corrals can be explained both by the reduced size and lack of environmental stimulation in the reintroduction oceanarium (e.g. Wemelsfelder, 1997). The reintroduction oceanarium represents a relatively small and highly predictable environment, without any form of enrichment in its physical structure. Additionally, their management is inadequate in the way food is offered. Unfortunately, while physical enrichment is of paramount importance for a number of highly investigative and creative marine mammals, such as dolphins and otters (e.g. Joseph & Antrim, 2010), it is still unknown how the calm and herbivorous West Indian manatees respond to these techniques. Thus, future studies should direct efforts to understand the effects of varied enrichment on the behaviour of West Indian manatees. On the other hand, it is already known that feeding plays a very important role in the behaviour of the manatees. In fact, they devote 6–8 hours/day searching for food in nature (Hartman, 1979; Best, 1981). More recent observations in captivity have confirmed those early findings and added the information of increasing feeding rates in the late afternoon (Horikoshi-Beckett & Schulte, 2006). Thus, the lack of food supply during daytime for individuals from Group 1 may have contributed to the deficient welfare found in all captive animals inhabiting this environment. Bassett & Buchanan-Smith (2007) suggest that the spatial and temporal variation of food offering simulating the situation of foraging

in the wild stimulates exploratory behaviours and increases the welfare of captive animals. It seems clear that a way to mitigate the effects of captivity of Group 1 would be to change the feeding regime from once a day to two or more times during daytime. Moreover, as manatees are considered elusive animals (Hartman, 1979), we suppose that a protected area keeping the animals out of sight of human visitors might also help improve their welfare. Future studies should test this proposition.

Interestingly, 'circle swimming' was found in animals from all environments, although in a higher proportion in individuals inhabiting the reintroduction oceanarium. Such stereotypical behaviour observed in manatees is also observed in other aquatic mammals. Kastelein & Wiepkema (1988, 1989) reported 'circle swimming' as stereotypical movements in walrus (*Odobenus rosmarus divergens*), and this stereotypy was reduced with environmental enrichment aimed at feeding, hampering the access to food and creating search strategies to obtain it. In our study, food offered to both groups confined in corrals was appropriate, as well as the enrichment of the environment, which is within the estuary in a natural area. Possibly, the stereotypical behaviour of some manatees captive in both corrals is a remnant of the previous period of life kept in the reintroduction oceanarium. In fact, it is well known that the captive environment of marine mammals is usually poor, typically consisting of four walls, and a floor with a drain (Goldblatt, 1993; Joseph & Antrim, 2010), in spite of efforts to improve this situation (e.g. Markowitz, 1982; Sweeney, 1990).

This is the first study that identifies the presence and describes the types of stereotypies in West Indian manatees. We also suggest management actions to improve the welfare and conservation of these aquatic mammals. The comparison of animals inhabiting or reintroduction oceanarium with those kept in natural environments indicated a clear improvement in the welfare of animals in the latter environments.

Thus, these results support the importance of environmental enrichment for West Indian manatees. In addition, this study also supports the idea that such animals should be kept in a reintroduction oceanarium for as short a period as possible (Lima *et al.*, 2007). Unnecessarily long periods in such an environment should be avoided to maintain good welfare and help conservation efforts for the West Indian manatees.

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