

ARTICLE

WHAT IS THE PROXIMATE CAUSE OF BEGGING BEHAVIOUR IN A GROUP OF CAPTIVE ASIAN SHORT-CLAWED OTTERS?

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Abstract: The study aimed to ascertain the proximate cause of ‘begging’ behaviour in a group of captive Asian short-clawed otters (*Aonyx cinereus*). Two alternative hypotheses were tested by manipulating aspects of husbandry in three experimental conditions. Condition 1 served as a baseline for comparison. In Condition 2 meal worms and crickets were provided every hour to stimulate natural foraging and hunting behaviour and alleviate boredom. During Condition 3 the food allowance was increased by 7.5% of the otters’ body weight and they were fed every hour to more accurately represent their natural foraging ecology. The results show that both Condition 2 and Condition 3 reduced ‘begging’ behaviour, however the reduction was significantly greater in Condition 3. Thus indicating that the main cause of ‘begging’ behaviour was hunger, however lack of stimulation is also likely to be a contributing factor. Inconsistency in feeding times might have contributed to the ‘begging’ problem as well, although a further long-term study is needed to determine the extent to which this is a factor. Some recommendations for changing aspects of husbandry and diet are provided

INTRODUCTION

Research Question

The study zoo had noticed that their Asian otters constantly displayed ‘begging’ behaviour towards staff and members of the public, even during and immediately after feeding. This was felt to be a welfare issue and the zoo staff was interested in elucidating the cause behind this behaviour.

Previous research on begging in Asian short-clawed otters

Asian otters have been observed ‘begging’ in a variety of captive environments (Maslanka and Crissey, 2002). However despite the widespread occurrence of this problem, there has been little published research into the underlying cause. In 1982

Markowitz and Foster-Turley used environmental enrichment in the form of live prey to reduce abnormal behaviour in Asian otters. They suggested that otters ‘begged’ because they were bored and the behaviour induced a response from visitors. Steen et al. (1995) reduced ‘stereotypical begging’ in Asian otters by randomly distributing food in time and place with the use of a catapult. This reduced dependence on keepers for food and added an element of unpredictability and control over their environment. Owen (2004) observed that the otters ‘begged’ from visitors when they were hungry and that visitors threw food into the enclosure reinforcing the behaviour. However this was an ad libitum observation as part of another study and the statement was not statistically tested. Although the previous research was successful at reducing the ‘begging’ through environmental enrichment, none of the previous studies looked into elucidating the cause at the root of the behaviour. Therefore the purpose of this research was to determine the proximate cause of ‘begging’ behaviour in a group of captive Asian short-clawed otters.

Hypotheses

H1: Boredom is the proximate cause of ‘begging’ behaviour as a result of lack of stimulation and opportunity to engage in the appetitive component of feeding behaviour.

H2: Hunger is the proximate cause of ‘begging’ behaviour as a result of inadequate nutrition and a feeding regime that doesn’t take into account the natural foraging ecology of Asian otters.

Boredom induced ‘begging’

Inglis et al. (1997) found that animals prefer to work for food in a phenomenon called ‘contrafreeloading’. It is possible to meet an animal’s entire physiological requirement and yet often they often will develop abnormal behaviour because of stress and boredom (Poole, 1992). A study into the behaviour of young rhesus macaques found that they exhibited less self-directed behaviour and were more exploratory when they were allowed to work for food (Chamove, 1989). In nature, working for food provides information about resource availability and through evolution it has become a rewarding activity in itself (Poole, 1992). Mammals rely for their survival on collecting and analyzing data and acting intelligently. Their psychological well-being depends upon having an environment that offers facilities to search for information to establish and monitor their concept of the world. Opportunists suffer more in captivity because they are adapted to highly variable environments and captivity does not provide enough stimulation. Social animals have higher cognitive abilities, which, also increases the need for constant sources of stimulation (Mench, 1998; Robinson, 1998). The Asian short-clawed otter is an opportunist and highly sociable and therefore it is possible that the captive environment is not stimulating enough for them (Kruuk et al., 1994). Behavioural problems associated with feeding may develop because foraging constitutes the main form of information gathering for otters, which spend 41 - 60% of their time in the wild involved in feeding or foraging activities (Davis et al., 1992; Spelman et al., 1999; Kruuk 1995, Hoover and Tyler, 1986).

Hughes and Duncan (1988) and Jensen and Toates (1993) argue that animals will suffer if they are unable to perform behaviour that they are motivated to do, even if it

is not necessary to meet their immediate physiological requirements. For any behaviour that is largely governed by internal factors, motivation levels will sooner or later increase above threshold. This will trigger appetitive behaviour but in some environments it will be impossible to reach the consummatory phase so the appetitive behaviour will continue, sometimes in an abbreviated form. It can result in boredom, redirected behaviours, vacuum activities, stereotypes and reduced health (Veasey, 1996). Carnivores devote a large amount of time and energy to hunting behaviour in the wild. In captivity there is little opportunity to express hunting behaviour while a strong motivation remains (Lyons et al., 1997). Shephardson (1993) found that providing small felids with hidden food satisfied the need to express foraging behaviour as well as information gathering. If the lack of stimulation and opportunity to engage in the appetitive phase of feeding behaviour hypothesis is correct, stimulating the otters hunting/foraging behaviour with live prey should reduce begging because it provides them with an outlet for foraging motivation and a more stimulating environment for information gathering thus negating the motivation to seek stimulation from outside the enclosure and allowing the appetitive component of feeding behaviour to progress to the consummatory phase.

Hunger induced ‘begging’

The second hypothesis suggests that poor nutrition or a feeding regime that does not take into account the natural foraging ecology and the physical adaptation of the species could result in hunger. It has been well documented that animals fed restricted amounts of food will develop behavioural stereotypes (Lyons et al., 1997). The stereotypes are built upon elements of redirected activities consecutive to thwarted attempts to reach food and may have been an expression of foraging motivation (Terlouw et al., 1993). Broiler hens have been found to excessively drink, preen and peck non food objects when food was restricted (Savoury et al., 1992). Pregnant sows living in food restricted environments developed pre-feeding stereotypes (Terlouw et al., 1993).

Wild Otters eat roughly 20% of their body weight per day (Duplaix-Hall, 1975). However the study group ate 384g per day each, which is only 12.5% of their estimated body weight. This is 36% less than they would eat per day in the wild. The dominant female was also lactating during the study period but no extra food was provided to minimize the weight loss and metabolic stress associated with milk production, despite recommendations to do so by Tumarov and Sorina (1997).

Asian otters have high metabolic rates (Borgwardt and Culik, 1999). Food is digested and defecated within one hour of ingestion and they eat frequently throughout the day (Lekagul and McNeely, 1988). Therefore Lombardi (2002) recommends that Asian otters are fed three times a day or more due to their natural feeding style of frequent small amounts, fast metabolism and generally high activity levels. The study group were fed roughly four times per day, however the difference between zoo feeding regimes and the natural foraging ecology and morphological adaptations of the Asian otter may mean that even four feeds per day are not frequent enough to prevent ‘begging’. If the hunger hypothesis is correct then increasing the quantity of food to 20% of the body weight and feeding more frequently throughout the day will reduce hunger and negate the need to ‘beg’ because it more naturally represents their foraging ecology and morphology.

METHOD

Study area

The outside enclosure is approximately 20m x 10m. There is an underground burrow, where the otters can not be seen by the public (area 8) and have open access to throughout the day. There are two sandy areas (1) and (2,10,12,13) and 2 pebbled banks (3 and 4). A waterfall runs from the top of the enclosure into the pool (11). These areas are separated by a large pool of water that flows through the enclosure (5, 6 and 7). There is also a bridge which they can go underneath (9). The otters can be viewed by the public from all sides although the viewing areas are set approximately 1m back on three sides, with only close proximity at the top end.

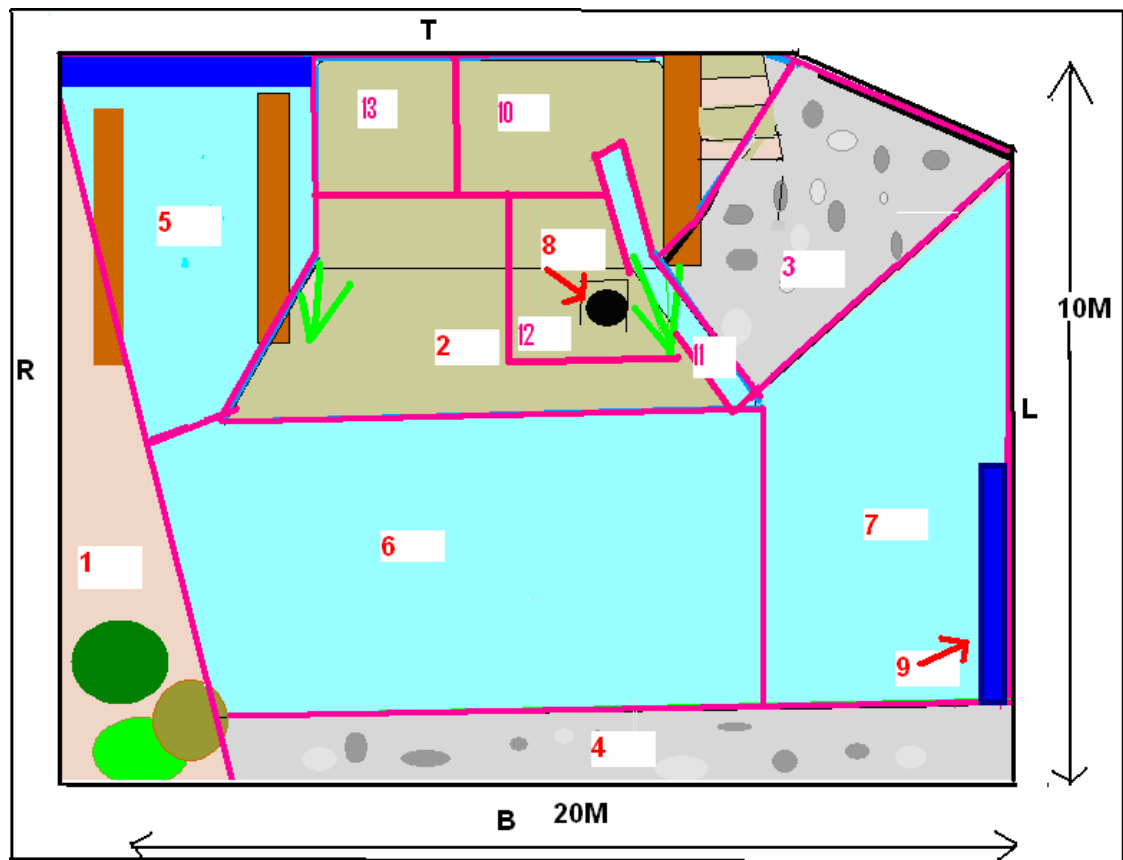


Figure 1: Map of enclosure

Study subjects

There were three adult Asian short-claws, five juveniles and five pups. The pups were five weeks old when the study began and therefore were not included in the study because they spent most of their time in the burrow and were not independent of their mother Mia, who was lactating during the study. The eight remaining otters were observed.

Table 1: Details of the group of otters used in the study

ID	Sex	ID code	Age (years)	Distinguishing marks	Relationship to group members
Mike	Male	1	13	Darker pelage	Father of Ollie and 5 juveniles
Mia	Female	2	6	More white on throat and pink spot above mouth (lactating)	Mother of Ollie and 5 juveniles
Ollie	Male	3	3	Larger and appeared slightly overweight in comparison to the other otters	Son of Mike and Mia, older brother of juveniles
Juvenile 1	Male	4	1	Lighter pelage	Offspring of Mike and Mia
Juvenile 2	Male	51	1		Offspring of Mike and Mia
Juvenile 3	Male	52	1		Offspring of Mike and Mia
Juvenile 4	Male	53	1		Offspring of Mike and Mia
Juvenile 5	Female	54	1		Offspring of Mike and Mia

Begging' definitions

Steen et al. (1995) referred to begging as a stereotypical movement. However the 'begging' observed in this study group was not an invariant functionless behaviour and it was not strictly repetitive. Therefore for the purpose of clarification, in this study the broad term 'begging' has been replaced with the term 'feeding anticipation behaviour', which has then been graded on 3 levels: scan, FA1 and FA2 (refer to table 2 for operational definitions).

Research design

The method is based on a study by Repp et al. (1988) in which stereotypic and self injurious behaviour in humans were treated based on hypotheses about their cause. A baseline was used to formulate hypotheses and two groups were treated based on alternative hypotheses. The cause could then be determined by the response of the groups to treatment. For the purposes of this study both treatments were applied to the same group of otters due to lack of availability of two comparable groups. To reduce the confounding effect of applying one treatment after another, two days were left between treatments to allow behaviour to return to baseline. The experiment was split into three experimental conditions. In Condition 1 the normal husbandry regime was observed to provide baseline data. In Conditions 2 and 3 the feeding regime was manipulated based on two alternative hypotheses; Details of experimental conditions in table 3. Lombardi (2002) argues that it is important to look at how other zoos manage the husbandry. Therefore questionnaires were sent out to zoos housing Asian otters requesting information regarding feeding regime

Table 2: Operational definitions of behaviour

Behaviour	Description
Begging behaviour	Behaviour concerned with looking for food
Scan	Sitting or standing scanning the perimeter of the enclosure in the direction from which food arrives. The lowest intensity begging behaviour
FA1	1m or less from the enclosure wall looking in the direction from which food arrives. The otter may be vocalising at intensity level 1 or 2
FA2	1m or less from the enclosure wall standing in an upright posture straining to see outside the enclosure in the direction from which food arrives. The otter may also be vocalising at intensity 1 or 2
Other behaviour	
Feed	Consumption of food item
Pebble roll	Rolling a pebble between paws or down a slope
Pebble roll hand to mouth	Standing in an upright posture, extending front paw with pebble in, then bringing the paw back towards the body and placing the pebble in the mouth, then repeating the sequence .
Vocalisation 1	A short high pitched tone
Vocalisation2	A high pitched screech that lasts more than 5 seconds
Vocalisation3	A grunt or snort

Data collection and analysis

Group scans were conducted every fifteen minutes on the instant between 8am and 5pm. For each experimental condition 180 scans were taken over 45 hours of observations. The ID, nearest neighbour, nearest neighbour distance, body orientation, behaviour and vocalisation were noted down for every otter. Visitor numbers and weather conditions were also taken in every scan, as well as any other relevant details such as keeper presence or disturbances.

SPSS was used to analyze the data; non-parametric statistics were used because of the relatively small sample size and because the data were not normally distributed. Friedman and Wilcoxon matched pairs tests were used to determine significant differences between conditions for the group because the data was related. Appropriate graphs were then produced to demonstrate significant trends using SPSS and Excel (Hawkins, 2005). A critical significance level of $P=0.05$ was used.

Table 3: Experimental Conditions implemented in the study

Condition	Description
(1) Baseline	<p>The otters were observed under normal feeding conditions 08:00-17:00 for five days as a control for subsequent conditions.</p> <p>Baseline feeding conditions (per otter per day): Approx 8am : 4 x day old chicks Approx 12pm: 3 x day old chicks Approx 2 pm: 2 x day old chicks Approx: 4.30pm: 4 x day old chicks</p> <p>The chicks were occasionally substituted for mice and the feeds were thrown around the enclosure for the otters to find. The otters were fed boiled eggs in addition to their daily meals, once per week.</p> <p>Food (g) per otter per day: 384 % estimated body weight: 12.5%</p>
(2) Stimulation	<p>Baseline feeding condition (see above) +15g of meal worms (<i>tenebrio molitor</i>) and crickets (<i>acheta domestica</i>) thrown into different areas of the enclosure on a random basis every hour to stimulate appetitive foraging behaviour between 08:00-17:00 for five days. The crickets and mealworms were chosen to stimulate foraging behaviour. They additional nutrients and energy were negligible and therefore wont confound the results of condition 2</p> <p>Food (g) per otter per day: 399 % estimated body weight: 12.8%</p>
(3) Feeding regime manipulation	<p>The otters were fed once an hour between 08.00-17.00 for five days and the mass of food provided was increased to 20% of their body weight.</p> <p>08.30 & 16.30: 3 x chicks per otter 9.30,10.30, 11.30, 13.30, 15.30:1x chick per otter 12.30 & 14.30 2 x chick per otter</p> <p>Food (g) per otter per day: 600 % estimated body weight: 20%</p>

RESULTS

Activity Budgets

The group data was collated for each stage and the mean percentage of group scans between 8am and 5pm calculated for each behaviour for the group. The results indicate that there were significant differences in time budget between experimental conditions.

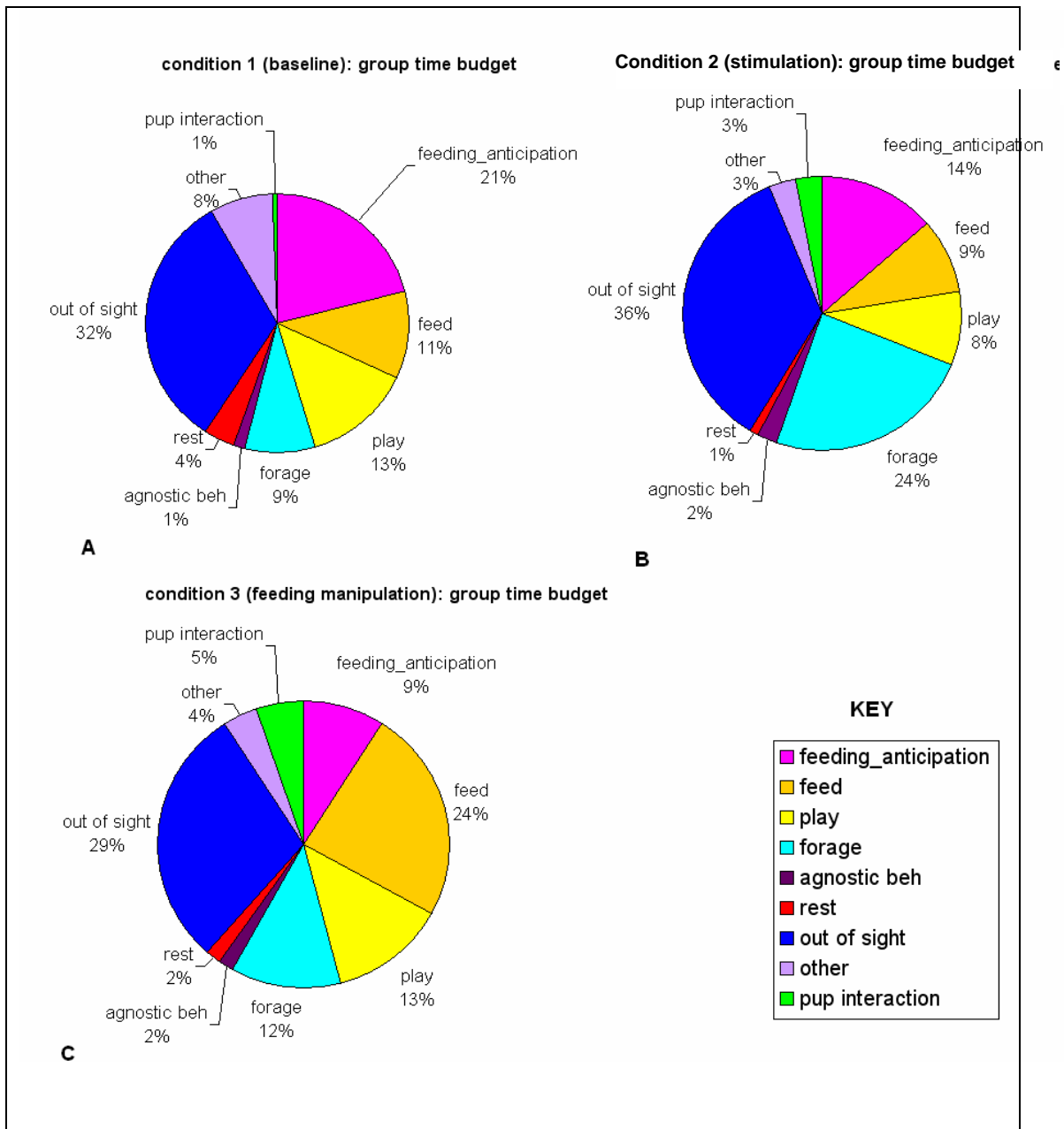


Figure 2. A) Percentage of group scans in Condition 1 in which each behaviour was observed B) Percentage of group scans in Condition 2 in which each behaviour was observed C) Percentage of group scans in Condition 2 in which each behaviour was observed

The percentage of group scans in which any feeding anticipation was recorded declined significantly from 21% in Condition 1 (baseline) to 14% in Condition 2 (Wilcoxon, $Z=2.366$, $N=8$, $P=0.016$) (Figure 2). Feeding anticipation declined further to 9% in Condition 3, this was significantly less than that in both Conditions 1 and 2 (FA: con 1 and 3, Wilcoxon, $Z=2.383$, $N=8$, $P=0.017$) (FA: con 2 and 3, Wilcoxon, $Z=2.383$, $N=8$, $P=0.035$).

The mean percentage of group scans in which foraging behaviour was recorded increased significantly from 9% in Condition 1 to 24% in Condition 2 (Foraging Con1 and 2: Wilcoxon $Z=2.524$, $N=8$, $P=0.012$) (Figure 2). Foraging behaviour then decreased to 12% in Condition 3, which was significantly less than in Condition 2 (Foraging Con2 & 3: Wilcoxon, $Z=2.521$, $N=8$, $P=0.012$). However there was

significantly more foraging in Condition 3 than in Condition 1 (Foraging Con1 and 3: Wilcoxon, $Z=2.521$, $N=8$, $P=0.012$).

Effect of experimental condition on feeding anticipation behaviour

The mean percentage of group scans in which the group was displaying scanning behaviour was significantly less in both Conditions 2 and 3 compared to Condition 1 (Scanning Con 1 and 2: Wilcoxon, $Z=2.383$, $N=8$, $P=0.03$) (Scanning Con 1 and 3: Wilcoxon, $Z=2.243$, $N=8$, $P=0.025$) (Figure 3). There was not a significant difference between Conditions 2 and 3 (Scanning Con2 and 3: Wilcoxon, $Z=0.690$, $N=8$, $P=0.490$).

Mean FA1 increased slightly from Condition 1 to Condition 2 but this was not statistically significant (FA1 Con1 and 2: Wilcoxon, $Z=1.778$, $N=8$, $P=0.075$) (Figure 3). FA1 was significantly lower in Condition 3 than both Condition 1 and 2 (FA1 Con 1 and 3: Wilcoxon $Z=2.380$, $N=8$, $P=0.017$) (FA1 Con 2 and 3: Wilcoxon, $Z=2.103$, $N=8$, $P=0.035$).

Mean FA2 decreased from 7.5% of scans in Condition 1 to 4.4% in Condition 2 and decreased further to 2.7% in Condition 3 (Figure 3). These differences were statistically significant between all conditions (FA2 Con 1 and 2: Wilcoxon, $Z=2.527$, $N=8$, $P=0.012$) (FA2 Con 1 and 3: Wilcoxon, $Z= 2.524$, $N=8$, $P=0.012$) (FA2 Con 2 and 3: Wilcoxon, $Z=2.226$, $N=8$, $P=0.026$).

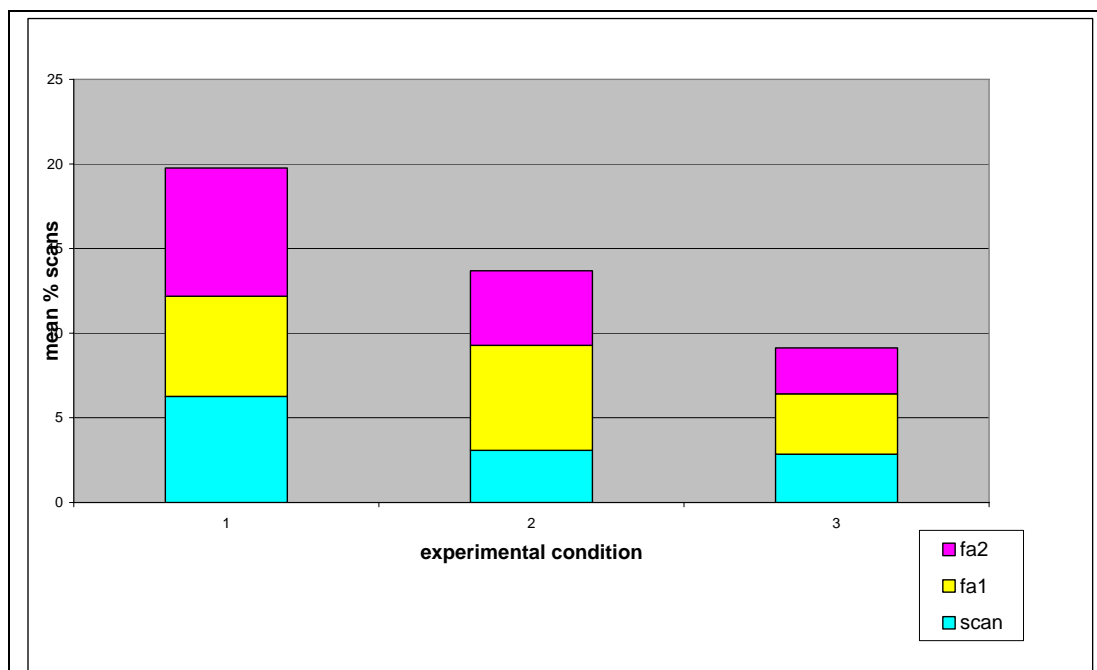


Figure 3. A graph to show the trend in each feeding anticipation intensity and the overall trend for feeding anticipation behaviour as a whole for the group. Standard deviation values in Table 4.

Table 4. Feeding anticipation (STD)

	Standard deviation		
	condition1	condition2	condition3
scan	3.02	4.44	5.04
fa1	3.04	1.54	4.15
fa2	2.03	2.8	1.55

Effect of visitor density on feeding anticipation

Feeding anticipation behaviour differed slightly between different numbers of visitors, the highest density visitor group does have the highest feeding anticipation, and however the second largest group had the lowest mean % scans in which the otters were displaying feeding anticipation (Figure 4). There was no significant difference between visitor numbers and the mean % scans in which feeding anticipation was present (Friedman: $\chi^2=5.438$, $df=4$, $P=0.245$).

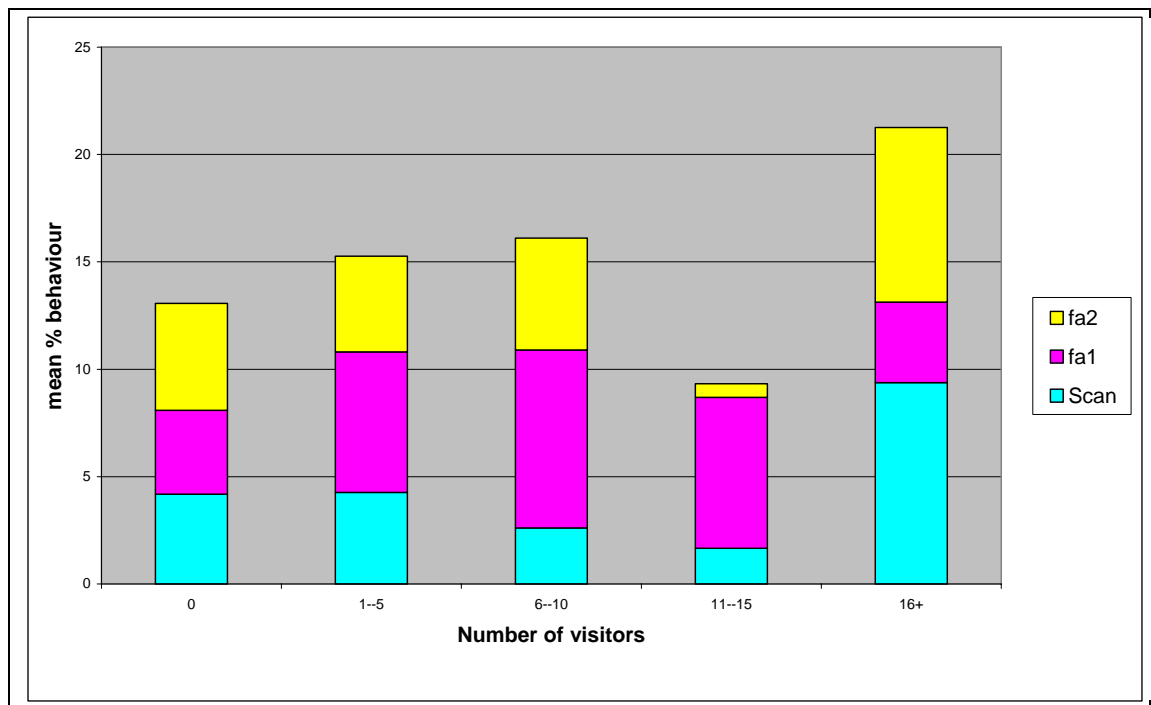


Figure 4. Mean % feeding anticipation behaviour in relation to the number of visitors

Effect of the presence of a keeper on feeding anticipation behaviour

Feeding anticipation behaviour was slightly greater when no keepers were in sight (Figure 5). However this was not statistically significant (Wilcoxon signed ranks, $Z=-0.140$, $N=8$, $P=0.889$).

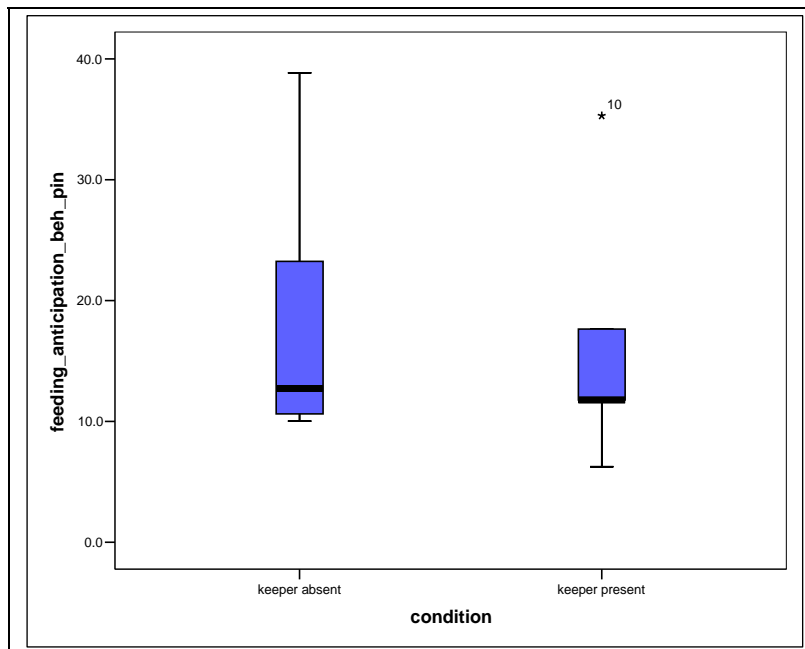


Figure 5*. Effect of the presence of keepers on mean % of scans in which feeding anticipation behaviour was present

* The data used for keeper present excluded scans when the keeper was feeding the otters as it confounded the results because they were always feeding during feeding time and therefore would not be showing feeding anticipation.

Differences in feeding anticipation behaviour within the group

Feeding anticipation changed with experimental condition for each individual and highlight differences within the group (Fig. 6-8). There is variation within the group in Condition 1 (Figure 6). The adults (1-3) show significantly greater feeding anticipation behaviour than the juveniles (4-54) (FA Con1 Adults–Juveniles: Mann-Whitney, $U=0.000$, $n_1=5$ $n_2=5$, $P=0.009$). Mia (2) showed the greatest feeding anticipation behaviour. However there was not a significant difference within the adults or within the juveniles (FA Con1 ID 1-3: Kruskal-Wallis, $\chi^2 = 3.933$, $df = 2$, $P=0.140$) (FA Con1, ID 4 -54: Kruskal- Wallis, $\chi^2 = 0.962$, $df = 4$, $P=0.916$).

All individuals were anticipating food less in Condition 2 than Condition 1 (Figure 7) except for Mia (2) who still exhibited high feeding anticipation behaviour, which was significantly higher than the other adults (1 and 3) (Con2: ID: 2and 3: Kruskal Wallis, $\chi^2=4.870$, $df = 1$, $P=0.027$) (Con2: ID: 1 and 2: Kruskal-Wallis, $\chi^2=6.400$, $df=1$, $P=0.011$). There was no significant difference between the two adult males (Con2: ID 1 and 3: Mann-Whitney U, $U=6.500$, $n_1=5$ $n_2=5$, $P=0.202$). The adults (1-3) showed significantly greater feeding anticipation behaviour than the juveniles (4-54) (Con2: adults – juv: Mann- Whitney U, $U=0.000$, $n_1=5$ $n_2=5$, $P=0.009$) There was no significant difference between juveniles (Con2: ID: 4 – 54: Kruskal-Wallis, $\chi^2=2.609$, $df=4$, $P=0.625$).

Feeding anticipation behaviour was further reduced in condition 3 from conditions 1 and 2 for all individuals except Mia (2) (Figure 8). The juveniles showed the greatest overall reduction in feeding anticipation behaviour. The adults showed significantly greater feeding anticipation than the Juveniles (Con3: ID: adults and juv: Mann-Whitney U, $U= 0.000$, $n_1= 5$ $n_2= 5$, $P=0.009$). There was a significant difference in feeding anticipation behaviour between all the adults in Condition 3 with Mia (2) demonstrating the greatest feeding anticipation followed by Ollie (3) and Mike (1)

(Con3: ID: 1 and 2: Mann-Whitney U, $U=0.0005$, $n_1: 5$ $n_2: 5$, $P=0.008$) (Con3: ID: 1 and 3: Mann-Whitney U, $U=3.000$, $n_1: 5$ $n_2: 5$, $P=0.04$) (Con3: ID: 2 and 3: Mann-Whitney U, $U=0.000$, $n_1: 5$ $n_2: 5$, $P=0.008$). There was no significant difference between the juveniles (Con3: ID: 4 – 54: Kruskal-Wallis, $\chi^2=2.935$, $df=4$, $P=0.56$).

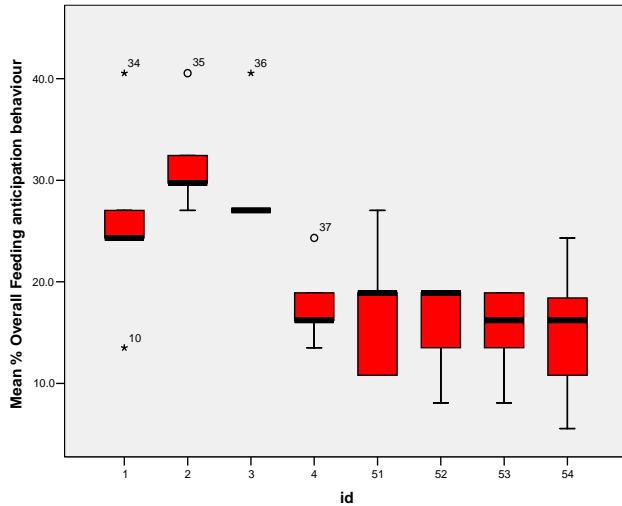


Figure 6. Condition 1 – Difference between the otters in the % of scans in which feeding anticipation behaviour was observed

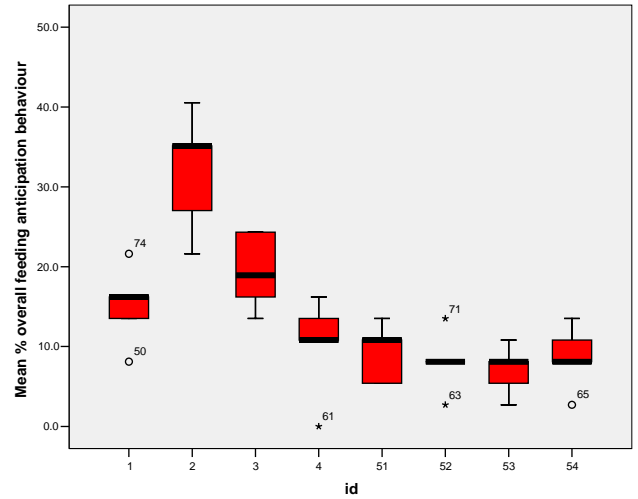


Figure 7. Condition 2 – Difference between the otters in the % of scans in which feeding anticipation behaviour was observed

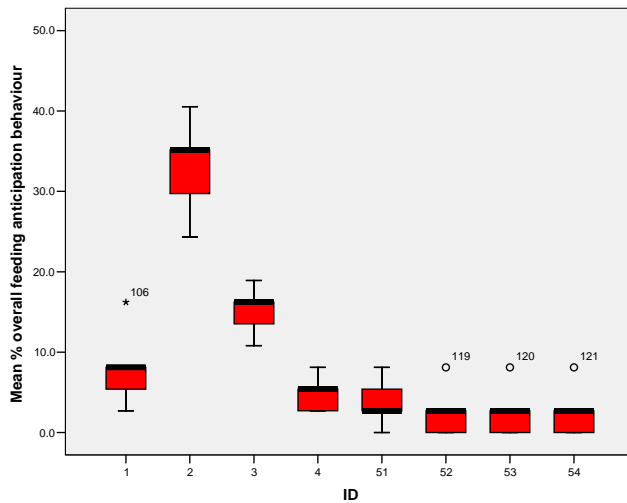


Figure 8. Condition 3 – Difference between the otters in the % of scans in which feeding anticipation behaviour was observed

Vocalisations

Effect of experimental condition on vocalisation 1

The mean percentage of group scans in which the group were vocalising at intensity 1 in all three conditions. Vocalisation 1 decreased in Conditions 2 further in Condition 3. There was a significant difference between Condition 1 and 2 but not between

Condition 1 and 3 and Conditions 2 and 3 (V1: Con 1 and 2: Wilcoxon, $Z=2.383$, $N=8$, $P=0.017$) (V1: Con 1 and 3: Wilcoxon, $Z=1.183$, $N = 8$, $P= 0.237$) (V1: Con 2 and 3: Wilcoxon, $Z=1.402$, $N=8$, $P=0.161$).

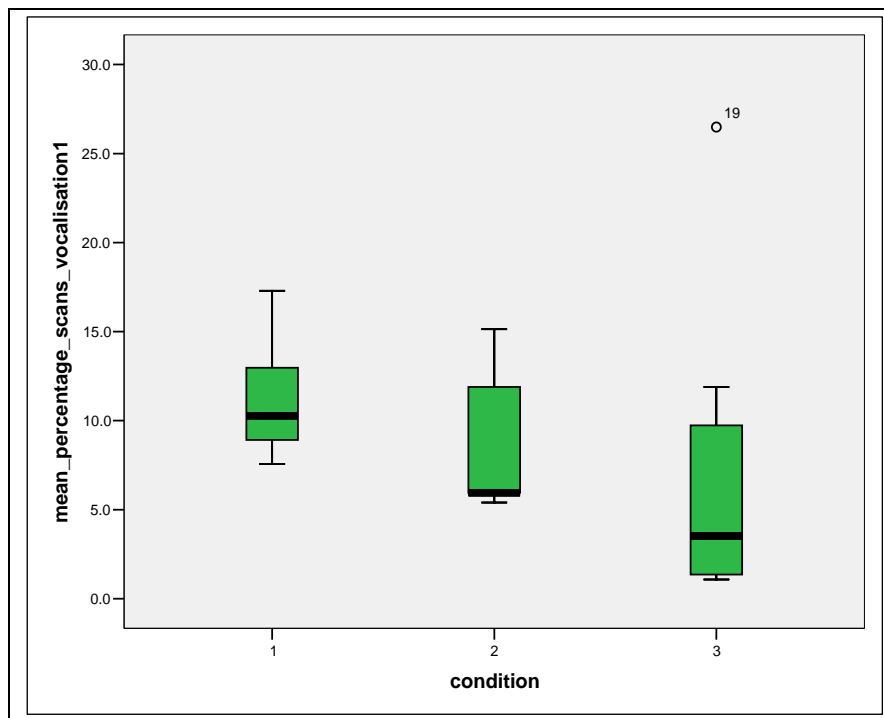


Figure 9. Mean % of scans in which the group was vocalising at intensity 1 during each experimental condition

Effect of experimental condition on vocalisation 2

The mean percentage of group scans in which the group were vocalising at intensity 2 in the three conditions. The mean percentage of group scans in which vocalisation 2 was recorded decreased in Conditions 2 and 3 from Condition 1. There was a significant difference between Condition 1 and 2 and Condition 1 and 3 but not between Conditions 2 and 3 (V2: Con 1 and 2: Wilcoxon, $Z=2.383$, $N=8$, $P=0.017$) (V2: Con 1 and 3: Wilcoxon, $Z=2.243$, $N=8$, $P=0.025$) (V2: Con 2 and 3: Wilcoxon, $Z=0.690$, $N=8$, $P=0.490$).

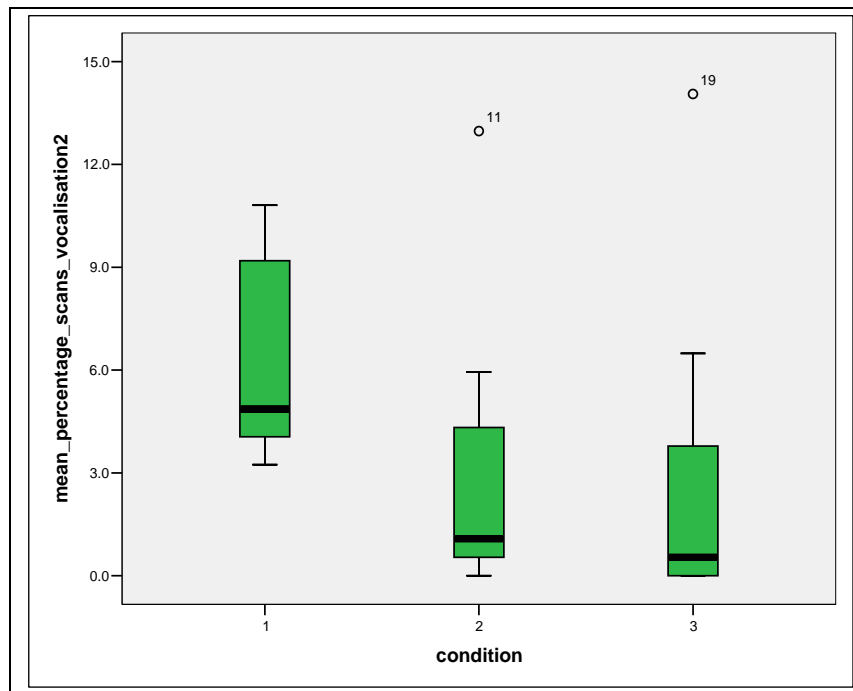


Figure 10. Mean % of scans in which the group was vocalising at intensity 2 during each experimental condition

Zoo Questionnaire

Out of seven zoos the quantity and type of food provided was similar across all institutions, although ‘begging’ was observed to some extent in all of them (Table 5). The nutritional content of the 3 main foods eaten by the study otters was adequate according to guidelines by Lombardi (2002) (Table 6).

DISCUSSION

Feeding anticipation behaviour ‘begging’

Experimental condition

From the results in Figures 2 and 3; Condition 3 had the greatest effect on reducing feeding anticipation behaviour. This supports hypothesis two (hunger is the proximate cause of ‘begging’ behaviour). However Condition 2, although less than Condition 3 also reduced feeding anticipation behaviour significantly from the baseline. Therefore hypothesis one (lack of stimulation and opportunities to carry out the appetitive part of feeding behaviour) cannot be ruled out as a contributing factor towards the motivation behind ‘begging’ behaviour. This may have been further confounded by the fact that Condition 3 was implemented after Condition 2 and the possibility exists that Condition 2 had an overall motivating effect on the otters behaviour and therefore will have contributed to the reduction in ‘begging’ in Condition 3.

Table 5. Quantities of food fed to Asian otters and 'begging' information for zoos

Zoo	Average daily feeding regime (per otter)	Food mass (g) Per otter	# Feeds per day	Beg 30 mins before feed?	Beg at other times of day?	Types of food
1	Morning: 4 chicks Noon: 2 chicks 2pm: 2 chicks Evening:4 chicks	384g	4	YES	YES up to 2 hours before a feed	day old chicks; mice horse meat; egg
2	Morning: 2 chicks Late morning: fruit Afternoon: 400g fish	464g	3	YES	When they see keeper	day old chicks; sprats herring ;egg ; fruit
3	Morning: 4 sprats or 2 chicks Afternoon:4 sprats or 2 chicks Evening: Alternate between chicken leg, rabbit leg and hamsters	300g	3	YES	YES up to two hours before a feed	Sprats:Day old chicks Rabbit:Hamster: Chicken
4	Morning: 1 chick Evening: 1 chick + pieces of meat	100g	2 + Occasional treats	YES	YES up to two hours before a feed (especially when they see a keeper)	day old chicks: Trout Minced heart:, liver, carrot : cod liver oil peanuts:
5	Morning: 1 mackerel or trout Evening: 1 mackerel or trout Scatter feeds of rats, mice, peanuts, insects, egg, crab claws	460g	2 feeds + 1-4 scatter feeds	YES	YES	mackerel trout mice rats crab claw egg
6	Various protein inc 3 chicks given morning and evening	453g	2 feeds winter 3 summer	YES	NO	egg; lobster crayfish; day old chicks
7	Early morning 11.30 public feed Evening feed (morning and evening no set time) 4 chicks ¼ chicken carcass per day	300g	3 feeds	YES for the public feed	Only when the keeper is seen	horsemeat sprat chicken day old chicks

Table 6. Recommended nutrients for otters compared with three common foods

Item	Target nutrient ranges*	Day old chick**	1 mouse**	Horsemeat**
Crude Protein %	24- 32.5	67.9	58.3	71
Fat %	15- 30	16.8	23.9	20.9
Calcium %	0.6-0.8	1.7	3.4	0.07
Phosphorus%	0.6	0.9	1.8	0.5
Mass (g)	NA	34.3	27.6	NA

* Maslanka et al. (2002)

** Allen et al. (1997)

Visitor density

Visitor density and intensity have been found to affect the behaviour of zoo animals (Foster-Turley, 1982; Marguilis et al., 2003; Sellinger, 2005; Hosey and Druck, 1987; Chamove, 1988). Therefore the number of visitors was recorded during every scan to measure the effect of this possible confounding variable. The results showed that there was no significant difference in feeding anticipation between visitor densities ranging from 0 to 16+ (Figure 4). This suggests that visitors had no effect on feeding anticipation behaviour therefore they were not a confounding variable. From ad libitum observations I noticed that the otters largely ignored the visitors, often trying to see past them to the path where food arrived from. The only visitors that they 'begged' directly from were wearing blue shirts in the same shade as that worn by the keepers. This contradicts findings by Owen (2004) who found that Asian otters only 'begged' in the presence of people. Research into the intensity of visitor interactions on Asian otter 'begging' behaviour may be an avenue of further study.

Keeper presence

It was felt that keeper presence may confound the results of the study. Therefore when the keepers were present during a group scan it was recorded along with the nature of their visit. The results showed that there was no significant difference in feeding anticipation behaviour between scans when the keeper was present and absent (Figure 5). This result was initially surprising as it appeared that the otters would nearly always 'beg' from keepers. The result may have been because the majority of instances where the keepers were present, they were carrying out maintenance on the enclosure and the otters were more curious as to what the keeper was doing rather than begging for food. They may have also picked up on the cue that when the keeper is in the enclosure they are not going to be fed, as they were always fed from the outside, therefore they could relax knowing that they would not be fed. This provides tentative support for the proposal by Waitt et al. (2001) that reliable cues as to when feeding will and will not occur allows animals to relax and engage in non anticipatory activities.

Difference in feeding anticipation behaviour within the group

The results of differences within the group showed that in every condition the adults showed significantly higher levels of feeding anticipation behaviour than the juveniles. This lends support to hypothesis one (lack of stimulation). Abnormal behaviour caused by captive environment is often more difficult to reduce in adults even when the environment becomes enriched because the behaviour pattern is more fixed (Wemelsfelder, 1993). However Mia (2) consistently 'begged' more than all the other otters and showed the least reduction in feeding anticipation behaviour. She was lactating to provide milk for a litter of five during the study and therefore her energy requirements would have been the greatest. Even in Condition 3 when the otters were fed 20% of their body weight based on the amount they eat in the wild, this did not account for Mia's lactation needs and therefore it is plausible that she was still hungry. The fact that Mia did not improve and 'begged' significantly more than the other adults in Conditions 2 and 3 supports hypothesis two (hunger).

Vocalisations

Vocalisations often accompanied feeding anticipation, particularly vocalisations 1 and 2. Vocalisation 1 was less shrill and lasted for a shorter duration than vocalisation 2 and was more often associated with less intense feeding anticipation behaviours. There was a significant reduction between Condition 1 (baseline) and the two experimental conditions for both vocalisations but not between Conditions 2 and 3. The fact that there is not a significant difference between Conditions 2 and 3 in vocalising did not lend support to either hypothesis over the other. The fact that there was a significant difference between baseline and both experimental conditions suggests that feeding anticipation may be due to both hunger and lack of stimulation.

Time budget

The group data was collated for each stage to produce graphs on time budgets to help to determine if behavioural diversity increased and if abnormal behaviour and inactive behaviours were reduced (Figure 2). The results show that abnormal behaviour and rest declined significantly and foraging significantly increased in Condition 2 when stimulation in the form of foraging for live insects was introduced. This supports hypothesis one (lack of stimulation and of opportunity to engage in appetitive behaviour; result: 'begging' behaviour). However, play behaviour decreased and instances of 'out of sights', where the animals were in the burrow, usually resting, increased. This provides evidence in favour of hypothesis two because the increase in out of sights suggests a greater need to rest possibly due to the energetic demands of the extra foraging opportunity. The decline in play behaviour adds extra weight to this argument because play behaviour can be an indicator of nutritional status. For example, studies by Barrett et al. (1992) and Sommer and Mendoza Granados (1995) found that play behaviour was strongly correlated with habitat quality in monkeys. Good habitat quality leads to better nutritional status because the food is more plentiful and nutrient rich. Animals with better nutritional status play more because they can afford to engage in this luxury behaviour.

In Condition 3, play behaviour increased significantly from Condition 2 back to baseline levels. Foraging behaviour declined in Condition 3 although it was still significantly greater than in Condition 1. The fact that foraging behaviour did not decline to baseline levels in condition three might have been due to a residual motivating effect from Condition 2 or it could be interpreted as an increase in activity due to more energy from a more appropriate husbandry routine, therefore supporting both hypotheses. However percentage time resting and 'out of sight' (behaviours characterized by inactivity) were both significantly lower in Condition 3 than the other two Conditions, which supports hypothesis two (hunger) because they were engaged in more active behaviour as a result of receiving more energy in their diet despite the fact that there was little stimulation in their environment.

Feeding time

I was unable to analyze the correlation between feeding time and feeding anticipation behaviour because the feeding times were too varied in Conditions 1 and 2 for a particular time of day to be positively correlated with feeding anticipation. This inadvertently led to a possible explanation as to why they 'begged' so frequently and

for such long periods of time. They were routinely fed four meals a day, however on two out of ten occasions the afternoon feed was recorded as missed. Furthermore on five out of twenty feeds the keeper had presumably fed the otters before observations began in the morning or after they finished in the evening creating the possibility of other missed feeds. The morning feed was recorded to occur at times between 8.00-10.00, the lunchtime feed between 10.00 -12.30, the afternoon 12.30-14.30 and the evening 16.15 -16.45. This meant that there was the possibility that the otters might be fed in 7 out of 9 hours of observation during the day. The schedule might have been too unpredictable for Asian otters to rely on cues informing them when feeding would definitely not occur and therefore they were in a constant state of alert, unable to relax. This theory is supported by Waitt (2001) who argues that animals pick up on external cues to reliably predict feeding time and these cues cause the change in behaviour prior to feeding. The safety-signal hypothesis suggests that reliably signalling to an animal prior to delivering food allows the animal to predict when not to anticipate the event allowing the animal to relax during times that it knows it will not be fed. Unreliable signals and unpredictable feeding times result in the animal anticipating the delivery of the stimuli which may or may not be forthcoming causing frustration. Waitt (2001) concludes that if animals had a clear distinct and reliable signal that informed them about the event, then pre-feeding behaviours might not occur. This is an interesting area for a long-term study; It would be interesting to determine how feeding the otters on a truly predictable schedule with reliable pre-feeding cues over a long period of time would affect their feeding anticipation behaviour.

Mia: Adult female

Mia the alpha female in the group was lactating during the study and unique in much of her behaviour. She typically 'begged' for longer periods and more intensely than the other otters and her play was characterized entirely by pebble rolling. She also performed a type of pebble rolling behaviour that was unique to her in the group. She would pick up pebbles and extend her paw towards the perimeter of the enclosure and then pull it back placing the pebble in her mouth repeating the sequence often for prolonged periods of time. The behaviour looked very analogous to human 'begging' and may have been reinforced by the public who thought she was 'begging' for food creating an association between the behaviour and acquiring food. However, no visitors were observed feeding the otters during the study. The correlation between feeding time and frequency of pebble rolling could not be analyzed because of the great variation in feeding time. However from ad libitum observations the behaviour increased in intensity the longer the period without food has been. The behaviour may be a form of coping with the stress or an expression of frustration about lack of control over feeding opportunities and therefore a welfare concern. Further study is required to establish the cause of this behaviour and if indeed it is a form of oral stereotypy.

Zoo Questionnaire

In seven zoos the quantity and type of food provided was similar across all institutions, although begging was observed to some extent in all of them indicating that it's possible that they all underfeed their otters (Table 5). The nutritional content of the 3 main foods eaten by the study otters was adequate according to guidelines by

Lombardi (2002) (Table 6). However there are no formal guidelines on the quantity of food to feed otters, therefore they may not be receiving enough to provide the quantity of nutrients needed, which may in turn lead them to beg for food.

Limitations of the study

The adult female was lactating during the study which may mean that feeding anticipation levels were higher than in times of less physiological stress. All three conditions were studied on the same group of otters, possibly making the results dependent on each other. However it is very difficult to find groups that are similar in enough respects to do a comparative study without further factors confounding the results. The relatively small sample size of eight otters makes it difficult to generalize about all Asian otters in captive environments, therefore reducing the application of the findings to the study zoo. The study is also limited by its short-term nature. Ideally it would run over several months to determine the long term effect of each condition and prior to the study an investigation into the efficiency of digestion of the different food items fed to the otters would have occurred. It may be that they digest certain food items badly and therefore are hungrier on the days they are fed them. However this was not possible because of time constraint.

CONCLUSIONS

In conclusion, I get the impression from the results that Hypothesis 2, hunger, is the major proximate cause of 'begging' behaviour. However boredom as a result of lack of stimulation and opportunity to perform the appetitive components of feeding was also a major factor. Foraging enrichment could help alleviate 'begging' behaviour by providing a distraction and giving the animal a sense of control over the environment. Thus reducing the frustration associated with captive feeding. This will only be effective if hunger levels are not too high. In the case of Mia hunger levels definitely have been too high. The inconsistency in feeding times may have also contributed to the extent of the feeding anticipation behaviour although this needs further study.

RECOMMENDATIONS

1. Feed otters on a highly predictable schedule with reliable pre-feeding cues. This will allow the otters to relax and engage in non feeding activities when they are not being fed and reduce the frustration associated with captive feeding.
2. Provide otters with enrichment that stimulates natural foraging/hunting behaviour. This will allow them to exert control over the environment and satisfy their behavioural need to forage.
3. There is an increased need for energy during lactation and this should be taken into account when feeding lactating females.
4. Asian otters should be fed 20% of their body weight per day. Preferably in small frequent amounts to more closely match their natural foraging ecology and the functional anatomy of their digestive tracts, which digest and defecate food within one hour of ingestion.

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Résumé: Quelle Est La Cause Proximale Du Comportement De Mendicite Observe Chez Un Groupe De Loutres Cendrees Captives ?

Le but de cette étude fut d'établir la cause proximale du comportement de "mendicité" observé chez un groupe de Loutres cendrées (*Aonyx cinereus*). Deux hypothèses alternatives furent testées par des modifications des conditions de vie en captivité, au cours de trois situations expérimentales. La première situation servit de témoin. La situation 2 consista à fournir des repas à base de vers de farine et de crickets toute les heures, afin de stimuler un comportement naturel de chasse et de recherche de nourriture et d'atténuer l'ennui. Dans la situation 3, l'apport de nourriture fut augmenté d'une quantité égale à 7,5 % du poids des loutres et elles furent nourries toutes les heures afin de davantage simuler leur écologie alimentaire naturelle. Les résultats montrent que les situations 2 et 3 toutes deux réduisirent le comportement de "mendicité", cependant la diminution la plus importante fut observée pour la situation 3. Ceci montra que la principale cause du comportement de mendicité fut la faim, cependant, un manque de stimulation a aussi tendance à jouer un rôle. Une irrégularité dans les heures de nourrissage, semble également avoir contribué au problème de mendicité, mais une étude à long terme est nécessaire afin de déterminer l'importance de ce facteur. Certaines modifications des conditions de maintien en captivité et de l'alimentation furent recommandées.

Resumen: ¿Cual Es La Causa Inmediata Del Comportamiento De Mendiguelo En Un Grupo En Cautiverio De Nutrias De Río Asiáticas De Garras Cortas?

Este estudio se orientó a la identificación de las causas inmediatas del comportamiento de 'mendiguelo' en un grupo en cautiverio de nutrias de río asiáticas de garras cortas (*Aonyx cinereus*). Dos hipótesis alternativas fueron testeadas mediante la manipulación de aspectos de la producción en tres condiciones experimentales. La condición 1 sirvió como control. En la condición 2 gusanos y grillos se ofrecieron cada una hora para estimular el comportamiento de forrajeo y caza, y disminuir el aburrimiento. En condición 3 la ración de alimento se aumentó a un 7,5% de la masa corporal de las nutrias, las que fueron alimentadas cada una hora para representar con más exactitud su ecología natural de forrajeo. Los resultados muestran que Condiciones 2 y 3 redujeron el comportamiento de 'mendiguelo', con la reducción más significativa en la Condición 3. Esto indica que la mayor causa de comportamiento de 'mendiguelo' fue el estado alimentario; sin embargo la falta de estímulo es otro factor que probablemente contribuye. Inconsistencia en los momentos de alimentación puede haber contribuido también a este comportamiento; sin embargo un estudio de mayor duración es necesario para determinar si la falta de estímulo es otro factor. Algunas recomendaciones para cambiar las características de la producción son mencionadas.