

Department of Physics, Chemistry and Biology

Bachelor's Thesis

The effect of extra feed supply on stereotypic behaviour in
Asian elephants (*Elephas maximus*)

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1. Abstract

Stereotypic behaviours in captive elephants is a widespread issue. Ways to tackle this is with e.g. social or food enrichment. The aim of this study was to investigate if extra feed supply would affect stereotypic behaviour in Asian elephants held in captivity. Three elephant cows were provided with extra feed and recorded during the night and early morning. The results showed a significant decrease in stereotypic behavior for one of the elephants, from 31% to 9,5% ($P = 0,003$) of the observed hours. While the second elephant did not engage in stereotypic behaviour, the third elephant showed the same frequency of stereotypic behavior, 9%, during both baseline and treatment. The third elephant also increase her foraging significantly, from 31% to 54% ($P = 0,02$). Of the time spent awake foraging increased for all three elephants to 64-80% which is in the same range as in wild Asian elephants. Additional enrichment in the form of extra feed supply can be used both to reduce stereotypic behaviours and to increase foraging.

Keywords: asian, behaviour, elephant, enrichment, feed, stereotype, stereotypic

2. Introduction

Animals in the wild often live in complex environments. It is very challenging and often impossible to re-create these environments when wild animals are held in captivity, depending on both financial and practical factors. Animals in captivity sometimes develop stereotypies (Mason et al, 2007) which here will be defined as repetitive behaviours induced by stress or frustration (Mason, 2006). Environmental enrichment is often used to counteract stereotypic behaviour. Environmental enrichment means that animals are given the opportunity to perform species-specific behaviours, in order to decrease stress and to increase the animal welfare (Swaigood & Shepherdson, 2006; Young, 2003). The opportunity to perform species-specific behaviours reduces the stress caused by not being able to perform these behaviours, which in turn may reduce the frequency of stereotypic behaviours (Rees, 2009; Swaigood & Shepherdson, 2006; Young, 2003; Thomas et al, 2001; Gloyns, 2000).

One animal species that often displays stereotypic behaviours in captivity is the elephant (Mason et al, 2007). Stereotypies such as head bobbing (rhythmical head movements up and down), weaving (swaying from side to side or back/forth) and pacing have been observed in elephants (Rees, 2004; Clubb & Mason, 2002; Kurt & Garai, 2002). Stereotypic behaviours in elephants are affected by body mass and temperature (Rees, 2004), daily management routines (Wilson et al, 2004), barren environments (Elzanowski & Sergiel, 2006) and social interactions (Kurt & Garai, 2002), among others.

The difficulties in re-creating the environment of wild elephants lies in their size, intelligence, complex social environment and their tendency to destroy their environment. Also they normally spend a large proportion of their time on foraging (Veasey, 2006). Foraging involves both to find food, manipulate it (for example to pull leaves of a twig) and to consume it. Wild elephants spend between 60 and 80% of their time awake on foraging, i.e. approximately 16 hours a day (Clubb & Mason, 2002; Stoinski et al, 2000; McKay, 1973). The time spent on foraging is considerably lower in captivity, between 24-43% (Posta, 2011 ; Rees, 2009) since the food is more easily available and of higher quality than in the wild and therefore consisting of a smaller volume (Wiedenmayer, 1998). Thus food as a form of environmental enrichment to increase the occurrence of foraging is a good idea, provided that it is given in reasonable amounts. The more time spent on foraging by an elephant the less

time spent on stereotypic behaviours (Rees, 2009) Wild elephants spend a large part of the night on foraging (McKay, 1973), so do elephants held in captivity if they are given the opportunity (Posta, 2011 ; Wilson et al, 2006; Brockett et al, 1999). Morimura and Ueno (1999) showed that elephants with constant access to food spend less time on stereotypic behaviours in comparison with elephants being fed with smaller amounts several times a day. Morimura and Ueno writes “This study showed the importance of maintaining the consumption of foods for elephants rather than increasing the frequency of feeding”. Environmental enrichment has a continuing need for evaluation and development to maintain its effectiveness (Glyons, 2011).

Concerning other factors affecting stereotypic behaviour, except the opportunity to forage, social interactions are very important. Socially isolated elephants show a higher frequency of stereotypic behaviours than individuals with access to social interactions (Kurt & Garai, 2002). It has also been observed that circus elephants engaged in weaving as soon as they were expecting something to happen, for example before being showered or fed (Kurt & Garai, 2002).

Stereotypic behaviours have been showed to vary between individuals, seasons and from day to day (Rees, 2009). Few studies have been made concerning elephant behaviour and stereotypies during the night and early morning. Therefore the aim of this study was to investigate if the availability of additional enrichment in the form of seed hay provided in a hay net bag would affect the frequency of stereotypies in Asian elephants (*Elephas maximus*). The question at issue was whether the frequency of stereotypies would decrease when the elephants were provided with extra seed hay during different times in the morning or not and if the activity of the elephants would change during the night or morning. Hypothesizing that when providing captive Asian elephants with increased opportunity to forage during the morning the frequency of stereotypic behaviour during the morning would decrease.

3. Materials and methods

3.1. Animals

The study was performed on three elephant cows housed at Kolmården Zoo; Saba 43 years old, Saonoi 15 years old and Bua 14 years old. Saba arrived at Kolmården in 2008, she was captured from the wild but her origins were unclear; she had been chained for long periods of time and most recently she came from a French zoo where she had been held separately because she did not get along with the other elephants. Saonoi and Bua arrived at Kolmården in 2004, they were born in an elephant work camp in Thailand where they were trained together. All three cows displayed at least some form of stereotypic behaviour; Saba mainly displayed head bobbing and could get unresponsive performing her stereotype; Bua mainly displayed head bobbing; Saonoi occasionally displayed weaving. During the night Saba was kept separated from Saonoi and Bua since she was not feeling comfortable along with them.

3.2. Housing

The elephants were housed both indoors and outdoors during the spring. They were housed indoors during the afternoon and the night and if the weather permitted outdoors during the day. Indoors they were kept in two exhibits, one 170m² with sand bedding and one 250m² with concrete floor. The exhibits had concrete walls on three sides and a dry moat with electric wire on the fourth; this side turning towards the visitor area. Outdoors they were housed in either a 3000m² exhibit for public display or a smaller 600m² off-exhibit enclosure secluded from visitors. The elephants were kept together between 07:45-16:00 except from

training when they were alone with the trainers. Saonoi and Bua were held together. Saba respectively Saonoi and Bua were held on sand bedding or concrete with hay every other night.

The daily routine began at approx. 07:30 when the keepers arrived. If the weather permitted the elephants were let outside at approx. 07:45. No matter if they were inside or outside they were fed with concentrated feed (Saba 4.0 kg, Saonoi 4.0 kg and Bua 2.5 kg) and seed hay (5.0 kg each) at approx. 07:45. The elephants were showered and checked after the feeding. They were held indoors or outdoors depending on the weather, but the policy was to keep them outside as much as possible. At least two sessions of training were carried out each day, the training always include so called management training, for example pedicure. At approx. 16:00 they are fed with seed hay (Saba 20.0 kg, Saonoi 15.0 kg and Bua 15.0 kg) indoors after which the keepers left for the day. During the day seed hay was provided ad libitum and during the day and night branches, mainly birch, were provided ad libitum.

3.3. Data collection

The elephants were observed during 10 nights each, 5 baseline nights and 5 treatment nights. The observations were conducted during 26 days (5-25/4 2011). Three observers were used, observing the same elephant throughout the whole study. During the treatment a hay net bag with seed hay (approx. 10.0 kg) was lowered down from the ceiling to within reach of the trunk using a timer (multifunction time relay), CMFR-66 (www.conrad.se, Conrad Elektronik Norden AB, Jungmansgatan 12, 211 19 Malmö). This occurred between approx. 06:00-06:30 each morning.

The days and nights were recorded using video cameras; one Ikegami ICD-47E (Ikegami Electronics GMBH, Ikegami Strasse, DE-414 60 Neuss 1), with an additional IR lamp, Videor Technical MFL-I/LED 60 (MonCam AB, 141 05 Kungens Kurva); and two LG Mercury/2 VR-DN3V10IRH (Svensk Säkerhetsvideo AB, Gruvgatan 35 B, 421 30 Västra Frölunda) with two additional IR lamps, Eneo IR-LED 150-A-50 (MonCam AB, 141 05 Kungens Kurva). 5 hours of each recording (16:30-17:30, 22:00-23:00, 03:00-04:00, 06:00-07:00, 07:00-08:00) were used for observations. The elephants behaviours were recorded using instantaneous sampling with 2.5 minutes intervals. For a description of the recorded behaviours, see Table 1 below.

Table 1. Ethogram of Asian elephant behaviour

Functional term	Descriptive term
Stereotypic behaviour	Repetitive movement, weaving or head bobbing for example, can occur at the same time as other behaviours not included in this ethogram, dust bathing for example
Foraging	Manipulating food or water with the trunk/mouth, feeding/drinking for example, can occur at the same time as other behaviours
Social behaviour	Touching other individual with any body part
Locomotion	Locomotion of at least ½ body length
Standing	Standing up
Lie down	Lying down
Other	Other behaviours not included in this ethogram, dust bathing for example
Not visible	Individual is not visible

3.4. Statistical analysis

The data below refer to mean behaviour frequencies measured between 16:30-17:30, 22:00-

23:00, 03:00-04:00, 06:00-07:00, 07:00-08:00. Frequencies were calculated as a proportion of each actual observation, after which mean values were calculated. Behavioural differences for each individual before and after treatment was examined using the Students t-test. To examine time spent awake on foraging before and after treatment mean values were compared. All data points registered as foraging was divided with the total amount of data points. The total amount of data points were calculated by removing the data points registered as lying down, assuming that the elephants were sleeping when lying down. When one of the elephants was not clearly visible her behaviour was registered as not visible and when she was let outside by the keepers in the morning her behaviour was registered as no data. Excel 2007 was used for all calculations.



Figure 1. Saba feeding from hay net bag.

4. Results

4.1. Saba

During baseline Saba spent approx. 30% each of her time foraging, engaged in stereotypic behaviour and lying down, respectively. When extra feed was supplied the time she engaged in stereotypic behaviour was significantly decreased to 9,5% ($P = 0,003$). Additionally foraging increased significantly to 61% ($P = 0,002$). The time spent on remaining behaviours was rather unchanged and no significant changes were found (Fig. 2).

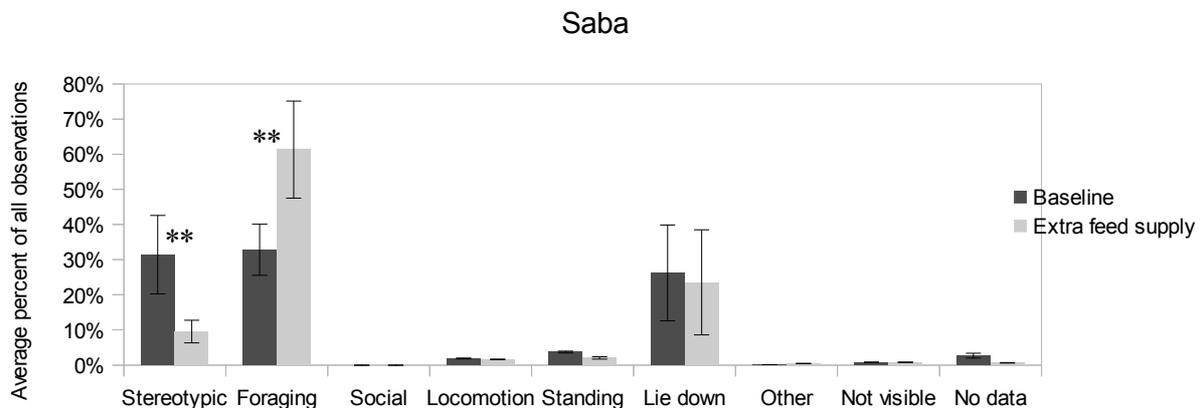


Figure 2. The average percent spent on each behaviour. Means are calculated from 5-hour observations. Bars shows variance. (** = $p \leq 0,01$)

4.2. Saonoi

Saonoi did not engage in any stereotypic behaviour during either baseline or treatment. During baseline she spent most of her time foraging and lying down. During treatment she did increase the time spent on foraging, from 41% to 51%, and decreased the time spent lying down, from 30% to 21%. The time spent on remaining behaviours was rather unchanged. Though there was a significant increase in locomotion, from 1% to 3% ($P = 0,01$), no significant changes were found in any of the other behaviours (Fig. 3).

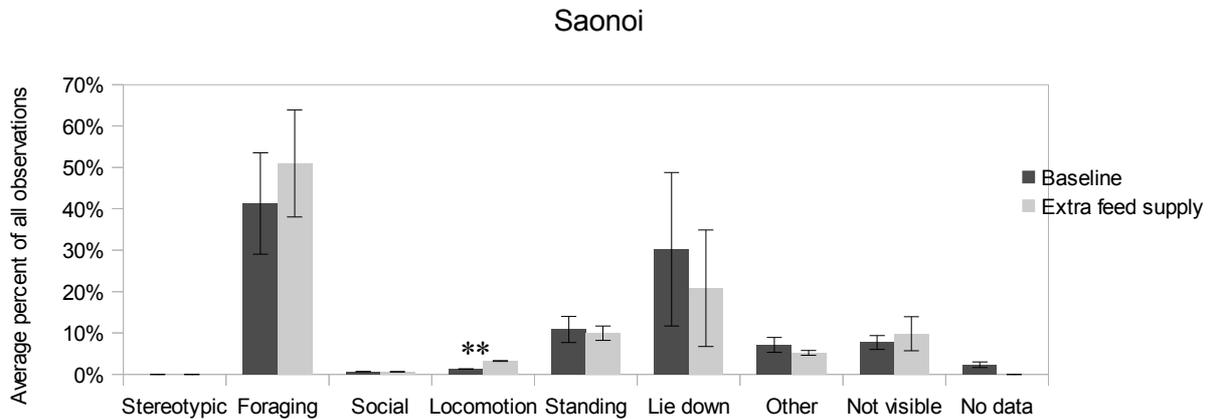


Figure 3. The average percent spent on each behaviour. Means are calculated from 5-hour observations. Bars shows variance. (** = $p \leq 0,01$)

4.3. Bua

During both baseline and treatment Bua spent 9% engaged in stereotypic behaviour. During baseline she spent most of her time foraging and lying down. Foraging was significantly increased during treatment, from 31% to 54% ($P = 0,02$). The time spent lying down was decreased from 32% to 16% during treatment. The time spent on the remaining behaviours was rather unchanged and no other significant changes were found (Fig. 4).

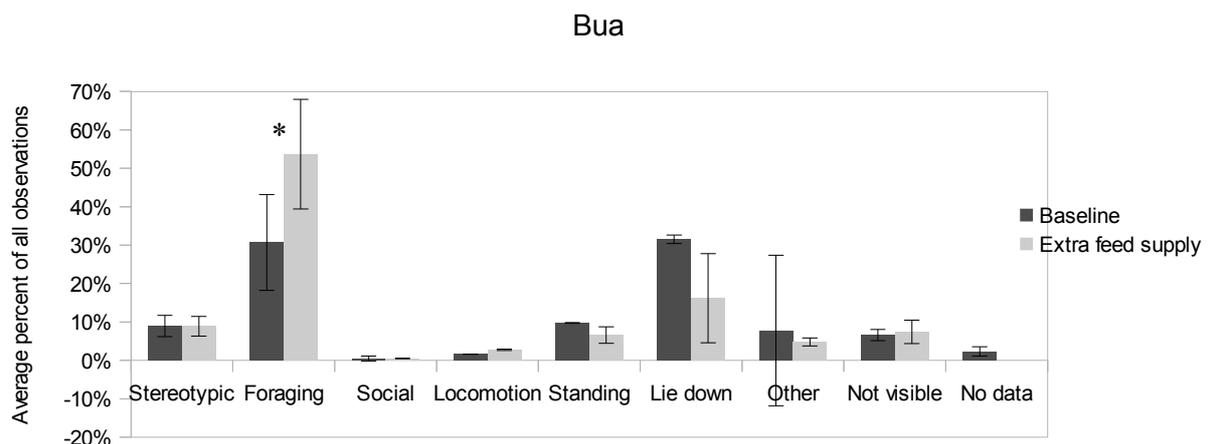


Figure 4. The average percent spent on each behaviour. Means are calculated from 5-hour observations. Bars shows variance. (* = $p \leq 0,05$)

4.4. Time awake spent on foraging

All three elephants increased their time awake spent on foraging (Tab. 2). Saba had the highest increase with 35%. Saonoi increased her foraging time with 6% and Bua with 19%.

Table 2. Percentage of waken time spent on foraging by each individual. Numbers are the fraction of data points registered as foraging of the total amount of data points.

Individual	Foraging	
	Before	After
Saba	45%	80%
Saonoi	59%	65%
Bua	45%	64%

5. Discussion

5.1. Saba

The aim of this study was to investigate if increased access to food might reduce stereotypic behaviour. As hypothesized Saba decreased her stereotypic behaviour when extra feed was supplied. She also increased her foraging which suggests the relationship between feed and stereotypes as Rees (1999) found.

Her stereotypic behaviour was thought to originate from that she was kept alone and chained during the bigger part of her upbringing. Kurt and Garai (2002) showed that socially isolated elephants and chained elephants had a high frequency of stereotypies which applies to Saba. Some of her stereotypic behaviour remained which may be due to her upbringing. Her upbringing left her lacking the social skills needed to communicate with other elephants. This resulted in that she rarely had social interactions with the other elephants at Kolmården and seemed to be unable to perform social behaviours. Her social inability and lack of social interactions could be one of the reasons why she still engaged in stereotypic behaviour to some extent (Kurt & Garai, 2002). One might think that the fact that she is alone during the night limited her opportunities to social interactions even more but due to her social inability she needed time away from the other elephants.

The extra feed supply put Saba in the normal range of time spent on foraging by wild Asian elephants (Clubb & Mason, 2002; McKay, 1973) which is desirable and hopefully her stereotypic behaviour can be reduced even more using more food enrichment.

5.2. Saonoi

Saonoi did not engage in any stereotypic behaviour during the study but she increased her time spent foraging which was a good thing. She was now in the same range of foraging as wild Asian elephants (Clubb & Mason, 2002; McKay, 1973) which was desirable.

One of the reasons that no stereotypic behaviour at all was registered could possibly be that she might be engaged in some stereotypic behaviour at some rare point but that it was not distinguished clearly. If so happened the observer did not recognize this and it was not registered. The overall impression of Saonoi was that she was a balanced elephant that had the patience to wait and could handle being unoccupied.

5.3. Bua

The result of Bua's stereotypic behaviour did not support the hypothesis as her stereotypic behaviour frequency remained unchanged. She did increase her time spent on foraging a great deal which was positive and she was now within the same range as wild Asian elephants

(Clubb & Mason, 2002; McKay, 1973). This result might suggest that Bua engaged in stereotypic behaviour as soon as she was expecting something, as seen by Kurt and Garai (2002). All the feed in the world would probably not affect her stereotypes in the morning because she has learned at what time the keepers arrive knows when it is approaching.

The fact that Saonoi and Bua came from the same work camp where they were trained together suggest that there are individual differences as showed by Rees (2009) in the cause and extent of stereotypic behaviours in captive Asian elephants (Clubb & Mason, 2002; McKay, 1973). Bua was rather thick and her weight could also have influenced her time spent on stereotypic behaviour (Rees, 2004).

5.4. Factors influencing the whole group and other aspects

A couple of other things could have influenced the frequency of stereotypic behaviour, first of all it has been showed that the season of the year can affect the frequency (Rees, 2009). This is probably due to the fact that the elephants were kept inside during most of the days. The management routines were pretty much on a fixed schedule which could also have an effect on the stereotypic frequency (Wilson et al, 2004). However it is recognized that it is practically very difficult to not have a fixed schedule which makes this difficult to alter. A flexible schedule would require different times for the keepers to arrive in the morning and leave in the afternoon and the possibility for foot care for example to be carried out at any time of the day. Also a light in the hay loft was left on one night which seemed to make the animals more restless. This may have had some effect on the behaviour that night and ultimately an effect on the final result.

The data collection method might have affected the result, it would have been better to observe the whole nights instead of picking single hours here and there. This would have given a better overall view of the occupation of the elephants. To use a rather small number of observers and that they observed the same animal throughout the whole study is positive. If the observers judge behaviours differently it would not affect the results as much as if they were all observing all of the animals. The observers got used to her animal which made her consistent in judging the behaviour of her animal.

5.5. Conclusions

Providing extra feed as an additional enrichment to increase the opportunity to forage and decreased stereotypic behaviour in one of three Asian elephant. When extra feed was provided all three elephants increased their time spent awake on foraging to above 60%. The effect of extra feed supply varies among individuals but when stereotypic behavior was decreased it was decreased greatly.

Extra feed supply can be used both to decrease stereotypic behaviour and to increase foraging.

6. References

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Datum
Date

20110531

Språk

Language

- Svenska/Swedish
x Engelska/English

Rapporttyp

Report category

- Licentiatavhandling
x Examensarbete
C-uppsats
D-uppsats
Övrig rapport

ISBN

ISRN

Serietitel och serienummer

ISSN

Title of series, numbering

LITH-IFM-A-EX—11/2499—SE

URL för elektronisk version

Titel

Title:

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Författare

Author:

Kim Björk

Sammanfattning

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