

# The domesticated Thai elephants as a sustainable resource

*A comparative behavioural study on camp and zoo elephants*



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## **CONTENT**

ABSTRACT.....	4
SVENSK SAMMANFATTNING .....	5
INTRODUCTION.....	6
Concept of welfare.....	7
Stereotypic behaviour .....	7
Problems domesticated elephants are facing in Thailand .....	8
Zoo elephants .....	9
Natural behaviour .....	9
Special features.....	11
Traditional working .....	14
AIM OF THE STUDY .....	14
MATERIALS AND METHODS.....	15
Study sites .....	15
Daily schedule .....	16
Animal observation.....	17
Interview .....	19
Data analysis.....	19
RESULTS .....	20
Behavioural observations.....	20
Interviews.....	28
Bull observations.....	29
DISCUSSIONS.....	30
Stereotypic behaviour .....	31
Safety and musth .....	32
Environmental enrichment and nutrition .....	34
Effects of Breeding .....	35
Camp management .....	36
CONCLUSIONS.....	38
ACKNOWLEDGEMENTS.....	38
REFERENCES.....	39
Appendix 1.....	1
Appendix 2.....	2

Appendix 3.....	3
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## **ABSTRACT**

In this study the welfare among domesticated Asian elephants in Thailand (*Maximus indicus*) and Zoo elephants in Sweden and Thailand were investigated. The aim of the study was to see if elephants owned by local people and hired by camp managers showed a higher frequency of stereotypic behaviour than those owned by the camp, if zoo elephant perform a lot of stereotypic behaviours and what could be done to decrease that level, if calves contribute to an increased welfare of their mothers and what could be done to ease the problems connected with musth in bulls. The study was performed at two different camps in Thailand; Thai Elephant Conservation Centre (TECC) and Surin Elephant Study Centre (SESC) and three zoos; Dusit Zoo, Borås Zoo and Kolmården Zoo. In total 39 individuals were studied and their behaviour was recorded each minute in a time interval protocol during four hours. Interviews were also carried out with mahouts and elephant keepers. No significant difference was seen in time-budget when comparing the two camps in Thailand. At Dusit zoo the level of stereotypic behaviour was higher than expected while little stereotypic behaviour was observed at the Swedish zoos. Altered feeding regimes will most probably decrease the level of stereotypic behaviour. Calves contribute to low level of stereotypic behaviour among their mothers and a wider variety of behaviours were seen. More money should be invested in research concerning musth control as musth related problems causes large animal welfare problems.

## SVENSK SAMMANFATTNING

I denna studie undersötes välfärden hos domesticerade asiatiska elefanter (*Maximus indicus*) i Thailand samt hos djurparkselefanter i Sverige och Thailand. Studiens syfte var att ta reda på om elefanter som ägdes av lokalbefolkningen och som hyrdes ut till elefantcenter uppvisade en högre frekvens stereotypisk beteende än dem som ägdes av centren direkt, om zoolefanter uppvisade en hög frekvens stereotypiskt beteende och vad man kan göra för att sänka nivån, om kalvar bidrar till ökad välfärd för sin mamma och vad som kan göras för att minska de mustrelaterade problemen hos tjurar. Studien utfördes på två elefantcenter i Thailand; Thai Elephant Conservation Centre (TECC) och Surin Elephant Study Centre (SESC) samt tre djurparker; Dusit Zoo, Borås Djurpark och Kolmårdens Djurpark. Totalt studerades 39 individer vars beteende registrerades i ett protokoll var minut under fyra timmars tid. Intervjuer hölls med mahouter och elefantskötare. Ingen signifikant skillnad sågs vid jämförelse av de två centren i Thailand. På Dusit Zoo var nivån stereotyp beteende högre än förväntat och lite stereotypt beteende sågs i de svenska djurparkerna. Förändringar i utfodringsrutiner har störst påverkan för att minska stereotyp beteende. Kalvar bidrar till en låg nivå av stereotyp beteende hos sina mammor samt ett mer varierat beteende. Mer pengar bör investeras i forskning kring kontrollen av must eftersom mustrelaterade problem orsakar sämre välfärd hos elefanterna.

## INTRODUCTION

There have been 365 different species of elephants living on earth. Today only three of them remains, the African (*Loxodonta africana*), the Asian (*Elephas maximus*) and the small forest elephant (*Loxodonta cyclotis*) in Africa (Clubb & Mason, 2002). The Thai elephant (*Maximus indicus*), a subspecies of the Asian elephant, has been domesticated for nearly 4 500 years (The National Elephant Institute, 2006). It has played a prominent role in Thai society and was first used for transportation and later on in wars and in the logging industry (Fowler & Mikota, 2006), thanks to its great strength and ability to respond to verbal, physical and visual commands (Hart, 1994). Because of this it also became a religious symbol (The National Elephant Institute, 2006).

There were approximately 100 000 domestic elephants and equally as many wild ones at the beginning of the last century (Masakazu, 2001). Forty years ago, 11 000 elephants remained in Thailand. Today they have declined to around 5 000 and half of them are domesticated (The National Elephant Institute, 2006). They are distributed on 73 camps and villages according to the Tourism Authority of Thailand. The domestic population is declining at a rate of 3% per year (Chatkupt & Sollod, 1999). Wild elephant numbers have decreased rapidly in later years due to poaching and habitat loss (Clubb & Mason, 2002). The elephant's natural habitat is nowadays diminished to small reserves with little connection in-between which creates a limited genetic selection for generations to come. In 1988 the elephant was classified as a threatened wild animal with risk of extinction by IUCN (International Union for the Conservation of Nature) and it is also put on the appendix 1 list over the world's most threatened animals by CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). This strictly prohibits trade in elephants or elephant body parts among member countries (The National Elephant Institute, 2006). Still four African countries are allowed to trade ivory, but only from existing stocks (Fowler & Mikota, 2006). If no actions are taken to protect the wild elephants, scientists predict that there will be no wild Asian Elephants left in the wild 50 years from now (The National Elephant Institute, 2006).

Today trucks and tanks have replaced transport and war elephants and the logging is strictly controlled. In 1989 a national logging ban was adopted in Thailand to protect the forests and prevent flooding due to deforestation. This was a result of a national catastrophe the previous year that claimed many human lives (Chatkupt & Sollod, 1999). It became illegal for the mahouts (English name for people living and working with elephants in Thailand) and their elephants to work in the forests and many mahouts were unemployed and were left without income and with a consuming animal to support. To find a new source of income many mahouts have changed their work towards tourism, with the consequences that the large animals are concentrated to the cities and coastal regions, an environment

less suitable for elephants (The National Elephant Institute, 2006). Previous logging camps have turned into tourist camps and new have been established for business reasons (Kalmapijit, 2007). Other mahouts earn a living by illegal logging (Prasob, 2001). A third common way of supporting the animal is to roam the city streets. The mahouts sell fruit and fodder to people passing by who take pity in the elephant. The food is then given back to the animal (Chatkupt & Sollod, 1999). This can be lucrative and a mahout can earn as much in 4 days as on an ordinary monthly salary. As elephants health and welfare are jeopardised in the city environment and traffic accidents sometimes happen, the government tries to stop this activity. Therefore it often takes place during evenings and nights. There is a law allowing the police to take the elephant into custody, but they lack resources to make it powerful. It is dangerous to handle an unknown elephant as it is large and very demanding to keep.

The Thai elephant is a valuable natural resource that is turning into a problem in Thailand as their natural habitats are shrinking due to human activity. It is important to study the situation of the elephants in Thailand to create a closer description and judgement of the elephant's situation and to be able to bring suggestions forward, how to take good care of the domesticated elephants and make them a lasting resource in the Thai society.

### **Concept of welfare**

Indicators of poor welfare includes mortality, injury or pathological changes post mortem, diseases, physiological changes associated with stress such as increased heart rate, elevated corticosteroid levels and abnormal behaviour such as stereotypies (Clubb & Mason, 2002).

There are two difficulties associated with measuring welfare. One relates to the impossibility to measure directly how an animal feels i.e. one can only make inferences about it based on behavioural and other observations. Therefore conclusions about an animal's welfare must be made with caution. Secondly it is difficult to define precisely what good welfare is. The response to unpleasant feelings is crucial for survival and therefore good welfare can not be total absence of such feelings (Soulsby, 2003).

### **Stereotypic behaviour**

Stereotypies are repetitive behaviours with no obvious goal or function (Ödberg, 1978). They are often used as indicators of poor welfare for three main reasons. 1: Animals that are held in environments we consider to be poor tend to develop more stereotypies than animals in larger, more enriched enclosures. 2: Stereotypies develop more easily in animals that are frustrated or thwarted from performing a behaviour they are highly motivated to perform. 3: Stereotypies are

associated with other indicators of poor welfare such as high cortical levels or injury (Clubb & Mason, 2002). Reduction in stereotypic performance has been reported when providing the animal with better activities or less limitation of mobility (Friend & Parker, 1999). There is evidence that performance of stereotypies may help animals to cope by lowering heart rate, lower cortical levels and release of endogenous opioids (Clubb & Mason, 2002). Stereotypies can be established as habits and may not necessarily improve by changing the environment. They can reflect the past history more than being an accurate reflection of the welfare at the time of observation (Mason, 1991).

### **Problems domesticated elephants are facing in Thailand**

There are several problems associated with domestic elephants in Thailand. Some of them are listed below.

- The animals weigh up to 3-4 tons and consume 10% of their body weight each day in fodder as they only can digest 40% of what they eat. The food needs to be transported to the elephants if the elephants cannot live in their natural environment. Short supply of fodder is a big problem today, as well as the large amount of dung that is produced (Prasob, 2001; The National Elephant Institute, 2006).
- Elephants are very sociable animals and highly dependent on their social group to feel happy and to learn and transfer behaviour between generations. Today individuals are separated breaking family bonds and many calves are leaving their mother early and are held as single individuals, performing for tourists (The National Elephant Institute, 2006).
- A growing conflict between tourism business and the Forest Department develops because most of the tracking and feeding areas are in forest reserve land (Prasob, 2001).
- The elephant is a sacred animal and it is not accepted in the society to euthanize a sick animal. At the same time, their large size makes them resource consuming when they become ill. They can also be dangerous for people that take care of them. This can create a situation where the animal suffers (The National Elephant Institute, 2006).
- Elephants are large and strong and have to learn to fear the ankus, the sharp hook that the mahout uses to control the animal. The elephant learns to obey when they start training around 3 years of age. The struggle for money sometimes leads to abuse of the elephant. A hungry, thirsty or over heated animal gets moody and an angry or scared elephant is hard to control and can easily become dangerous. This is also true for males in musth that can become violent. (The National Elephant Institute, 2006).

- Illegal activity involving elephants can threaten animal welfare. Illegal logging is often hazardous to the elephant as the work take place in haste at night in steep slopes. To boost productivity and overcome the natural nocturnal sleepiness of elephants drugs as amphetamines are often administered to the animals (Chatkupt & Sollod, 1999). Elephants are also being used to smuggle guns, ivory, hides and drugs in rough terrain along the northern borders at night time as they move quietly. Illegal trading with animals over borders also take place and some end up in zoos with false papers. Elephants at the border of Myanmar sometimes step on land mines resulting in large parts of their feet being blasted away (Staff, 2007)

### **Zoo elephants**

Evidence of longevity, reproductive success and health status in captivity suggests that the standard of management of elephants is not as high as it is for many other species kept in zoos (Veasey, 2006). The mean life span when looking at the EEP (European Endangered species Program) stud book, is for European Asian elephants 21 years when first year mortality is excluded whereas elephants in extensive systems are reported to have a mean life span of 30 years. Mortality rate during the first year is 26%. Also data on morbidity, conception rate, stillbirth, infanticide by mother and maternal rejection suggests that the welfare of zoo elephants in Europe could be better (Clubb & Mason, 2002).

Today mainly three different handling systems exist, free-contact (where the handler interact with the elephant by standing next to it), protective-contact (where the handler is protected behind bars) and no contact (where handlers do not interact at all). Free contact is used in 79,7% of European zoos with female Asian elephants and juveniles, 38,2% use no contact and 21,9% use protective contact. One zoo can have more than one type of handling system and adult bulls are held in no contact systems in 51% of the zoos (Clubb & Mason, 2002).

In European zoos the climate is often wetter and colder than what is natural for elephants. The effects on welfare is not known, but the time elephants spend in small indoor enclosures during cold days is of concern as it reduces activity level and contribute to overweight (Clubb & Mason, 2002). Elephants in zoos often get a poor balanced diet with less variation than in the wild. They consume it in a short time. This creates obesity in 86.8% of the European zoo populations and deficiency in zinc, iron and vitamin E are sometimes seen (Clubb & Mason, 2002).

### **Natural behaviour**

Fowler and Mikota (2006) state that the most important aspect of a husbandry program is to understand the species needs from a physiological, social and psychological point of view. Healthy, wild elephants will swing their trunk and

wag their ears and tend to search for food at all times and move over large home range areas. Those are from 40-800 km<sup>2</sup> for Asian elephants depending on the productivity (Clubb & Mason, 2002) often associated with precipitation as well as presence of mates, predators and level of human activity (Fowler & Mikota, 2006). No good data of daily movement exists and distances anywhere between 3.2 and 50 km has been reported (Fowler & Mikota, 2006). A recent study from the world heritage Huai Kha Khaeng Wildlife Sanctuary in Kanchanaburi, northwestern Thailand, shows that elephants moved 5.9 km a day and consumed at least 260 different species belonging to 193 genera in 94 families (Sookmasuang, 2007).

Asian elephants normally live in family herds consisting of 4-8 related female elephants and their offspring (Clubb & Mason, 2002; The National Elephant Institute, 2006). Sometimes a few family herds join together in clans (The National Elephant Institute, 2006). A female elephant often stays in the same herd where she is born and strong bonds are established between mother and daughter. Information based on previous experiences is passed down to the next generation and accumulated in the herd (Fowler & Mikota, 2006). The matriarch is typically an old female with a lot of life experience, who has knowledge where to find food and water resources that are important to the survival of the herd (National Elephant Institute). Leadership and experience play such a crucial role that the female lifespan extends past the age of reproduction. This is very unusual in animals except in humans. If the matriarch is injured, other adults try to raise her to her feet and walk one on each side to support her. This shows a remarkable development of altruism among individuals of this species (Douglas-Hamilton et al, 2006). If the matriarch becomes too old she often leaves the herd and the second oldest takes over leadership. When a group extends over 10 individuals it tends to split, but the two families associate closely and the greeting ceremony is intense even after a short separation (Estes, 1991).

Males leave the maternal herd when they become sexually mature, anywhere from the age of 12-20 years. Adult males live as solitary animals or in loose herds with other bachelors. During musth periods (a physiological status where testosterone levels peak) they leave the group and tend to move over much larger areas in search for females to mate. Old bulls are the most stationary of all elephants. They stay near swamps where they find soft vegetation they can still chow with their worn out teeth (Estes, 1991).

An optimal habitat consists of booth grass and browse. According to seasonal variation, elephants select the most nutrient and palatable of the plants available and have a more catholic diet than other herbivores (Estes, 1991). Thanks to the trunk they can feed from ground up to 6 m high. They pick up nuts, bark trees, strip off leaves, select herbs and take down bamboo sprouts. The fibrous dung shows that digestion is very incomplete. Only 44% is assimilated, compared with

ruminant's 66%, but elephants, which are hindgut-fermenters, process much coarser forage at a rapid rate of 12 hours (Estes, 1991). This produces around 68 kg of manure each day from a single adult (Fowler & Mikota, 2006).

Elephants have a larger impact on the environment than any other mammal but humans. The beneficial effects include among others creating trails, bringing food within reach of smaller browsers, spreading seeds with the dung over large distances and digging up water holes with their tusks (Estes, 1991). Water can gather in the footprints from the animals providing drinking water for smaller animals on the ground (Estes, 1991). Over population can also cause large damage to the environment by destruction of trees, a problem more often seen in Africa (O'Connell-Rodwell, 2000). On the other hand can tree destruction contribute to biodiversity and soil turnover when spread over a large area (Estes, 1991).

Elephants feed 16-18 hours a day and sleep 3-4 hours, sometimes lying down a couple of hours at night (The National Elephant Institute, 2006). In the wild elephants do not have access to water at all times (Fowler & Mikota, 2006) and they can walk several days without drinking, but drink and bathe daily if they have the opportunity (Estes, 1991). They can drink 100 litres at a time and often submerge completely when bathing (The National Elephant Institute, 2006).

## **Special features**

Communication is important among these sociable animals. They have a variety of ways to express themselves by glandular secretion, keen sense of smell, expressive ears, varied vocalisations, infrasound and a highly mobile trunk (Estes, 1991). Tactile communication is important and used when greeting, slapping, caressing, twining and checking reproduction status, but is also seen when family members just stand close to each other resting (Estes, 1991). The elephant can perform four different sounds, but by variation in pitch, duration and volume it can express a wide range of emotional states. Rumbling is used when communicating over large distances (Estes, 1991) and it can have a broad range of frequencies and reach as low as 14 Hz and as loud as 103 db. Infrasound can reach over 5 km (The National Elephant Institute, 2006). This is important to enable elephants to meet for sexual or social interaction. Growling is audible to human ears and is used when the herd is feeding. It is used to warn the rest or to localize them again when spread out. Elephants can probably recognize individuals by this sound. Trumpeting is used during excitement and is produced by blowing through the nostrils. It can be used as an alarm or cry for help or in greeting ceremonies. Screaming is used by calves to retrieve immediate attention from its mother or by adults to intimidate opponents (Estes, 1991). In Africa research implicates that elephants can arrive to areas where it has recently rained.

by identifying seismic waves produced by lightning strikes (O'Conner-Rodwell, 2006b).

The female is pregnant for 22 months and a cow that givea birth for the first time often relies on other females to support her (Schneck, 1997). The calf remains feeble for several days and shaky for weeks. The trunk becomes useful gradually and it will suckle for up to three years when the next calf often is born (Estes, 1991). The bond between mother and offspring is very close and can endure for 50 years (Estes, 1991). The mother supports her calf by washing it with water, putting it under her stomach for shade and lifting it over fallen trees (Estes, 1991). The cow can regurgitate water from her stomach and spray it over her calf during hot days (Estes, 1991).

An elephant has sex sets of molar teeth (The National Elephant Institute, 2006). When they are worn out a new set replace the old one from the back. When all sets are used, usually at the age of 70, the elephant will die from starvation when it no longer can support itself and chew vegetation. Tusks, the incisors, are used as weapons to defend the elephant from other animals or maintain mating rights among bulls and to dig for water and take down trees (Estes, 1991). The trunk contains over 40 000 muscle groups that give the trunk booth strength, pliable and fine motor ability (The National Elephant Institute, 2006). It is used as a multiple tool to smell, breathe, suck up water to drink or spray water or dust to cool down, as a snorkel when bathing, lifting items up to 100 kg, carry things, holding tail and as a hand to pick up small objects. The trunk is also a powerful tool for killing (The National Elephant Institute, 2006). The skin is thick, 1.3-2.5 cm, and constitute almost 10% of the body weight. It is folded and heals slowly. It can take up to a year to heal if the cut is deep. The large ears fill two purposes as radiators to cool down the body temperature during hot days and as detectors of and amplify sound (The National Elephant Institute, 2006). The tail can be moved in all directions to scratch, spread vulva odour or whisk away insects. Deep groves in the sole gives an excellent grip even in muddy slopes and the fat pad can make the elephant walk almost without a sound.

Elephants have the largest brain with the largest volume of cerebral cortex of all terrestrial animals. They also have the largest volume of non sensory motor cortex which is involved in higher-order brain functions. When calculating EQ (encephalization quotient as a ratio of brain volume to body mass) humans have 7.5, chimpanzees 2.5 and Asian elephants 2.3 (Hart & Hart, 2007). Compared to humans and chimpanzees, elephants show less ability to cognitive thinking, tool use, mirror-based self-recognition, learning and insight-behaviour (Hart & Hart, 2007). The temporal lobe in proboscideans is larger than that of humans (Hart & Hart, 2007). It is more convoluted and denser (Haug, 1987). In humans, function related to the temporal lobe include recognition, storing and retrieving of information related to sight, touch, smell and hearing, which are functions related

to short- and long-term memory (Hart & Hart, 2007). Elephants are believed to have long-term memory that exceeds that of great apes and probably also humans important for acquiring food and water resources (Hart & Hart, 2007). A study from Tarangire National park in Tanzania point out the fitness value of long-term memory in old matriarchs. Herds with an old matriarch had a higher survival rate compared to others where matriarchs were younger due to poaching under periods of severe drought, as the old cows possessed higher ecological knowledge from previous experiences. They choose to leave the park and walk old paths where resources could be found (Foley, 2006; Douglas-Hamilton et al, 2006). The memory also contributes to identify family members by chemosensory communication decades after last encounter which is an important feature in avoiding inbreeding (Hart & Hart, 2007).

The elephant's intelligence makes it challenging to handle them both in camps, zoos and in the wild as they are considered to be well-equipped when it comes to solving problems. African elephants can check if the locks are properly closed to the enclosure, or else they will try to get out (Tommy, pers. com., 2006). They are known to push trees over electric fences to get trough whereas cattle tend to stay inside, but pushing down trees is natural to elephants and not to cattle (Fowler & Mikota, 2006). Wild African elephants destroy watch towers built to look for elephants and worn the village when a heard is approaching to raid crops (Fowler & Mikota, 2006). There have been reports of elephants sneaking into villages and lifting out sleeping humans and killing them during night (Fowler & Mikota, 2006).

Musth is a condition in bulls where their testosterone level increases considerably. This is likely to happen once a year between December and February in Thailand and last for around 2 weeks. The temporal glands on each side of the head, situated between the eye and the corner of the mouth, start to swell to the size of an egg. Sticky oil is released after approximately one week. The elephant will change its behaviour, become aggressive and tries to find a female to reproduce with. This means it will be difficult and dangerous even for its mahout to handle (The National Elephant Institute, 2006). The aggression is often directed towards its mahout, who normally limits the elephant's freedom. The bull tries to tear himself loose from the restricting chains and run off. A normal procedure among mahouts, when signs of musth are seen, is to take the elephant out in the jungle and tether it tightly (3-4 legs with a thicker chain) near a water source. The elephant is fed low calorie and high fibre food in small amount until the condition is over (Fang, 2006). To starve the elephant is an effective way to shorten the musth period. In very healthy elephants musth can occur 2-3 times a year and last for 45-60 day each time. The musth period can remain for several months up to half a year in zoo bulls due to their good nutritional state. This also applies for the royal white elephants that does not work and get a lot of food of high quality

which leave them in a very good nutritional state (The National Elephant Institute, 2006).

### **Traditional working**

Two ethnic groups in Thailand, Karen in the north and Suay or Kui in the east, are known historically for their skill in capture and training of wild elephants. The elephants work in a close relationship with their mahout (Chatkupt & Sollod, 1999). Karen tribe performed logging for the East Indian Company and extracted teak for ship construction in early colonial days. Kui or Suoy people are a small ethnic group that for centuries have been specialized in the art of capturing wild elephants for use in wars (Fuller, 2008a). The last wild capture in Thailand took place in Surin 1963 (Lair., 2005). In Myanmar for example wild elephants are still being captured (Staff, 2007).

### **AIM OF THE STUDY**

The aim of this study was to evaluate the welfare and general health of elephants in a dynamic environment that followed the national logging ban in Thailand and compare it to the situation in zoos.

The following questions were asked for this study:

- 1) Do elephants owned by local people and hired by camp managers show a higher frequency of stereotypic I predict that managers that own their own elephants are willing to invest more in them in terms of providing good conditions as the elephants will stay for a longer time and a healthy elephant will bring in more money.
- 2) Do zoo elephants perform a lot of stereotypic behaviour and what improvements could be done to decrease the level in that case? Zoo elephants are generally kept in a relatively small area and get little exercise. I assume that this affect their welfare in a negative way.
- 3) Do calves contribute to an increased welfare of the mother or does it create more stress to protect and care for an offspring in an already stressful environment? Reproduction is a deep instinct and motherhood brings natural behaviour forward. I predict that mothers are more satisfied when raising and nursing a calf.
- 4) What can be done to ease the problems connected with musth in bulls?

## MATERIALS AND METHODS

The survey consists of an ethological study and an interview part.

### Study sites

Recordings took place at five different locations, two elephant camps in Thailand and three zoos, two in Sweden and one in Thailand. The camp sites consisted of the Thai Elephant Conservation Centre (TECC) outside Lampang in northern Thailand ( $18^{\circ} 21' 56.0''$  N;  $94^{\circ} 14' 11.6''$  E) and Surin Elephant Study Centre (SESC) in the village Ban Tha Klang in the northeast of Thailand.

TECC was established from the previous Elephant Training School and was moved to its present location in 1991. It is also known under the name “The National Elephant Institute” (Tipprasert, 2007). In 2001 the centre had about 90 elephants and 110 employed mahouts. It was well organized and all elephants were owned by FIO (the Forest Industry Organisation) (Prasob, 2001). The conditions was pretty much the same at the time of my visit. The centre was a governmental initiative to perform quality mahout and elephant education and preserve Thai traditions. It was under the patronage of Her Royal Highness Princess Galayani Vadhana (Tipprasert, 2007). The centre provided a wide variety of activities for tourists like tracking, home stay, mahout training school providing personal involvement in traditional mahout culture, exhibition, elephant painting art school, elephant music school and a show that focused on traditional work like logging skills. The centre also educated elephants and mahouts in traditional work. An elephant hospital was situated close to the centre where five veterinarians worked. They assisted in managing the elephant’s physical care, performed research and supervised reproduction and contributed to elephant conservation work. The centre took part in a breeding program and at the time of my visit the centre contained two calves 3 and 7 months old, one was a result of artificial insemination. The veterinarians also took care of a rescue centre, Pang-La, for abandoned and sick or old elephants. Retired elephants would come to this place to be taken care of without performing any work. Some mahouts composed a rescue team responsible for capturing and managing aggressive elephants and save them from unnecessary killing (Tipprasert, 2007).

Several solutions were found to make use of the dung. At TECC more than a ton dung was recycled daily (Fang, 2006). It was fermented to produce methane gas used for cooking and lights indoors and outdoors. The byproduct was used as fertilizer and some of the fibers were used in paper-production. From the paper, books or albums were made and sold to tourists and some was used as canvas for elephant to paint on. The nature was typical for this region, low mountains covered with dense forests. The climate was humid and the temperature was ranging from  $15\text{--}25^{\circ}\text{C}$  with a mean of  $20.2^{\circ}\text{C}$  during my observations.

SESC opened two years ago, but lack of financing has delayed the work. Local people owned one to a few elephants per family which they keep at home and trained. They came to the centre every day to work with different tourist attractions and some lived at the centre. At the time of my visit there were 115 elephants in the village Ban Tha Klang (Prakit Klangpattana, 2007). The work consisted of home stay program, taxi, show that focus on circus skills as standing on for or hind limbs, playing soccer, smashing balloons with darts, playing basket ball, painting, giving massage on the back of tourists for example. Mahouts that performed in the show got extra tip. They were also participating in annual ceremonies and festivals. A big annual festival, Surin Elephant Roundup, was held at Surin National Arena in November where 200 elephants gather to perform in a big show and work as taxi during the two day festival. The mahouts gathered weeks before at Ban Tha Klang for rehearsal before the event (Fang, 2006). Many elephants were taken to the centre each day, just standing for tourists to see without performing any work. The environment was agricultural flat land which seasonally becomes dry. The forests were less dense and extended than in Lampang area and the temperature was higher and stretched from 16-32° C with a mean of 28.0° C during my visit that was during the cold season. Previously to attract tourists to this region the riding fees were reduced and sometimes elephants had to work longer hours a day and this condition had forced some mahouts to leave the camp and search for a better income in the big cities (Prasob, 2001).

Additional study sites consisted of three different zoos. Two female Asian elephants at Kolmården Zoo and four African elephants (two cows and two female calves states the relationship) at Borås Zoo were studied to evaluate the observation protocol. These elephants were compared to four Asian elephants at Dusit Zoo in Bangkok. At Kolmården they were 2.5 keepers taking care of 2 elephants and at Borås Zoo they were 4 keepers on five elephants, including the bull, and they always work in pairs when handling the animals.

### **Daily schedule**

At TECC mahouts commonly retrieved their elephants from the forest at 6:30 am if they were to take part in the home stay program where tourists spend the whole day with one elephant, or a bit later if they worked as taxi. On the way back to the camp they commonly stopped for a bath and the elephant had breakfast when tethered at the camp from 7 - 9 am. Some show elephants that participated in the home stay program where tourists learned how to ride on the neck and command an elephant to perform different tasks like lying down, letting people on and off, picking up tools from the ground and move in the desired direction, started to work at 8:30 am. They worked for half an hour when it was time for the morning show. The show began with a joint bath of approximately 20 elephants participating in the show with tourists or mahouts riding them. The elephants were taken to the mahout's home to have lunch when the morning show was finished at

10:30 am. The afternoon show started at 2:30 pm and when it was finished around 4 pm the elephants were taken care of and taken back to the forest at 5 pm where they were tethered on a 30 m long chain and left to browse over night. Taxi elephants were prepared and waited all day with a chair on their back for the tourists to come and ride. Most tourists went for a ride after the shows had finished. The mahout stayed close to their elephant and provided food and looked after it all day.

At SESC most elephants arrived at the centre at 9 am. Shows were performed at 10 am and 2 pm and took approximately one hour. The elephants participating usually got a shower before the performance. At around 4-4:30 pm the mahouts returned to the forest or back yard with their elephants, but some stayed at the centre during the night and were provided with food by their mahout.

All zoo elephants got four meals a day, but at Borås and Kolmården zoo they got food to search for in between. At Borås zoo they had an enrichment schedule running for two weeks where they fed the elephants carrots spread out along a wall to search for, or fruit frozen in blocks of ice that were hanging down from the roof etc to stimulate manipulation. Every morning the elephants got a shower and a daily check. During visitor hours all zoo elephants had to be available for viewing. During winter time the Swedish zoo elephants were mainly kept indoors and only let out for shorter periods if the weather allowed. The females at Dusit Zoo were taken for a walk around the zoo every morning. The male never left his enclosure. At Borås Zoo the elephants were exercised outside the enclosure 3-4 times a month. At Kolmården the elephants were sometimes tethered in a 30 m chain in the forest during summer nights.

### **Animal observation**

All collecting of data in Thailand was carried out between the 10th of October to the 10th of December 2007. The elephants at the Swedish zoos were observed from the 19-21 of June 2007. In the camps only female elephants from 10-50 years were included to make more homogeneous groups to compare. Elephants that met the observation criteria of being accessible for two hours undisturbed viewing at two different times were included. Attempts to match the two groups as equal as possible according to age and occupation were made. The individuals were not known by the observer before the study and were chosen with the help of the Thai students. No individual was included or excluded according to special behavioural patterns as little was known about the individuals at the time of observation. In the zoos all accessible elephants were included, except for the bull at Borås zoo as the original focus was on females. At TECC all elephants were working, but at the hospital some elephants had been treated for a long time and considered recovered by the veterinarians. Those were compared with the group of standing elephants at SESC.

*Table 1: Number of elephants distributed on different locations and occupations*

Location	Elephant distribution					Total
	TECC	SESC	Dusit Zoo	Borås Zoo	Kolmården Zoo	
Individuals	16	13	4	4	2	39
Age span	11-45	10-50	26-53	2-30	10-11	
Taxi	5	3				8
Standing		5				5
Show	4	4				8
Sick	5					5
Mother	2	1				3
Zoo			4	4	2	10
Forest(show)	4 (extra)					4

The elephants were studied according to the time they spent on different activities such as working, eating, resting, social interaction with other elephants and performing of stereotypic behaviour. Each elephant was observed for two hours at two different times. Their behaviour was recorded in a time interval protocol each minute (see appendix 2). In total 39 different individuals were studied at five different locations (tab 1). The mean age of elephants working in the show was 16.6 years. The mean age for elephants working as taxi was 42.3 years. Data from a total of 159 observation hours were collected. The uneven number of hours refer to seven extra observation hours made on four individuals already included in the study. They performed a lot of stereotypic behaviour and the idea was to see if there was any difference when they were tethered in the forest on a 30 m long chain to browse over night. One elephant disappeared in the dense vegetation and became impossible to observe after one hour. It was considered too dangerous to move closer as the elephant was tethered on a long chain, which explains why it is only seven observation hours. Two elephants were only observed for two hours at one time as they had moved from the centre before the next observation was carried out. To be able to study the show elephants at TECC, the observation had to be divided into one hour interval at four different times as the elephants were either engaging in the show or handled by their mahout and the daily routines did not allow two hours undisturbed continuous observation. No single standardized ethogram exists for elephants (Fowler & Mikota, 2006) and the one used in this study was developed from reading previous studies on wild and captive elephants (see appendix 2 and 3).

Body condition, sanitation and grooming level, interaction possibility, attitude, response to owner, access to water, food and shade was only recorded once in the beginning of each observation session (see appendix 1).

## **Interview**

One mahout for each camp elephant ( $n=29$ ) and one elephant keeper at each zoo ( $n=3$ ) was interviewed and asked to give their point of view on the strengths and problems of elephants in captivity and how they look upon the future and their ability to support themselves and their elephant. They were also asked about management and time and care invested in the elephant each day, type of work they did, and how they train their animals. The questionnaire was composed of 72 open ended questions divided into 7 categories; experience as a mahout, the elephant history and training, work, health record and feeding regimes, welfare, breeding and view on the future.

The interviews in Thailand were carried out with the help of three Thai veterinary students taking their 5th year at Chulalongkorn University. Interviews were performed after observation of the elephant so that information would not influence the observers' objectiveness.

## **Data analysis**

Data from observation protocols were processed in Excel sheets and later in SAS (Statistical Analysis System Inc. Cary, USA, version 9.1). Mean number of recordings for different grouped behaviours at different locations (TECC, SESC, Dusit, Kolmården and Borås) or for different occupations (taxi, show, standing, mother, zoo and sick) were calculated. Wilcoxon signed rank test was used as it was a suitable choice for a small random sample where no normal distribution is seen (Ejlertsson, 1992). Data for grouped behaviours (stereotypies, abnormal, social, eating, resting, comfort, and other behaviour) for two different locations (TECC, SESC) were compared with each other. Significant differences was stipulated to 5%-level ( $p<0.05$ ) and tendency of significance was put to 10%-level ( $p<0.1$ ). All data was put in one file with column titels and different calculations were run according to questions asked. In complex calculations where many factors were compared mean value was calculated instead.

As little discrepancy was seen between the two camps (see results) the results from both camps were put together to compare time budgets for different occupations. When different locations were compared the sick and forest elephants were excluded as they were considered too extreme and might affect the result in a negative way.

## RESULTS

### Behavioural observations

When looking at different groups of elephants the time spent on varying activities differed (Fig. 1). Older elephants that worked as taxi spent most time resting (32.6%). Standing and sick elephants spent more time performing stereotypies than other groups (25.6 and 19.6% respectively). Zoo elephants spent least time and forest elephant spent most time eating (36.2 and 72.2%). They were also the two groups that walked the most (13.1 and 14.8%). Young show elephants showed a lot of comfort behaviour (10%). Mothers showed a wider range of behaviours and therefore had a high level of “abnormal” behaviour compared to other elephants (11.3%). They also had higher level of “other behaviour“ together with young show elephants (7.5 and 10%). Examples on such behaviours were helping the calf to suckle and tap the trunk against the ground to raise awareness among other elephants that the calf needed protection from the herd if a threat would occur. Show elephants often pulled the chain in attempts to get loose. Mothers and sick elephants were more sociable than other groups (6.7 and 4.7%).

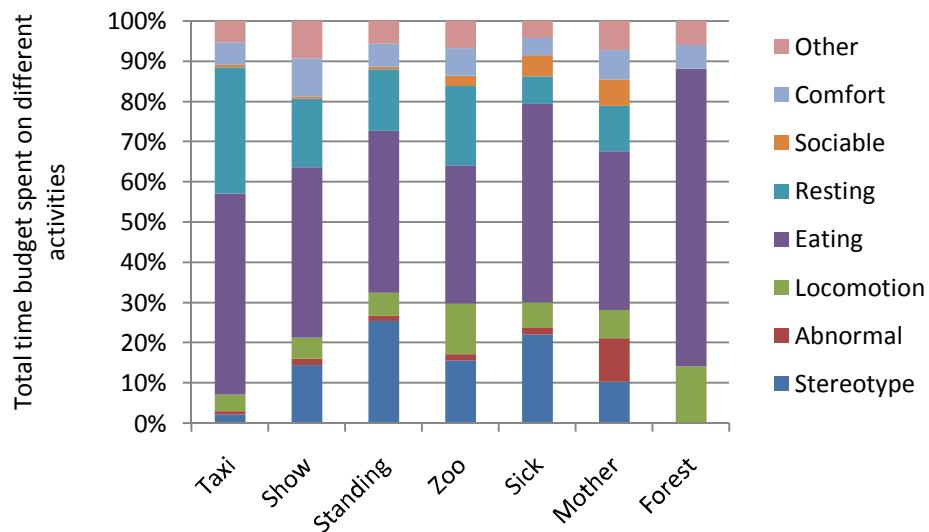
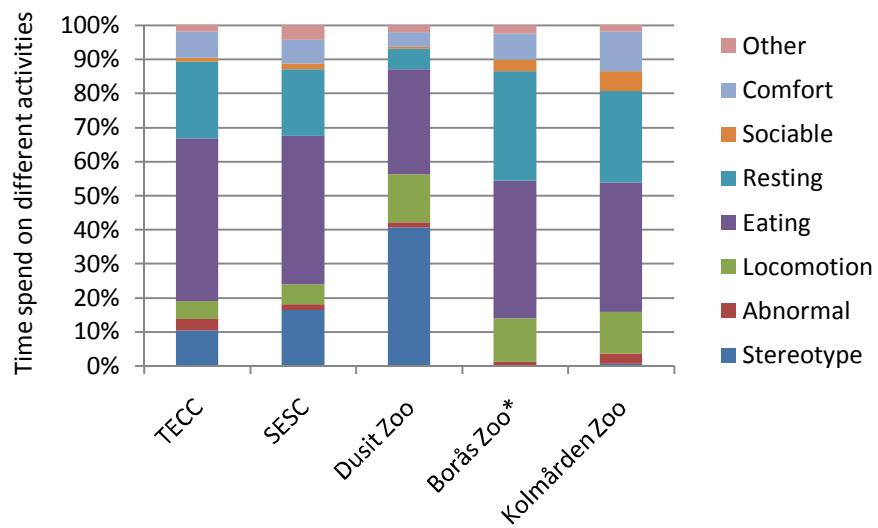


Fig. 1: Total time budgets for different occupations.

When looking at elephant groups at different locations (Fig. 2.) the elephants at TECC and SESC behaved very similar whereas the elephants at the zoos differed a lot. At Dusit zoo the elephants spent a lot of time performing stereotypes (40.5%), which was hardly seen at Kolmården and Borås zoo, where elephants spent much more time resting (27.1 and 32.2%) compared to Dusit zoo (6%). Elephants at Kolmården zoo showed the highest amount of social behaviour (5.8%) and Dusit zoo the lowest ( 0.4%), despite that both groups could interact as much as they felt like as they were not limited by restraints.



\*African elephants

Fig. 2: Total time budgets for different locations.

When comparing the elephants at the camps there were no significant difference between the two locations (fig 3). However there was a tendency of increased proportion of time spent on other behaviour for the elephants at SESC ( $p=0.033$ ). When looking at different behaviours, elephants spent most time eating, from 40-50% of the observed time. The second most performed behaviour was resting and on third place came stereotypes.

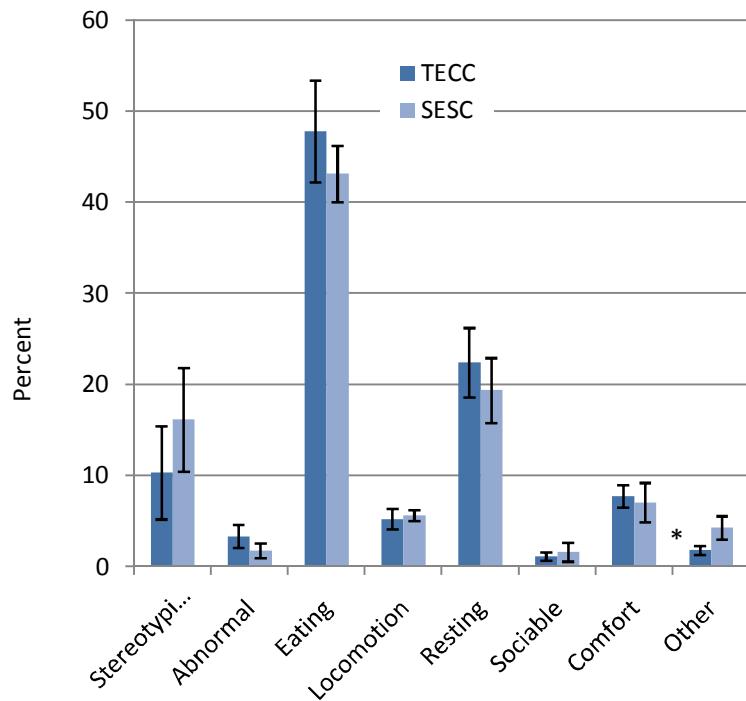


Fig. 3: Mean ( $\pm$  SE) % of observations spent on different behaviours for elephants at TECC and SESC (samples of one minute intervals).

When looking at stereotypic behaviour alone elephants at the zoos differed most and there was a obvious difference between the Swedish and the Thai zoos (fig 4). At Borås zoo it was not recorded at all during the observation. There was a wide difference in time spent on stereotypies between individuals involved in different occupations. Only Taxi (2.4%) and forest elephants (0%) stood out by performing stereotypies to a lesser extent (fig 5). It was most commonly seen in standing (25.6%) and sick (19.6%) elephants (fig 5). Even mothers did perform stereotypies (10.5%), but to a lower level than the average of 14.8% (N=39). An interesting observation was that show elephants often performed stereotypies with quick movements. 15 individuals did not perform any stereotypies during the observation and individuals from all occupations were represented among them. 61.5% of the individuals observed (N=39) performed stereotypies at some stage and the mean value was 5.8% of the time.

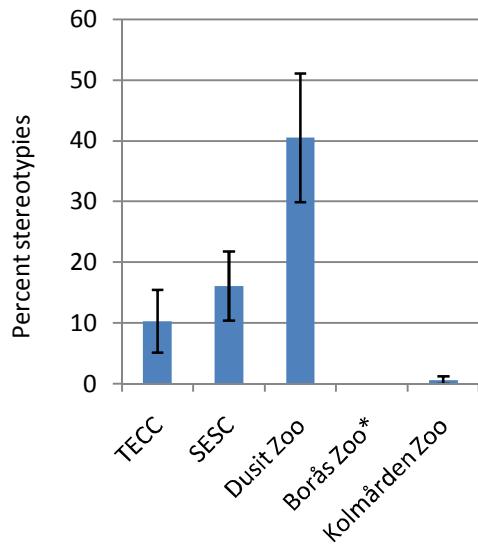


Fig. 4: Mean ( $\pm$  SE) % of observations spent on stereotypic behaviour for elephants at different locations.

\*African elephants

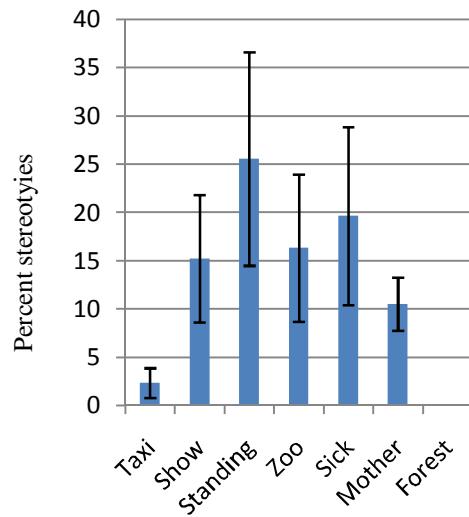


Fig. 5: Mean ( $\pm$  SE) % of observations spent on stereotypic behaviour for elephants with different occupation.

The proportion of abnormal behavior was higher at TECC, were the study of two mothers raised the level, and at Kolmården where tail intertwining were observed. There was not much difference in the frequency of performing abnormal behaviours between elephants with different occupation except for mothers where it was eight times more common than in the rest, whereas forest elephants lacked that type of behaviour (fig 7). Example of such common behaviours were begging for food, threatening and making other sounds than trumpeting. The mothers act of vocalizing express their concern on the safety of the calves and was not abnormal in the role of being a mother.

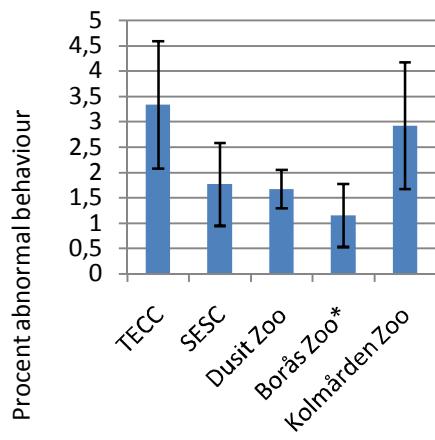


Fig. 6: Mean ( $\pm$ SE) % of observations spent on locomotion for elephants at different locations.

\* African elephants

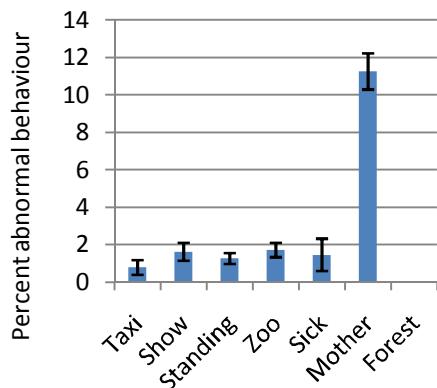


Fig. 7: Mean ( $\pm$ SE) % of observations spent on abnormal behaviour for different occupations.

Locomotion was performed equal much among zoo elephants and to a greater extent than for camp elephants (fig 8). When looking at locomotion behaviour for different occupations, forest and zoo elephant moved significantly more than the other groups as they had the full possibility to do so (fig 9).

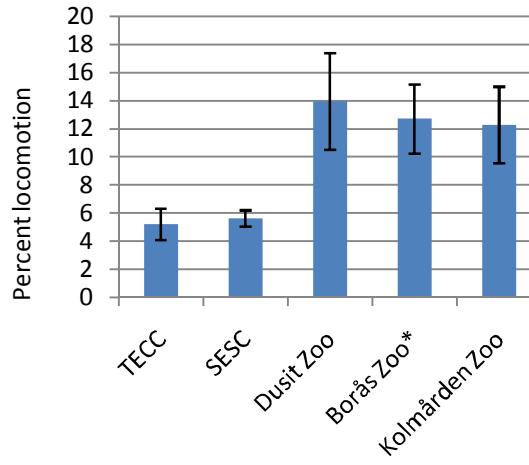


Fig. 8: Mean ( $\pm$  SE) % of observations spent on locomotion for elephants at different locations.

\* African elephants

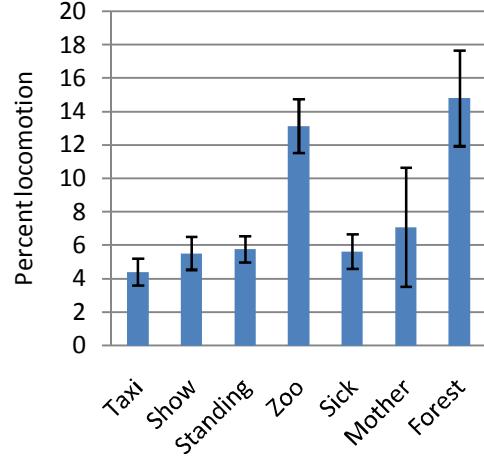


Fig. 9: Mean ( $\pm$  SE) % of observations spent on locomotion for elephants with different occupations.

The movement ability for elephants differed between the locations. At TECC four elephants tethered on one foot, were additionally observed in the forest tethered on a 30 m long chain on one foot. If they are included the percentage of elephants observed with chain on one foot is 79% if they are recorded only when observed at the centre the group is 63% (tab 2).

*Table 2: Type of restraining method between different locations (%)*

	Distribution of tethering method				
	TECC	SESC	Dusit Zoo	Borås Zoo*	Kolmården Zoo
No chain	12	0	100	100	100
One foot	63 (79)	85	0	0	0
Two feet	9	15	0	0	0
30 m long chain	16	0	0	0	0

\*African elephants

The elephants at Dusit Zoo spent only 30.9% of their time eating whereas elephants at TECC spent on average 47.8% of their time eating (fig 10). Forest elephants had unlimited access to food and spent approximately 77.2% of their time eating (fig 11).

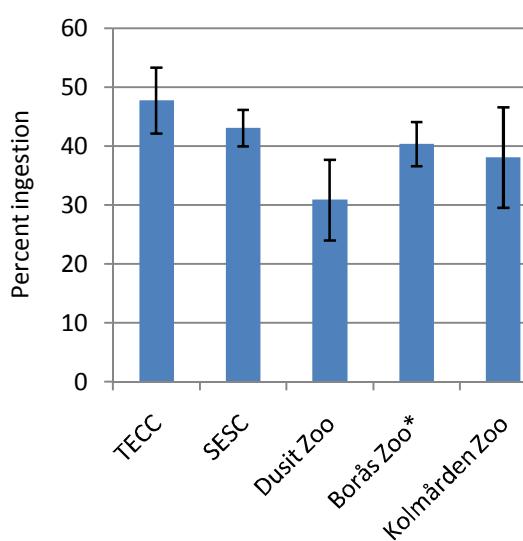


Fig. 10: Mean ( $\pm$  SE) % of observations spent on ingestion for elephants at different locations.

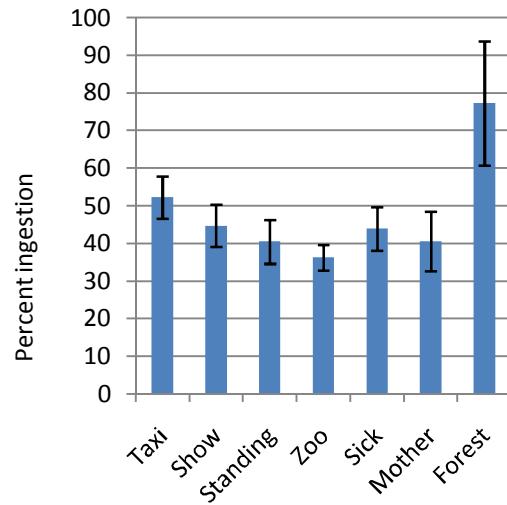


Fig. 11: Mean ( $\pm$  SE) % of observations spent on ingestion for elephants with different occupations.

Elephants at Swedish zoos were more inactive than the elephants in Thailand (fig 10). At Dusit zoo the elephant rested on average 14.5% and at Kolmården and Borås zoo 65% and 77.3% on average (fig 12). Older taxi elephants spent more time resting than the other groups and sick elephants did it to a much lesser extent. Mothers rested less time than most other groups and the once in the forest did not rest at all during the observation (fig 13).

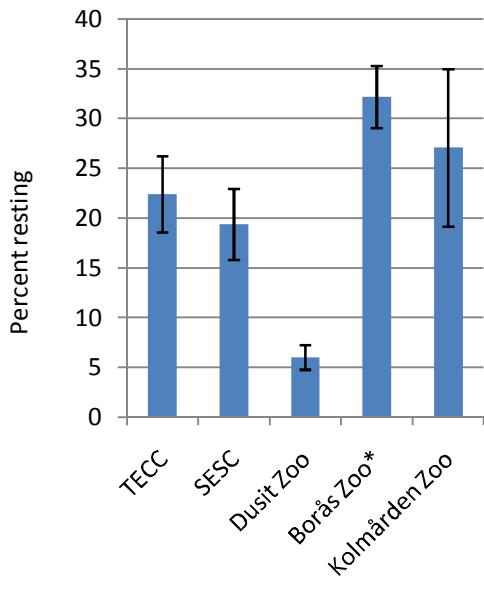


Fig. 12: Mean ( $\pm$  SE) % of observations spent on resting behaviour for elephants at different locations.

\*African elephants

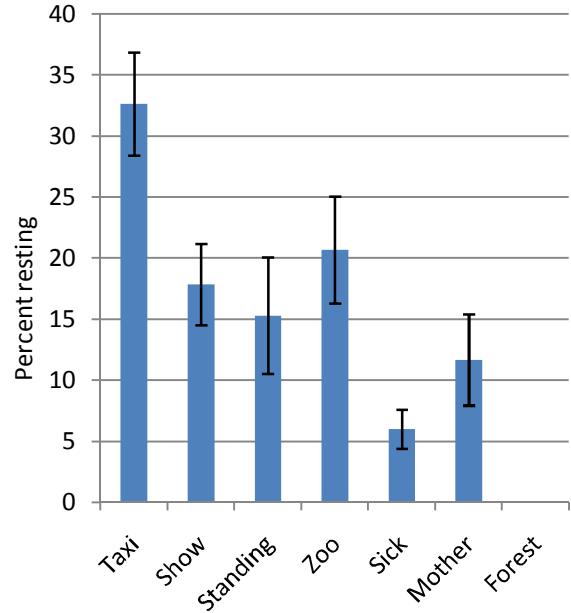


Fig. 13: Mean ( $\pm$  SE) % of observations spent on resting for elephants with different occupations.

Elephants at Kolmården Zoo were more sociable than the rest of the elephants and the elephants at Dusit zoo were less sociale (fig. 14). Both groups had the possibility to interact as much as they wished. Mothers generally performed more social behaviour than other elephants (fig 15), but the frequency differed greatly between them. When looking at the age of the calf one can see a connection. The mother with a calf of two weeks spent 13.7% on social behaviour, the mother with an offspring of three months spent 4.6% and the mother with a calf of 7 months spent only 1.6% of her time on social interaction with the offspring. These results come from individual observations and has not been statistically tested.

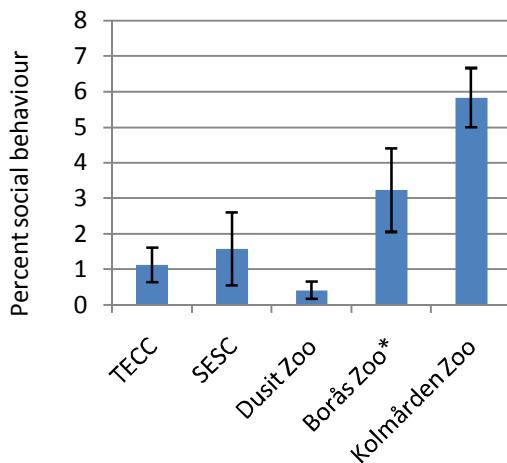


Fig. 14: Mean ( $\pm$  SE) % of observations spent on social behaviour for elephants at different locations.

\*African elephants

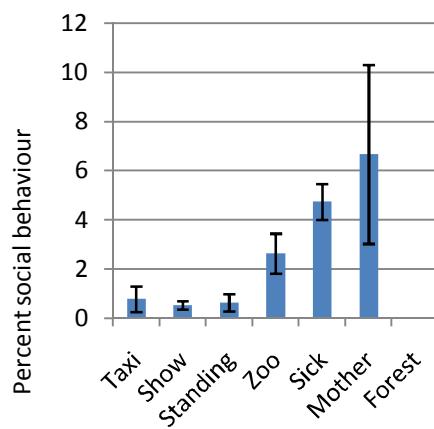


Fig. 15: Mean ( $\pm$  SE) % of observations spent on social behaviour for elephants with different occupations.

Forest elephants did not have a chance to physically interact with each other as they were tethered so far apart that the chains would not get entangled during night when the elephants were left unobserved. Not all taxi, show and standing elephants had the possibility to interact with each other (tab 3). At Dusit zoo the bull was kept solitary.

*Table 3: Percentage of elephants that were able to interact with each other*

	Able to interact with other elephants physically				
	TECC	SESC	Dusit Zoo	Borås Zoo	Kolmården Zoo
No	40	46	25	0	0
Yes	60	54	75	100	100

When dividing the behaviour on different locations one can make an interesting notice. Elephants at Kolmården Zoo spent most time on comfort behaviour, whereas elephants at Dusit Zoo spent least time on comfort behavior (fig 16).

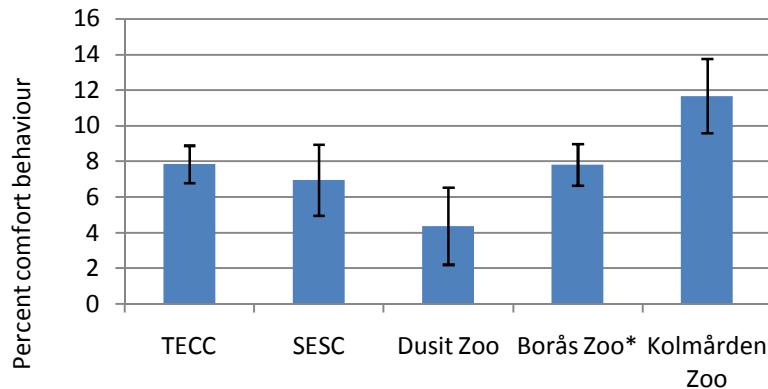


Fig. 16: Mean ( $\pm$  SE) of % of observations spent on comfort behaviour for elephants at different locations.

\*African elephants

When looking at different occupations, elephants in the natural environment (forest) moved their ears more frequently whereas Zoo (and standing elephants did it to a lesser extent.

*Table 5: Percentage of ear movement for different occupations*

	Shade amount						
	Taxi	Show	Standing	Zoo	Sick	Mother	Forest
Frequent	50	37	17	15	25	50	87
Intermittent	14	63	67	50	37	50	13
Rare	36	0	16	35	38	0	0

Amount of shade at different locations varied (tab 6). The temperature and thereby the need of shadow also varied. The high numbers of insufficient shade at Swedish zoos referred to the few number of elephants and that the adequate amount was measured only once per observation time. Observations took place during the midday when some individual choose to stay in the sun when shadow was limited. At SESC the elephants with insufficient shade were tethered and had no choice but to stay in the sun and the weather was much hotter.

Elephants at SESC that did not perform any work except standing for tourists to see, were sometimes left a whole day in the sun when the mahouts were elsewhere. They constantly sprayed the body with dust and waved their ears to cool down. At TECC most elephants were standing under permanent shadowing roofs and they seemed more pleased and not disturbed by the sunlight. At Dusit Zoo the elephants had shadow at all times but at Kolmården the shadow in the outdoor enclosure was sparse and the elephants shared the narrow spot along the

wall at noon. At Borås there was a shadow spot and the leader elephant chased the water buffalo away during the sunny hours in the middle of the day. The spot was quite small for the elephants to share if they did not get along well together.

*Table 6: Percentage of shade at different locations*

	Shade		Dusit	Borås	Kolmården
	TECC	SESC	Zoo	Zoo*	Zoo
Insufficient	3	12	0	25	25
Adequate	97	88	100	75	75

\*African elephants

Of the healthy elephants at both locations 100% had body index B whereas Swedish zoo elephants had body index A and elephants at Dusit zoo had body index B.

## Interviews

The interviews lasted from 30-60 minutes each. At SESC only twelve out of thirteen interviews were carried out as one mahout did not want to participate because he was anxious about the consequences. At TECC only fourteen out of sixteen interviews were completed due to problems getting in contact with two mahouts during the time period spent at the location.

The mean age among the mahouts were 39.7 years for SESC and 38.1 for TECC. The mean time spent as a mahout was 21.4 years and 15.4 years respectively and the mean time spent with this particular elephant was 9.3 years for SESC and 6.7 years for TECC. For SESC 83% had a father that was a mahout and 50% wanted their son to become one. At TECC 29% of the mahout's fathers had the same occupation and most did not express their wishes for their sons. When asked what was required to become a good mahout most answered a brave heart and love for elephants. Many said that you had to love working many hours a day and a few said patience and calmness. At SESC 83% claimed that the salary was too low and at TECC 93% did not see the income as a problem. All mahouts at SESC reported that it was hard to find enough food during the dry season between March and May for the elephants. They all bought supplementary food from neighboring provinces. At TECC 100% of the mahouts said that the camp bough enough food for their elephant.

The previous experience among elephants working at SESC was 50% roaming, 25% national park, 17% taxi, 8% logging though many elephants had had many different occupations before coming to the centre. For TECC the division was 43% logging, 21.5% illegal logging, 21.5% born at the centre and 14% had

performed in shows. One elephant was captured from the wild by the mahout's father and the rest were bred in captivity as far as the mahouts knew. Two elephants had participated in capture and relocation of wild elephants in national parks that had got too close to peoples' homes and therefore had to be moved to avoid further conflicts.

The welfare was rated 4.3 by the mahouts on a scale from 0-5 at both SESC and TECC. At SESC 50% got a shower twice a day and 42% got a bath. Only 8% (one individual) got it every third day. At TECC 7% (one individual) got to bath once a day, the mother with the smallest calf got shower twice a day and the rest (86%) got to bath 2-4 times a day. At SESC 25% said that their elephant performed stereotypic behaviour, 42% said it did not and 33% did not understand the concept. At TECC 21% was aware of that the elephant performed stereotypic behaviour (when it wanted food), 58% said they did not and 21% did not understand the meaning of stereotypic behaviour. At SESC 100% could not think of any improvements that could be done to their elephant and at TECC the result was 93%. Only one mahout reported that the veterinarians were the ones who might improve the well-being by choosing the right treatment.

At SESC 17% answered that they were concerned about the tourists' safety around their elephant and 36% expressed that feeling at TECC. One mahout had refrained from teaching his elephant massage as he was afraid the elephant would injure the back of a tourist. At SESC 17% reported that their elephant sometimes got angry and 92% reported that they sometimes got scared. At TECC 43% of the elephants got angry and 93% were scared sometimes. The main reason for being angry was during training when the elephant did not want to obey, when the mahout did not have time to play, to protect offspring or on other elephants. The reason for fear was mostly connected with the sight of dogs, pigs, horses, poultry, cars, construction vehicles or loud sounds from drill, airplane, etc. At SESC 33% said they sometimes lost the control of the elephant and it run away. At TECC 50% of the mahouts sometimes lost the control of their elephant. They had to go after it when it stopped. At SESC 100% reported that they had not had an accident with their elephant and at TECC 42% reported they had had incidents, but the mahout was never injured.

## Bull observations

I was asked to include the bull at Dusit Zoo in the study as he seemed depressed and bored. I observed him for two hours at two different days and he performed stereotypies at 83% and 45% of the time respectively. He had little that stimulated him and it did not take him long to finish his meals. He had a rather small enclosure where he spent night and day with no physical contact from the keepers or other elephants. It was within EAZA, European Association of Zoo and

Aquaria recommend outdoor enclosures to measure 167.2m<sup>2</sup> for a single individual. The food was left outside the enclosure for him to reach and drag in, because he was considered dangerous to handle. He knew no commands and was aggressive and uncontrollable. A veterinarian examined him twice a year under sedation and he gets no regular foot care.

At Borås zoo, the bull elephant did not lay down to sleep at night, because he had difficulties to stand up again. To solve the problem a pile of sand against one wall was provided to support him. This enrichment was successful and he lay down for some hours at night. The sand was tearing on the soles though, which is not optimal. The bull could not be shown to visitors because he is aggressive and throws things on visitors, but he has a good influence on the herd during night time when they stay together and he was a confident leader.

During my visit to Thailand I saw three example of suffering related with aggression. At one elephant clinic a bull was treated for several deep wounds caused by another males tusks and on another elephant clinic a male was treated after injuries caused by a spear in order to control him during musth. He had tried to kill a man and several deep cuts were made into his flank. He had to go under hours of treatment and cleaning every second day several months after the incidence. Elephant skin heals slowly and fistula formation and heavy pus production prolonged the healing process. The last example is a bull that was not in musth, but hard to handle due to aggression. He was tethered on a short chain on both front legs and not moved from the spot for 10 days time during my visit and was performing weaving to a great extent. He together with some other bulls had human lives on their conscience and only a few people could approach them. During my visit to SESC I was warned several times when approaching the big, old males that were known “man killers”. At TECC there were a few elephants that did not work with tourists due to aggression. They were kept in the forest most of the time, away from people.

## DISCUSSIONS

There were no significant differences in the time budget of the behaviours between the two locations, TECC and SESC, in this study. This could be due to the few numbers of individuals studied, but also depend on the large individual variation found among all groups of elephants as one can see on the wide range of standard error. Elephants become old and have a lot of previous history and experiences that have an impact on their behaviour and this make it hard to find two homogenous groups to compare. Some elephant that performed very much stereotypic behaviour could have done that already when arriving to the camp and it does not necessarily reflect the present living conditions. Some elephants had

previously lived a more difficult life, some had changed mahout a lot more than others, some had suffered from illnesses and recovered. Factors influencing the well-being of elephants are many and complex which makes conclusions hard to draw.

### Stereotypic behaviour

The elephants observed in this study showed a varying degree of stereotypies which was related to how they were kept and used. Data on stereotypic frequency in elephants kept in tourist camps have not been available previously (Clubb & Mason, 2002), but work on circus elephants has shown that chaining is associated with much higher levels of stereotypy compared to when they are held in paddocks (Schmid, 1995; Friend & Parker, 1999). One study claims that the rate which elephants move their feet when weaving correlate with the walking rate of wild elephants, where younger elephants perform it in a faster manner (Kurt & Garai, 2001). This can be a reason why show elephants, which are younger, performed stereotypies with a higher frequency than older taxi elephants in this study. It can also depend on anxiety to start performing.

The awareness of stereotypic behavior was low among the mahouts and there was a discrepancy between what the mahout said about stereotypic behavior and the result. Little attention was put on this matter and focus laid more on diseases and how to prevent them in the preventive health work. However, stereotypic behavior is a sign of poor welfare which can lead to diseases. The mean occurrence of stereotypies was 64% higher at SESC than at TECC but the variations within the two groups were large which resulted in no significant difference.

The Taxi elephants were older and calmer and had their mahout close by at all times providing food when waiting for work, which can explain why they showed relatively little stereotypies. Elephants that did not perform any work showed most stereotypic behaviour implying that some kind of stimulation contribute to their well being. Another explanation is that difficult individuals were more exposed to punishment and less suitable to interact with tourists and therefore left alone standing, increasing the stress level. Four young show elephants that all performed stereotypic behaviour (mean 23.9%) showed neither of this when tethered on a long chain in the forest during night to feed. Both this increased access to food and the ability to move is obviously very important.

The recovering elephants at the hospital had got food available at all times, shade and social interaction with other elephants, but they still were the group performing most stereotypies. One reason could be that they were bored because they were standing on concrete with little to do. During night they were tethered on relatively short chains in the park with no access to browse. As the healing

often took long time they stayed in this environment for months and even years sometimes. The level of stereotypic behaviour could also reflect a history of pain.

The absence of stereotypies during my observations does not mean that the elephants were totally free from such behaviour. At Kolmården Zoo the elephants sometimes perform stereotypies when they were impatient to be let out or receive food. At Borås Zoo some elephants performed stereotypic behaviour during morning procedures when they were tethered to have a daily check and shower.

As stereotypies is an indicator of stress one should be concerned about a frequency of stereotypic behaviour as high as 40.5% among the elephants at Dusit Zoo. In another study of 21 female zoo elephants 40.9% performed stereotypies at some level but the mean frequency was only 5.2% of the observations. The median was 0% as most elephants did not stereotype at all (Clubb & Mason, 2002). Some elephants were studied over 24 hours in that study and the mean frequency for the Dusit elephants might alter when looking over a longer period of time. The level of stereotypies will perhaps decrease after closing hours when visitors leave as some of the stereotypies were connected with begging for food. The water cannon enrichment at Dusit Zoo, where people can put money and then shower the elephants, seemed to have a stressful effect on the animals. The water reached only the feeding area and all elephants dispersed when showered and were unwilling to continue to eat the soaked food. A large difference was seen in resting time between the zoos. The low level of resting and physical interaction among the individuals at Dusit zoo can be an indicator of stress and poor relation within the group. The high proportion of physical interaction between the elephants at Kolmården can on the other hand imply insecurity, loneliness and a search for comfort. Kolmården was the only location where tail intertwining were observed. Composition of the group with no relationship between mother and offspring, lack of a group leader, low age, and boredom has a tremendous effect on abnormal and social behavior (Kanchanapangka, 2006) and can be an underlying cause why such behavior were observed.

## Safety and musth

Safety around elephants is of great concern, both for mahouts and elephant keepers working directly with the animal, but also for tourists. Accidents can have a very negative effect on the possibility to make an income if tourists consider it too dangerous to interact with the animals. An estimated hundred handlers are killed annually in Thailand by elephants (Priest, 1992). A mahout elephant relationship is built on trust. Elephants often get scared despite their great size and if they do not put trust in the leadership of their mahout they tend to run away from the threat (Vortkamp, 2006; Gore, Hutchins, & Ray, 2006). The same conclusion was drawn from my interviews. If the ankus, the hook, has to be used often to control the animal, it will become moody. Some bulls had big scars on the

forehead after heavy use of the ankus. The same scenario might happen if an elephant face a high rotation in mahouts taking care of it with new trust to be built each time. Elephants have a similar lifespan to humans and before it was a common practice to let a young boy take care of a young elephant to create a lifelong relationship. This is not the case anymore as elephants often change mahout several times during their life (Hart., 2005). My results support this statement.

Injuries caused by elephants in zoos appear to have the character of being deliberately caused rather than being an accident (Gore, Hutchins, & Ray, 2006). From 1976-1991, 15 accidents in European zoos led to the death of an elephant keeper (Clubb & Mason, 2002). Equally as many keepers died in elephant accident in USA during the same time. This makes elephant keeping the most dangerous profession in North America (Clubb & Mason, 2002). The European Elephant Group has a record of 29 killings of humans in zoos during 22 years (1982-2004), but males in musth seem to be under represented and only responsible for 27.6% of the cases (Gore, Hutchins, & Ray, 2006). This might be due to fewer males being held in zoos, knowledge about their potential danger and the use of protective or no contact to a higher extent. Clubb and Mason (2002) state that painful disease, chaining, high turnover of trainer increase aggression in zoo elephants.

Bulls in zoos are often held separately and under protective contact (Clubb & Mason, 2002) which decreases the degree of stimulation. As they are dangerous to handle they are seldom let out from the enclosure. As their nutrient status typically is good, they will stay in musth for prolonged time, sometimes up to half a year (Prakit Klangpattana, pers. com., 2007), making them difficult to handle. Klangpattana travels around the world as an elephant consult to help with Asian elephant bull problems in zoos. He states that it is very difficult to solve the problem if he arrives later than one to two years after the trouble began and it is often associated with leadership during musth, when the keepers loose control of the elephant (Prakit Klangpattana, pers. com., 2007).

Previously a big, strong, aggressive bull was ideal to work with in logging industry. They are less suitable today among tourist when accidents can easily happen. Instead the cute calves bring in a lot of money to its owner, who used to have to wait around 20 years for it to start working and bring an income (Lair., 2005). To avoid dangerous situations elephants are often tethered during periods of time, decreasing their moving ability and level of stimulation. This becomes a viscous circle and an elephant that is hard to handle has to be restraint further and then the aggression increases. One mahout said during the interview that his elephant was more aggressive when it was hungry or too hot and he was afraid the elephant would hurt a tourist that came too close by ignorance. The same concern was expressed by another mahout in a previous study (Vortkamp, 2006).

It is important for the well-being of many bulls that money is invested in projects to develop a cheap, safe and efficient chemical castration that could be administrated to bulls in captivity to ease their handling as surgical castration is no option in elephants because their testicles remain intra abdominally (Fowler & Mikota, 2006). It is very frustrating not to be able to follow deep instinct like the desire to mate and today the most common restraint methods in Thailand is tethering and food restriction. Research on administrating tranquilizer to control bulls in musth to be able to move them to a safe area is carried out at the veterinary clinic at TECC. Resent research at another location has showed that GnRH vaccination was effective in suppressing aggressive behaviour in musth bulls, but little is known about side effects after long term administration (Stout, Bertschinger, & Colenbrander, 2007).

### **Environmental enrichment and nutrition**

Different improvements could be made to decrease the level of stereotypic behaviour. An enlargement of the enclosure was reported to decrease stereotypic behaviour at Chester Zoo (Clubb & Mason, 2002). Distribution of food throughout the environment and a complex social structure are the most important environmental stimulations that affect the psychological well being among elephants (Fowler & Mikota, 2006). Elephants in the wild constantly make decisions about where to be, who to be with, what to eat, what to do and when to do it. In an enclosure the elephants should be provided with choices (Clubb & Mason, 2002). An unsatisfied feeding motivation in zoo elephants may be a keyfactor in development of stereotypies (Clubb & Mason, 2002). As the elephants at Dusit Zoo spent less time eating than other elephants studied and as eating behaviour is occupying 50-75% of the time budget in wild elephants (Fowler & Mikota, 2006) efforts should be made to increase this behaviour in the total time budget and improve feeding regimes. This could be done in many ways. First of all it is important that the fodder is distributed in at least as many piles as there are individuals to decrease conflicts. At the time of my observation at Dusit Zoo the elephant with the lowest rank was left without food until she succeeded in stealing some from another individual, which clearly created distress and tension in the group.

Distribution of pellets over a large area to be searched for and picked piece by piece stimulate foraging behaviour and locomotion but little data exist on the effects on the elephants. Maybe this alternative is less suitable at Dusit zoo, because outdoors an attraction of birds, rodents and freely roaming Monitor Lizards could create a problem. It is not especially hygienic either. Treasure hunts by hiding fruit in the enclosure could imply the same beneficial effects. If there is little suitable places for hiding a wall of stones could be made along one edge with holes to examine, like in Kolmården Zoo. By scattering the “sweets” in

different places each time the elephants has to look everywhere to check if it is empty or not. A third strategy is to provide browse which requires more manipulation and increases activity when reaching for leaves and debarking branches. It takes longer time to gain the same amount of energy compared to just receiving grass on the ground and it has been suggested as the best ways to increase feeding behaviour without gaining weight (Stoinski, Daniel, & Maple, 2000). Food could also be supplied in different locations in the enclosure each time to force the elephants to move and check for food at other spots like they did at Borås Zoo.

Obesity, I would say, is a kind of malnutrition that predispose to different diseases that can cause suffering. At Swedish zoos the difficulties is not to supply the elephants with enough food, rather to get a variation comparable with the wild or not give too much energy that is stored as fat. Many elephants in captivity carry an excess fat deposit, which is not seen in wild elephants (Fowler & Mikota, 2006). It is not surprising as wild elephants go through nutritional stress patterns that vary with season, but overweight can imply many negative health risks in the long term. This can lead to problems with conceptions, parturition, leg problems, heart and vascular diseases as well as other internal diseases (Fowler & Mikota, 2006). A heavy elephant also becomes more inactive creating a vicious circle. One study show that female Asian zoo elephants were 31-72% heavier than the wild ones and that those who received regularly training had less weight problems (Kurt & Kumarasinghe, 1998). At the Swedish zoos all elephants had nutrient status A, which means the animal has too much fat stored than is optimal. A good idea is to weight the animal regularly and aim to gain a target weight. A more fibrous diet decrease energy intake and maintain a feeling of satisfaction for the elephant. A nutritional specialist should be involved in the project at zoos to balance calorie intake with exercise level.

## **Effects of Breeding**

A calf contributes to calorie burning for the mother by nursing and to the herd by raised activity level. Previous studies have shown that cows move around more, get better exercise and overall health status is improved in herds with a calf present to look after and interacting with (Fowler & Mikota, 2006). The three mothers in Thailand were also noticeable stimulated by their offspring by performing less stereotypic behaviour than show, zoo, standing or sick elephants. They also performed more variation in behaviour patterns. To be able to know how much the calf contributed to a lower level of stereotyping one would have to observe the cows again sometime after weaning. The observation at Borås zoo shows that calves is consequently a good enrichment for cows, but a cow that already perform stereotypies will probably not stop, but decreases in frequency are seen (Trotter, pers. com., 2007)

It would be a good decision if Kolmården continued their work to develop a breeding program. Since my visit to Kolmården in June 2007, they have received a new older cow to support the young ones (Widholm, 2007). She can probably have a calming effect on the young females if she is a good leader and they get along well together. Support from older, more experienced cows is important when taking care of the first baby (Kanchanapangka, 2006; Schneck, 1997).

WWF and IUCN do not consider that captive breeding contribute significantly to elephant conservation (WWF-international, 2001). Today 59.7% of Asian elephants in captivity comes from wild captures (Clubb & Mason, 2002). Captive breeding will decrease the need of captures from the wild. A calf will surely be a great attraction for visitors as they stay young for a long time and are very playful and amusing to look at. As males are difficult to hold in a satisfactory way I would recommend to use insemination at Kolmården Zoo rather than get a male transferred from another zoo. Insemination is costly, but it has been proved to work in elephants. A male would require rebuilding of the facilities to protective contact and take space in occupation that could be used to increase the females enclosures or build a new to change between.

## Camp management

Effective management of elephant camps provides great benefits to elephant conservation and can become appreciated tourist destinations. If the mahouts are well taken care of the elephants will be treated the same way (Kalmapijit, 2007). This is also what I saw. In a well organized centre like TECC tourists can choose from a wide variety of activities in a beautiful surrounding. This creates unforgettable memories that generate sympathy for the domesticated elephant, but also concern about wild ones. It would be desirable that the gathered information is spread to other mahouts in other provinces.

Elephant camps are businesses which are a good solutions for taking care of the domesticated elephants as well as conserving the genuine culture of mahout life, which has a long tradition in Thai society. Knowledge, experience and understanding of the elephants nature is crucial for a successful outcome (Kalmapijit, 2007), but money also plays a central part. In SESC mahouts took their elephants and left at an early stage of the project, delaying the start of it due to lack of financing (Fuller, 2008b). The low salary is a great concern among mahouts at SESC and that food sometimes were scares for the animals. The tradition was stronger though. The salary was the same at the two locations, but at SESC the camp manager does not own the animals or provide food and the monthly compensation for this was not considered enough. The obvious differences when visiting the two camps was the environmental condition, financial means and time since establishment which was in favour to TECC. When mahouts can not earn enough money they are forced to seek an income

elsewhere and the elephants might suffer due to this. Ironically the worst case scenario for the domesticated elephants in Thailand is that the world economy goes into a recession that declines tourist numbers.

Attempts to let some elephants and their mahout work in national parks have failed as money involved in the project was too scarce (Fuller, 2008b). It would be a good idea to try to raise money and develop this project once more as it would be suitable for previous logging elephants and their mahouts to work in one of the 150 national parks with forestry, supervision and tourism. This would prevent a too high concentration and lack of resources that is a problem at many centers today. The elephants can be in their right environment and feed from the natural habitat at night. In India elephant tourism in national parks are more developed and elephants are used to transport tourists in areas where no roads are established. One example is the elephant safaris which are recognized by the Ministry of Tourism in India (Indian Holiday, 2008). My conviction is that elephant tourism could be developed further as many tourists nowadays seek for eco tourism and hands on experiences.

There was a big difference in accessibility between taxi elephants (who were previous logging elephants and handled by a few people and often dangerous to approach for strangers) and show elephants (who interacted with the audience on a daily basis under supervision of the mahout) in Thai camps. If an elephant is trained it will stay well trained (Prakit Klangpattana, pers. com. 2007). This provides possibilities to stimulate zoo elephants by taking them for walks outside the enclosure or tether them in the forest over night during summer time. It would be a good idea to turn the problem of decreased stimulation during winter time into an asset in Swedish zoos. By intensifying the training during winter months when opening hours are shorter it also has the benefit of strengthening the relationship with the keepers. Reciprocal trust is important when breeding is attempted as the mother can get nervous if she does not trust the keeper and feels like she has to protect her offspring. There was a large difference in trust between different elephants and their mahouts in Thai camps and both mahouts and elephants seemed happier in good relationships and the mahout was able to calm the elephant down effectively if it got scared.

To avoid pain, injury and disease among elephants frequent and close observation of individuals is required and familiarity with their normal behaviour and biology in order to rapidly detect abnormalities indicative of injury is needed (Soulsby, 2003). There have been veterinarians working at all locations where I have been observing. At SESC there were veterinarians specialized in elephants and they were coming on regular visits with a mobile clinic. They had a harder work to fight parasitic pressure than at TECC as elephants constantly were leaving and arriving to the camp, making synchronized de-worming and ectoparasite control difficult. Some elephants standing in the middle of the centre had lice that could easily be

spread to others. A quarantine in a remote part of the centre should be established where new elephant have to be treated before interacting with the rest of the group. It is impossible to get the whole camp free if not using synchronized treatment. This would save money on treatment and decrease suffering among the elephants. Some elephants at SESC were standing very close to their dung hill increasing the endoparasite pressure. The dung should be transported to a central depot were it is taken care of and used as fertilizer etc.

## CONCLUSIONS

The conclusion is that stereotypic behaviour is quite common among domestic elephants in Thailand. Differences in time budget is highly individual and vary with age, type of work, health condition, previous experience, moving ability, access to food among other things. This can explain why no significant difference in behaviours was detected when comparing the elephants at TECC and SESC. If camps are well organized they can benefit both elephants, mahouts and tourists, but it is important that they do not hold more animals than the area can support. Thailand has both a tradition and knowledge that provide good development possibilities for elephant tourism. High level of performed stereotypic behaviour should be of concern among keepers of zoo elephants. Altered feeding regimes as well as increased moving ability are most important improvements affecting stereotypic behaviour. Calves contribute to lower level of stereotypic behaviour and to a wider variety of behaviours. They also raise activity level for the mother and the herd. Elephants in musth are a vulnerable group and many experience low welfare. More money should be invested in developing a safe and easily administrated chemical castration to decrease the suffering.

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## Appendix 1

### Observation protocol

Id-number:

Location:

Date:

Name:

Age:

Sex:

Temperature:

Time of the day:

Penned	Picketed (diagonal legs)	tethered (on a string)

#### Form of restraint method?

How many meters are the elephant able to move:

A	B	C	D	E

Body condition score:

Yes	No

Adequate water?

Adequate food?

Adequate shade?

Adequate sanitation? (level of urine and faeces on the ground)

Reduced grooming

Is the elephant able to interact with other elephants?


Healthy movement of tail and ears in a rhythmic manner?

Frequent	Intermitent	Rare

Attitude

Bright/Alert	Responsiv	Dull

How do the elephant respond to its mahut?

Cheerfully	Reluctantly	No respons	Anger/fear

Any visible injury/illness/skin problem?

Total impression of the elephant during the study:

Use of collar?  
Use of catapult?  
Use of feet fetter?  
Use of elephant hook

Yes	No

How do the mahout respond to its elephant:

with fear no responds squabbling happily

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## Appendix 2

Time	Time of start.....	Stereotyping	Abnormal behaviour	Ingestion	Locomotion	Socialisation	Resting	Comfort	Other
1		Weaving							
2		Headbobbing/trunk swinging							
3		Trunk tossing							
4		Pace along the same route							
5		Throwing faeces	Vocalizing/trumpeting						
6			Other sounds than trumpeting						
7			Aggression						
8			Bumping						
9			Kicking						
10			Threatening						
			Extreme timidity						
			Self mutilation						
			Begging for food						
			Clinging behaviour	Eating					
			Tail intertwining	Drinking					
				Foraging					
				Playing with food					
				Debarking branch or tree	Walking				
					Backwards				
					Running				
						Learning			
						Standing over			
						Touching			
						Twinning trunks			
						Smell on another elephant			
							Lying		
							Standing		
								Pawing	
								Rubbing	
								Scratching	
								Searching	
								Spraying	
								Trunk up	
								Play with water	
								Flyswitching with branch	
								Blowing out air through trunk	
								Smelling on dung from other elephant	

## Appendix 3

### Definitions and Ethogram

#### Body Condition Score:

A-B= good C-D = poor

##### Definition:

- A: Very well conditioned, no bony prominence can be visualized and the dorsal ridge is nearly covered
- B: The dorsal ridge is a little more prominent and the hip bones are barely visible = ideal score.
- C: Easily visible hip bones, and prominent dorsal ridge. The transverse spinous processus begin to show.
- D: The transverse processes are easily visualized and the ribs are starting to show.
- E: The ribs are easily visible and the animal is emaciated.

##### Behaviours observed

Category	Behaviour	Definition
Stereotypic behaviour:	Reduced grooming	Skin in poor condition due to lack of sand bathing
	Weaving	Side to side or back and forth repetitive swaying of the body
	Head bobbing	Moving head up and down in a repetitive manner
	Trunk swinging	Vigorous swaying of trunk from side to side
	Trunk tossing	Repeated extension of the trunk
	Pace along the same route	Walk in a repetitive manner or in a circle
Abnormal behaviour	Throwing faeces	Tossing it around the enclosure or onto the body in a repetitive manner
	Aggression	Threatening with raised ears and moving towards another elephant/human
	Bumping	Forceful pressure with the hip or other body part against another elephant
	Kicking	Forward or sideways thrusting of the foot at another elephant
	Threatening	Standing with ears spread and head held high
	Extreme timidity	Anxious
Ingestion	Self mutilation	Injuring itself in any way
	Begging for food	Trying to get attention from visitors/mahout in any way in order to get something to eat
	Clinging behaviour	Search for comfort by clinging on to another elephant
	Tail intertwining	Holding the tail of another elephant by the own tail
	Eating	Picking up food with the trunk, placing it in the mouth and swallowing

	Drinking	Picking water up with trunk, placing it in the mouth and swallowing
	Foraging	Using trunk or foot to search the ground for food.
	Playing with food	Tossing or spreading the food out instead of eating
	Debarking branch or tree	Peel a branch to eat the bark
<b>Locomotion</b>	Walking	Moving in any direction more than three steps
	Backwards	Moving backwards
	Running	Moving forward in a faster pace than walking
<b>Socialisation with other elephant</b>	Leaning	Leaning on another elephant
	Standing over	Standing over another elephant
	Touching	Touching another elephant in a non-aggressive manner with trunk
	Twining trunks	Gentle overlapping of trunk with another elephant
	Smell on another elephant	Examine another elephant with the trunk or greet a newcomer
<b>Resting</b>	Lying	Lateral recumbancy
	Standing	Standing on all four legs, trunk flaccid, not performing any other identified behavior
<b>Comfort</b>	Pawing	Pawing the ground with the foot before lying down
	Rubbing	Rubbing any body part against an object
	Scratching	Scratching the body with trunk or foot
	Searching	Searching the ground with trunk
	Spraying	Spraying water, food or dirt on the body with the trunk
	Trunk up	Trunk curved upward on the forehead
	Play with water	Spraying water on the body or elsewhere with the trunk
	Flyswitching with branch	Use the trunk to hold a branch to whisk insects away
	Blowing out air through trunk	Making sounds with the trunk or blowing out air without dust.
	Smelling on dung from other eleph.	Examine the faeces from another elephant with the trunk
<b>Training methods</b>	Free-contact	The mahout works unprotected
	Hands-on	The keeper works unprotected
	Protected	A barrier between the trainer and the elephant. The handler is safe and the elephant can choose not to have bodycontact with the keeper if it does not want to.
	Hands-off/Zero contact	No training
	Positive reinforcement	The elephant receive food or positive feedback from the keeper
	Negative reinforcement	The elephant is punished (something that gives pain or discomfort) when not obeying a command. The method is built on dominance.
	Target-training	The elephant is taught to move in the direction of the elephant-hook (ankus)
	Passive control	Entirely voluntary method with no negative reinforcement