



EXPEDITION REPORT

Expedition dates: 23 – 31 October 2017

Report published: August 2018

**Elephant encounters:
Studying Asian elephants in the hills of
northern Thailand to increase their
welfare and conservation**





มูลนิธิหัวใจรักช้าง
Kindred Spirit Elephant Sanctuary
Love. Care. Rescue.



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Authors:

Talia Gale
Kindred Spirit Elephant Sanctuary

Matthias Hammer (editor)
Biosphere Expeditions

Abstract

This study was a collaboration between Biosphere Expeditions and Kindred Spirit Elephant Sanctuary. It used direct observations of four free-roaming captive Asian elephants. Their activity budgeting, foraging habits and social-association behaviour was observed using instantaneous, all-occurrence focal and scan-sampling methods respectively, with the aim for three separate data sets to be collected simultaneously.

Sixteen hours of activity budget data collected on each elephant showed that, like wild Asian elephants, the study subjects spent the majority of their time foraging, followed by drinking and walking. There was no significant difference between the behaviours displayed by the four study subjects.

The foraging data collected during the expedition was combined with data collected by the project scientist since January 2017 and showed a high variety of plant species foraged on (162 species from 44 different families). The study subjects were characterised as a browse species. There was no significant difference in the plant species that the four study subjects foraged on.

The elephant association data set used the proximity of the study subjects to examine social affiliation and closeness among the elephants. Insufficient social-association data were collected for analysis.

Overall, the data collected is the first of its type on semi-wild free-roaming captive Asian elephants. There is much room for improvement in regards to management of captive elephant populations. The differences in behaviours exhibited by the study subjects when compared to other captive populations highlight this. Further research on the four study elephants will ensure data precision, with the intention of publication and the creation of an elephant management guide to be distributed to elephant venues in Thailand and around the world.

บทคัดย่อ

การศึกษาค้นคว้านี้เป็นความร่วมมือระหว่าง **Biosphere Expeditions**

และมูลนิธิหัวใจรักช้างซึ่งทำการสังเกตโดยตรงกับช้างเลี้ยงสายพันธุ์เอเชียที่มีอิสระในการหาอาหาร ได้ทำการสังเกตกิจกรรม, นิสัยการออกหาอาหาร และพฤติกรรมทางสังคมของช้างด้วยวิธีการแบบทันที, แบบภาพรวมและการสุ่มตัวอย่างตามลำดับ และการสุ่มตัวอย่างตามลำดับ โดยมีเป้าหมายที่จะเก็บรวบรวมข้อมูลสามชุดไปพร้อม ๆ กัน

การเก็บข้อมูลกิจกรรมของช้างแต่ละเชือกเป็นเวลา 16

ชั่วโมงแสดงให้เห็นว่าตัวอย่างศึกษาใช้เวลาส่วนใหญ่ไปกับการออกหาอาหาร, ดื่มน้ำ และเดินไปมาเหมือนช้างป่าสายพันธุ์เอเชียทั่วไป ไม่พบความแตกต่างอย่างมีนัยสำคัญระหว่างพฤติกรรมของช้างทั้งสี่เชือกที่ทำการศึกษา

ข้อมูลการออกหาอาหารที่เก็บรวบรวมในระหว่างการสำรวจถูกนำมารวมกับข้อมูลที่เก็บรวบรวมโดยนักวิจัยโครงการตั้งแต่เดือนมกราคม 2017 ซึ่งแสดงให้เห็นถึงความหลากหลายของสายพันธุ์พืชที่ช้างกิน (162 สายพันธุ์จาก 44 วงศ์)

ตัวอย่างศึกษาถูกจัดให้อยู่ในประเภทสัตว์ทะเลไม่มีพบบความแตกต่างอย่างมีนัยสำคัญของสายพันธุ์พืชที่ช้างทั้งสี่ตัวกิน

ชุดข้อมูลเกี่ยวกับการรวมกลุ่มของช้างใช้ระยะห่างของตัวอย่างทดลองเพื่อศึกษาความสัมพันธ์ทางสังคมและความใกล้ชิดระหว่างช้างแต่ละเชือก ข้อมูลเกี่ยวกับการรวมกลุ่มทางสังคมที่เก็บรวบรวมมาทำการวิเคราะห์ยังมีปริมาณไม่เพียงพอ

โดยรวมแล้วการศึกษาค้นคว้านี้เป็นการศึกษาการเก็บรวบรวมข้อมูลของช้างเลี้ยงสายพันธุ์เอเชียที่เดินหาอาหารได้อย่างอิสระในสภาพแวดล้อมกึ่งป่าเป็นครั้งแรก ยังมีสิ่งที่จะต้องศึกษาเพิ่มเติมอีกมากเกี่ยวกับการจัดการประชากรช้างเลี้ยง

ความแตกต่างของพฤติกรรมของตัวอย่างศึกษานี้แสดงให้เห็นถึงประเด็นนี้เมื่อเปรียบเทียบกับประชากรช้างเลี้ยงอื่น ๆ

การวิจัยต่อยอดกับช้างสี่เชือกที่ทำการศึกษา

จะช่วยรับรองความเที่ยงตรงของข้อมูลโดยมุ่งที่จะตีพิมพ์และสร้างแนวทางการจัดการช้างเพื่อเผยแพร่ไปยังสถานที่เลี้ยงช้างในประเทศไทยและทั่วโลก

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1. Expedition Review

Matthias Hammer (editor)
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Our projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Our expeditions are open to all and there are no special skills (biological or otherwise) required to join. Our expedition team members are people from all walks of life, of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This project report deals with an expedition to the hills in Northern Thailand that ran from 23 to 31 October 2017 with the aim of conducting close-encounter behavioural, diet and other studies on Asian elephants.

Asian elephants are the largest living mammals in Asia and can be split into three subspecies; *Elephas maximus maximus* (Sri Lanka), *Elephas maximus sumatranus* (Sumatra) and *Elephas maximus indicus* (mainland Asia). They are listed as Endangered by the IUCN as the total population has declined by over 50% in the last 65-70 years (Choudhury et al. 2008). Asian elephants are threatened by poaching and habitat degradation, as well as fragmentation leading to human-elephant conflict (Sukumar 2006). There are approximately 40,000 - 50,000 wild Asian elephants left worldwide, found in 13 countries in south and South East Asia (Sukumar 2006).

The wild elephant population in Thailand is around 3,000 and there is a domestic population of approximately 3,500 (Sukumar 2006, "Most Elephants" 2017). In Thailand the elephant is a highly revered species. Captive elephants have been part of Thai culture for hundreds of years, both as work animals and sacred beings. After a ban of logging in 1989, many elephants in Thailand were out of work. Elephant owners turned to the tourism industry to continue to earn a living from their elephants. However, often elephants in the tourism industry are kept in inadequate conditions, worked to exhaustion and offered little or no veterinary care. Kindred Spirit Elephant Sanctuary (KSES) returns elephants from the tourism industry back to the forest to live in semi-wild conditions and studies them in order to create more opportunities and strategies to re-wild more elephants in the future.

It is only one of a handful of projects to do so and due to the dense forest habitat wild elephants live in, there are also very few studies on natural Asian elephant behaviour and social structure. KSES's elephant herd presents an ideal opportunity to study the natural behaviour of semi-wild Asian elephants in safe and natural surroundings.

1.2. Research area

Thailand, officially the Kingdom of Thailand, is a country at the centre of the Indochinese peninsula. It is comprised of several distinct geographic regions. The north of the country is a mountainous area, the Thai highlands, with the highest point being Doi Inthanon in the Thanon Thong Chai Range at 2,565 m. The expedition took place in the foothills of this mountain range (Fig. 1.2a).



Figure 1.2a. Map and flag of Thailand with study site (red dot).

An overview of Biosphere Expeditions' research sites, assembly points, base camp and office locations is at [Google Maps](#).

Most of Thailand, including the expedition study site, has a tropical savannah climate. The south and the eastern tip of the east have a tropical monsoon climate. Thailand is the only country in South East Asia to have escaped colonial rule. Buddhist religion, the monarchy and the military have helped to shape the country's society and politics.

The diversity of animals and plants in Thailand is remarkable. This is partly due to Thailand's geography: a land between two oceans on the Malaysian Peninsula, numerous islands, plains in the central part of the country, the vast Mekong river and mountains covered by jungles in the north.

It has been estimated that Thailand supports 18,000 species of plant, 6,000 insect species, 1,000 kinds of bird, and 300 species of mammal¹. Even so, it is difficult not to escape the conclusion that the kingdom's flora and fauna are heavily depleted, mainly due to logging of forests. As recently as 1950, over half the country's land area was forested². Today forest cover has been reduced by as much as 90% and barely a day goes by before yet another scandal with an environmental tinge is revealed in the newspapers. This concern for the environment though is comparatively recent, dating back to 1973. In that year, an army helicopter crashed, and as investigators picked over the wreckage they discovered not just the bodies of the crew and passengers, but also the corpses of several protected wild animals. It became clear that the human victims - prominent army officers - had been illegally hunting in the Thung Yai Naresuan Wildlife Sanctuary. A public scandal ensued and the environmental movement in Thailand was born.

Kindred Spirit Elephant Sanctuary, the expedition's study site, was established in 2016 and comprises of highland and mountain tropical rainforest ecosystems. Slopes vary between 25% - 100% and the highest elevation is 1,100 m. There are four elephants in the study site who roam in an area of around 14 square kilometres. The flora consists of sphagnum bog, moist and dense evergreen cloud forest, dry evergreen, pine, mixed deciduous teak and dipterocarp forests. The fauna includes lar gibbons (*Hylobates lar*), red muntjac (*Muntiacus muntjak*), Indian civets (*Viverricula indica* and *Viverra zibetha*), Indian giant flying squirrel (*Petaurista philippensis*), as well as a plethora of bird, reptile and amphibian species. The area is based around a Karen hilltribe village with a population of 450 people. The Karen people are well known for their close relationship with elephants, their traditional clothing weaving and corn and rice agriculture.

1.3. Dates

The project ran from 23 – 31 October 2017. This period was chosen to coincide with the mildest climate in terms of temperature extremes. It is also a good time of the year to collect data as the forest food for the elephants, as well forest biodiversity was still thriving after the rainy season. A second group was planned for 3 -11 November 2017, but did not run due to lack of citizen scientist volunteers signing up for the expedition.

1.4. Local conditions & support

Expedition base

The expedition was based in a traditional Karen hill tribe village in a rural area. Sleeping was in homestays in single, twin or double (for couples) accommodation and there was a central dining and meeting area for the expedition team in one of the local houses. Overall conditions were rustic with simple living quarters, squat toilets and bucket showers. There was electricity (220 V) and also mobile phone coverage, including 3G internet services.

All meals were prepared by local community cooks and special diets were catered for.

¹ <https://www.nationsencyclopedia.com/Asia-and-Oceania/Thailand-FLORA-AND-FAUNA.html>

² https://en.wikipedia.org/wiki/Deforestation_in_Thailand

Weather

The Thai climate is controlled by tropical monsoons and the weather in Thailand is generally warm and humid across most of the country throughout most of the year. The weather in northern Thailand (where the expedition took place) is determined by three seasons: Between November and May the weather is mostly dry and the cool season and hot season occur from November to February and March to May respectively. The rainy season lasts from May to November and is dominated by the southwest monsoon, during which time rainfall in most of Thailand is at its heaviest. The expedition took place towards the end of the rainy and the beginning of the cool season with daytime highs of about 30°C, night time lows of about 10°C and some rainfall in October, decreasing to very little in November.

Field communications

There was a patchy 3G mobile phone network connection (Thai phone provider AIS 1-2-call) at base and in the study site. The expedition leader posted a [diary with multimedia content on Wordpress](#) and excerpts of this were mirrored on Biosphere Expeditions' social media sites such as [Facebook](#) and [Google+](#).

Transport & vehicles

Team members made their own way to the Chiang Mai assembly point. From there onwards and back to the assembly point all transport and vehicles was provided for the expedition team. After meeting at the Chiang Mai assembly point, the team travelled for about five hours to the study site and base camp by vehicle.

Medical support and incidences

The expedition leader was a trained first aider, and the expedition carried a comprehensive medical kit. Further medical support was provided by a clinic in Pang Un (about 35 minutes drive) or a hospital in Khun Yuam (about 1.5 hour drive). All team members were required to carry adequate travel insurance covering emergency medical evacuation and repatriation. Safety and emergency procedures were in place, but did not have to be invoked as there were no emergencies. However, three participants suffered from vomiting and diarrhoea and left early, as did one other participant because they were unhappy with the lack of luxury in the village. This resulted in a severe shortage of citizen scientists for the project.

1.5. Expedition scientists

Talia Gale was born in Vancouver, Canada where she studied Zoology at the University of British Columbia. Talia first came to Thailand in 2011 to study Asian elephant foraging behaviour. After working in Canada for 2 years in the field of veterinary science, she returned to Thailand again to work with and study Asian elephants on a project near Chiang Mai. Talia has been working in Thailand for over 4 years, both in the north studying elephants and in the south studying sea turtles and general biodiversity. In May 2016 Talia began working with Kindred Spirit Elephant Sanctuary where her main focus has been designing and carrying out studies on their elephant's social structure and behaviours.

Kerri McCrea was born in Co. Tyrone, Northern Ireland and studied Zoology at Queen's University Belfast. Having already worked on conservation projects in Australia and Sri Lanka, Kerri first came to Thailand in 2013 to help an elephant project with their community and research efforts. In May 2016, Kerri and her local partner Sombat, founded Kindred Spirit Elephant Sanctuary and brought home the first 4 elephants to live in the surrounding forests. Kerri's main focus is to oversee all projects, including but not limited to, research, community, teaching, admin, project expansion and maintenance.

1.6. Expedition leader

Malika Fettak is half Algerian, but was born and educated in Germany. She majored in Marketing & Communications and worked for more than a decade in both the creative field, but also in PR & marketing of a publishing company. Her love of nature, travelling and the outdoors (and taking part in a couple of Biosphere expeditions) showed her that a change of direction was in order. Joining Biosphere Expeditions in 2008, she runs the German-speaking operations and the German office and leads expeditions all over the world whenever she can. She has travelled extensively, is multilingual, a qualified off-road driver, diver, outdoor first aider, and a keen sportswoman.

1.7. Expedition team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds. They were (in alphabetical order and with country of residence): Bidgette Bennett (USA), Margot Coulter (Canada), Marion Fink-Schneider (Germany), Denise Marie Grathwohl (Germany), Maria Kukharenko (Russia), Amy McCarthy (USA), Greg Milledge (Canada).

1.8. Partners

On this expedition Biosphere Expeditions' main partner was Kindred Spirit Elephant Sanctuary & Foundation (KSES). Their mission it is to bring as many elephants as possible back to their natural environment to live in semi-wild conditions and provide an alternative and sustainable livelihood for the human communities with which they share a living space. One of KSES's ultimate goals is to stop and eventually reverse the effects of the illegal elephant trade, as well as provide some much-needed research to give insights into natural elephant behaviour.

1.9. Acknowledgements

The expedition provided labour and funding and permitted data collection to occur throughout the day, allowing for full data sets on Kindred Spirit Elephant Sanctuary's elephants to be collected. We are grateful to the citizen scientist volunteers, who not only dedicated their spare time to helping but also, through their expedition contributions, funded the research. A big thank you to all the members of the local community, especially those who welcomed expedition participants into their homes with open arms, who guided us through the forest, who helped with transportation and who cooked amazing meals. Biosphere Expeditions would also like to thank members of the Friends of Biosphere Expeditions and donors for their support.

1.10. Further information & enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org. Enquires should be addressed to Biosphere Expeditions at the address given on the website.

1.11. Expedition budget

Each team member paid a contribution of £1,580 per person per nine-day slot towards expedition costs. The contribution covered accommodation and meals, supervision and induction, special research equipment and all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses such as telephone bills, souvenirs etc., or visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how this contribution was spent are given below.

Income	£
Expedition contributions	18,352
Expenditure	
Staff includes local and Biosphere Expeditions staff salaries and travel expenses	4,689
Research includes equipment and other research expenses	503
Transport includes fuel, taxis and other local transport	398
Expedition base includes board & lodging and base hut upgrade	3,164
Administration includes miscellaneous fees & sundries	197
Set-up includes all pre-expedition set-up costs of inaugural expedition	6,761
Team recruitment Thailand as estimated % of annual PR costs for Biosphere Expeditions	6,733
Income – Expenditure	-4,092
Total percentage spent directly on project	122%*

*This means that in 2017, the expedition ran at a loss and was supported over and above the income from the expedition contributions by Biosphere Expeditions.

2. Activity budgeting, foraging and social behaviour of free-roaming semi-wild Asian elephants

Talia Gale
Kindred Spirit Elephant Sanctuary

2.1. Introduction

Activity budget data

Activity budgets are defined as the different activities an animal partakes in, in a given unit of time. The activity budgeting of elephants can be used to compare wild and captive populations. Differences, if found, can highlight areas in need of improvement in regards to captive elephant management (Baskaran et al. 2010, Ahamed 2015). Most studies on captive Asian elephants have had discrepancies in the activity budgeting of their elephants from wild populations (Elzanowski and Sergiel 2006, Varma et al. 2008, Mackey 2014, Samarasighe and Ahamed 2016). This study investigates the activity budgeting of Kindred Spirit Elephant Sanctuary's semi-wild elephants, the first of its kind looking at captive elephant behaviour while living the most natural life possible. It is hypothesized that the activity budgets will closely mimic that of wild elephants.

Elephant foraging data

As a mega-herbivore, eating approximately 200 kg of food each day, Asian elephants are generalist feeders, eating a vast selection of plant species (Sukumar 2003, Sukumar 2006). Studies (Baskaran et al. 2010, Roy and Chowdhury 2014, Koirala et al. 2016) have shown that different wild populations have strong feeding preferences and even differ in being characterised as a browse or graze species. For most elephants in captivity, only a handful of plant species make up the bulk of their diet, supplemented by vast amounts of high-sugar treats. There is a great need for a research-based guideline regarding fodder provided for captive elephants. Our first-hand observational study of free-foraging elephants in their natural environment will help to provide this.

Elephant association data

Over 6 million years of divergence, African and Asian elephants have developed different social structures due to different social, ecological and predation pressures (de Silva and Wittemyer 2011). For years, research has focused on African elephant social networks. It is well established that they live in large multilevel family groups with strong social ties, led by a matriarch. Males leave their maternal herd between the ages of 9-18 to form small, male-only herds (Lee and Moss 1999). Knowledge of the structure of Asian elephant societies is less detailed, but it is believed that they live in much smaller herds with less association between individuals (de Silva and Wittemyer 2011, de Silva et al. 2011). Due to the dense-forest mountainous habitat Thailand's elephants inhabit, there are few first-hand observational studies on their social preferences. The work with Kindred Spirit Elephant Sanctuary's semi-wild herd will provide valuable insight into Asian elephant social behaviour.

2.2. Materials and methods

Study site

The study site is described in chapter 1.2. and a topographic map of the site is in Fig. 2.2a.



Figure 2.2a. Topographic map of study site, located inside the yellow line.
For location of site in Thailand, see Fig. 1.2a.

Study subjects

Kindred Spirit Elephant Sanctuary's (KSES) herd of elephants consists of four individuals - three related individuals and one unrelated male. Too Meh is a 56 year old female, her daughter is Mae Doom, who is in her 20s. Too Meh's grandson, Gen Thong is a five year old male orphaned elephant. The fourth elephant, Boon Rott, is an unrelated 12 year old male. Before joining KSES, all four elephants worked in tourist camps giving rides and performing tricks. In May 2016, KSES was founded and the four elephants were walked to the study site. Elephant owners are given a monthly compensation in order for them to help provide for their families. KSES does not purchase elephants, as this has the potential to lead to illegal trafficking and capture from the wild. Currently KSES only has the funding to support these four elephants, but hopes to bring more elephants to join them in the near future.

During the day, the elephants are free to roam in the forest surrounding the hilltribe village and base location of Ban Naklang in the district of Mae Chaem, Chiang Mai province, Thailand. The mahouts (elephant caretakers), who act as forest guides for KSES, closely watch over the elephants to ensure they stay within the forest boundaries and do not enter any fields or cross any main roads. During observations the mahouts may interact with the elephants to guide them away from agricultural land. For this purpose direction are primarily given with vocal commands. On the training day, participants fed the elephants bananas, however, during data collection days participants solely observed the elephants.



Figure 2.2b. Pictures of the four elephant study subjects.
Top left: Boon Rott. Top right: Gen Thong. Bottom left: Mae Doom. Bottom right: Too Meh.



Figure 2.2c. Pictures of the agricultural areas and forests expedition participants trekked through to reach the elephants each day.



Figure 2.2d. Two examples of the areas the elephants roam in.
Left: In a rocky river bed. Right: On a steep forested slope.

Data collection started at 8:00 and ended at 16:00, and was split into one hour periods, with the aim of collecting data sets (activity budget, elephant foraging and elephant association) simultaneously.

Activity budget

Throughout the expedition, two full data sets (8:00-16:00) were collected for each elephant. Data were collected via instantaneous sampling at five minute intervals. At each interval, the observer noted the behaviour exhibited by the individual elephant using the behavioural ethogram (Table 2.2a). Cloud cover, at intervals of 25%, and ambient temperature was also recorded at each five minute interval.

Elephant foraging

Data were collected via all occurrence focal sampling. Due to low numbers of expedition team members, for data analysis purposes, data collected by the expedition scientist throughout the year (from January 2017) were used as well.

As the elephant selected plants to forage, the observer recorded the start and end time of the foraging bout, the name of the plant (if known by the mahouts or found in the field guide) and the part eaten by the elephant (bark, fruit, leaf, root, twig or stem). If the plant was not already in the field guide, a description of the plant and detailed photos of the entire specimen were taken. The GPS coordinates as well as the elevation were recorded at the start of the observation period.

Table 2.2a. Behavioural ethogram used in the field.

Behaviour	Description
Bathing	Standing/laying in water or mud; spraying water or mud over body with trunk
Digging	Digging in soil using the foot (but not as part of a dusting behaviour)
Drinking	Collecting water in the trunk and spraying it into the mouth
Dusting	Collecting soil and throwing it over the body/rubbing it into the skin (while standing still or walking), including digging in soil for this purpose
Exploring	Exploring any area of the environment; includes raising trunk to smell environment, using trunk on ground to explore substrate or other objects; does not include exploring forage
Foraging	Collecting solid food with the trunk and placing it in the mouth while standing or walking; includes tearing down tree and branches and exploring forage
Mahout interaction	Any interaction with a mahout
Rolling	Rolling in soil or mud (but not as part of playing with another individual)
Scratching	Scratching or rubbing any body part with another part of the body, or with an inanimate object
Socialising	Interacting with other individuals via touch of any body part
	Aggression - Hitting/pushing as a result of an antagonistic encounter (but not as part of play)
	Playing - Chasing another elephant or mock fighting with another elephant (but not as a result of an antagonistic encounter or as part of courtship)
Sex	Courting or being courted or mounting another elephant or being mounted by another elephant of either sex
Standing	Standing motionless
Walking	Walking (except while feeding)
Other	Any other behaviour
Cannot see	Elephant behaviour is not visible or not distinguishable

Elephant association

The elephant association data set used proximity to examine social affiliation among the herd. Data were collected via scan sampling at five minute intervals. At each interval the identity of an elephants' nearest neighbour and next nearest neighbour, and whether or not they were within touching distance of one another was recorded. Due to low numbers of expedition team members, there was insufficient data for analysis.

Statistical analysis

Activity budget: At each interval, if only one behaviour was observed by a given elephant, it was given a value of 1, if two behaviours were occurring simultaneously, they were both given a value of 0.5. Incidences where the elephant was recorded as 'Cannot See' were omitted from analysis. A one-way ANOVA was performed across all behaviours for the four elephants. A regression was performed on each elephant's bathing behaviour and temperature.

Foraging: A one-way ANOVA was performed across all species foraged on by the four elephants.

Training of expedition participants

In this study, data collection was performed by volunteer citizen scientists with no previous knowledge of wildlife research and conservation, or elephant research and behaviour. Training included an introduction to differentiating elephant behaviours and individual elephants. Expedition members had to pass an elephant identification and behaviour test prior to collecting data to ensure accurate data collection and quality.

A training hike and training data collection period was conducted in the forest to allow the participants to adjust to the hardships of collecting field data (e.g. walking on steep rocky slopes while recording elephant behaviour) prior to recorded data collection periods.

2.3. Results

Activity budget

During the study, 192 incidences of behaviours were recorded for each elephant, totaling 768. For 76 incidences, the animal was out of sight (recorded as 'cannot see'). Out of the 14 behaviours listed on the behavioural ethogram (Table 2.2a), the elephants displayed 13 behaviours. 'Other' was recorded only once, when the subject was urinating. Sex was never observed. If socialising was recorded, it was never distinguished between aggression and playing. There were 17 incidences where two behaviours were observed to be performed at the same time, and this was only observed in the older male and older female. Of these, eight incidences involved socialising-foraging and four incidences involved socialising-bathing. There was no significant difference in the behaviours observed by the four individual elephants (one-way ANOVA $F=0.016$, $p=0.997$). Foraging was the most dominant behaviour, with an average of 59% of the time spent eating. This was followed by drinking and walking, both at 8%, standing at 7%, exploring at 6% and bathing at 5% (Figure 2.2a).

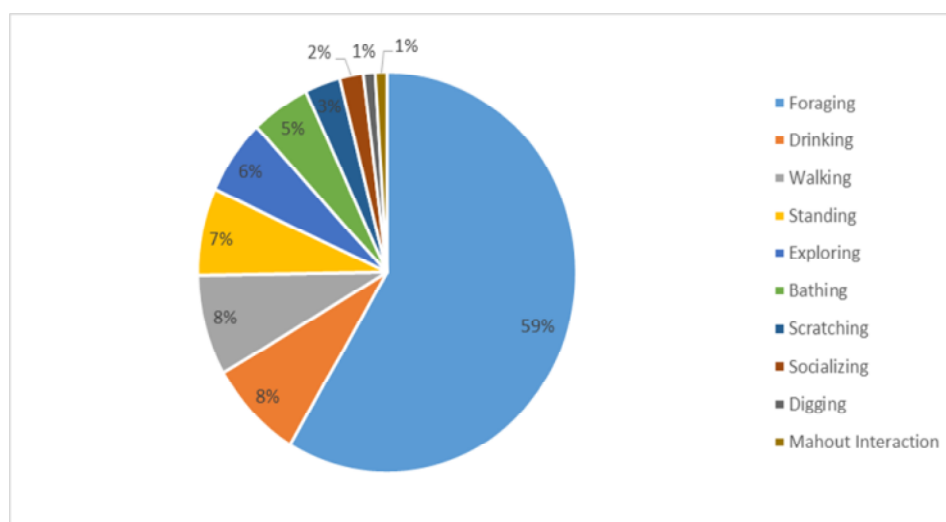


Figure 2.3a. Pooled behaviours displayed by the elephants (n=4).

Recorded temperature ranged from 21°C to 31°C, with mean temperature for each hour-interval of data collection ranging from 22°C to 30°C. None of the four elephants showed a correlation between temperature and bathing behaviour; Gen Thong ($r=0.36$, $p>>0.05$), Boon Rott ($r=0.01$, $p>>0.05$), Mae Doom ($r=0.31$, $p>>0.05$), Too Meh ($r=0.29$, $p>>0.05$).

Foraging

Table 2.3a. Most commonly consumed plant species.

Species	Type	Parts consumed	% of foraging encounters
Bamboo (Vami) Poaceae family	Bamboo	Whole plant	43.4%
Corn <i>Zea mays</i>	Shrub	Stem/Fruit	12.3%
Akar malam <i>Sphatolobus sp.</i>	Climber	Leaves, bark, stem	6.9%
Bamboo (Vasu) Poaceae family	Bamboo	Whole plant	2.7%
Golden gardenia <i>Gardenia sootepensis</i>	Tree	Leaves	1.9%
China doll <i>Radermachera sp.</i>	Tree	Bark	1.7%
Balan/Taengwood <i>Shorea obtusa</i>	Tree	Bark, stem	1.6%
Burmese varnish tree <i>Gluta usitata</i>	Tree	Bark	1.5%
Jicama <i>Pachyrhizus sp.</i>	Climber	Leaves, bark, stem	1.5%
Cashew family <i>Spondias pinnata</i>	Tree	Leaves	1.4%
Unidentified (Saykatoo) Apocynaceae family	Tree	Bark	1.1%
Longan <i>Dimocarpus longan</i>	Tree	Leaves	1.0%
Dillenia <i>Dillenia sp.</i>	Tree	Fruit	1.0%
Turkey berry <i>Solanum torvum</i>	Shrub	Stem, leaves	0.9%
Unidentified (Gammay) Poaceae family	Grass	Whole plant	0.9%
Kamala tree <i>Mallotus philippensis</i>	Tree	Leaves, bark, stem	0.8%
Ring-cupped oak <i>Quercus kerrii</i>	Tree	Twigs, leaves, roots	0.7%
Unidentified (Koh)	Tree	Bark, twigs	0.7%
Unidentified (Noh) Poaceae family	Grass	Whole plant	0.6%
Mountain date palm <i>Phoenix loureiroi</i>	Tree	Whole plant	0.6%
Bridal Couch Tree <i>Hymenodictyon orixense</i>	Tree	Twigs, bark, leaves	0.6%
Skunkvine <i>Paederia foetida</i>	Climber	Leaves, stem	0.5%
Unidentified (Poca) Rubiaceae family	Tree	Bark, twigs	0.5%

*NOTE: Not all of the collected plant samples have been identified yet. Remaining unidentified samples are currently with Dr. Prachaya of Queen Sirikit Botanical Gardens.

In total, 8184 minutes of foraging data were recorded, with 162 different species consumed, 108 of which have been identified. The plants consumed make up 44 different families; Adoxaceae (1 species), Anacardiaceae (5 species), Annonaceae (1 species) Apocynaceae (3 species), Araliaceae (1 species), Arecaceae (1 species), Asparagaceae (1 species), Asteraceae (2 species), Clusiaceae (1 species), Commelinaceae (1 species), Convolvulaceae (1 species), Costaceae (1 species), Cucurbitaceae (1 species), Dilleniaceae (1 species), Dioscoreaceae (1 species), Dipterocarpaceae (3 species), Equisetaceae (1 species), Euphorbiaceae (3 species), Fabaceae (23 species), Lamiaceae (1 species), Lythraceae (3 species), Menispermaceae (2 species), Moraceae (5 species), Musaceae (1 species), Myrsinaceae (2 species), Myrtaceae (1 species), Oleaceae (1 species), Orchidaceae (2 species), Pandanaceae (1 species), Passifloraceae (1 species), Phyllanthaceae (5 species), Piperaceae (1 species), Poaceae (10 species), Polygalaceae (1 species), Primulaceae (2 species), Rubiaceae (5 species), Rutaceae (1 species), Sapindaceae (1 species), Smilacaceae (1 species), Solanaceae (3 species), Tiliaceae (2 species), Ulmaceae (1 species), Vitaceae (1 species), Zingiberaceae (2 species).

The elephants consumed 85% browse species (bamboos, trees, shrubs and herbs) with grasses, including corn and rice crops, only making up 15% of their diet. Aside from two species of bamboo, that make up 46.1% of the species consumed, the most commonly consumed species were *Zea mays* (12.3%), *Sphatolobus* sp. (6.9%), *Gardenia sootepensis* (1.9%), *Radermachera* sp. (1.7%), *Shorea obtuse* (1.6%), *Gluta usitata* (1.5%), *Pachyrhizus* sp. (1.5%), *Spondias pinnata* (1.4%), Unidentified-local name Saykatoo (Apocynaceae family) (1.1%), *Dimocarpus longan* (1.0%) and *Dillenia* sp. (1.0%) (Table 2.3a).

There was no significant difference in the species foraged on by the four individual elephants (one-way ANOVA $F=0.175$, $p=0.913$).

2.4. Discussion and conclusions

Activity budgets

Many studies conclude that wild Asian elephants spend a majority of their time feeding (Baskaran et al. 2010, Ahamed 2015). This is corroborated by the results presented here. Looking at captive elephants, there is more variation in which behaviours are dominant: Elzanowski and Sergiel (2006) concluded that an elephant at Municipal Zoo, Poland spent 52% of its time in stereotypic behaviour (bouts of rhythmically repeated movements including swaying and head-bobbing). A study examining captive elephants in India, comparing forest camp elephants, temple elephants and zoo elephants, when pooled together, found that the elephants fed only 29% of the time (Varma et al. 2008). Mackey (2014) found elephants at San Diego Zoo spent the majority of their time feeding and standing. Samarasinghe and Ahamed (2016), looking at captive orphaned elephants in Sri Lanka, found their behaviours were dominated by feeding.

Diet analysis

The present study recorded over 107 species foraged on by the four study elephants. In similar studies, Jin et al. (2006) collected 106 samples from elephants in China, Joshi and Singh (2008) found elephants in Rajaji National Park, India, to eat 50 species of plants and Koirala et al. (2016), looking at elephants in Nepal, collected 57 plant species. To our knowledge there are no published studies on elephant foraging in Thailand.

Geographically, the closest publications to our study site are in Myanmar where Himmelsbach et al. (2006), looking at working elephants in their natural habitat, found that they consumed over 124 species and Campos-Arceiz et al. (2008), also looking at working timber elephants, recorded 103 species. This species diversity is more consistent with the diversity of plant species we have collected. Similarly to our study, Campos-Arceiz et al. (2008) relied on traditional local knowledge of mahouts to identify plant species. However, our study also employed the methods of Himmelsbach et al. (2006), using direct observation of the elephants as opposed to surveying locals or dung analysis. This type of observation provides more detailed information regarding the specific plant species eaten, as opposed to just investigation on the portion of grass and browse.

Our analysis of plant species foraged show exploitation of a large selection of species within the study area. Browse dominated the diet of our study elephants and this result is similar to elephants in dense-mixed and open-mixed forests in Northern West Bengal, India (Roy and Chowdhury 2014). By contrast, grass dominated the diet of elephants in deciduous and dry thorn forests of Nilgiri Biosphere Reserve in southern India (Baskaran et al. 2010). In Nepal, seasonal changes dictated whether the elephants preferred browse or graze food sources (Koirala et al. 2016). The significant differences in diets of Asian elephants from different areas shows the need for more research into the preferred diet of individual elephants in captivity. The American Zoo Association Guidelines for Elephant Management and Care (2012) suggest elephant diet should “include hay (e.g. meadow or timothy), supplemented with fruits, vegetables, a pelleted supplement or grain” and that. “Fresh browse should be made available daily, if possible.” This type of diet, however, would only be suitable for elephants originating from grassland habitats, where graze makes up a majority of their diet. For captive elephants in Thailand, there are no standards for elephant dietary requirements, but anecdotal evidence suggests that at many tourist venues graze species, including on grass and corn, make up the majority of the diet.

Natural behaviour and the implications for captive elephants

An expedition such as this enabled observations of captive Asian elephants displaying natural elephant behaviours while living in semi-wild conditions. The data collected showed that Kindred Spirit Elephant Sanctuary’s elephants’ behaviours more closely mimic those of wild Asian elephants, than of elephants in captivity.

The expedition also highlighted some areas for improvement in regards to management of captive elephant populations. For example, the discrepancies in the amount of time an elephant dedicates to feeding in captivity vs. KSES’s elephants vs. those in the wild demonstrate the importance of feeding as part of natural behaviour.

There is a need to improve captive conditions so that the behaviour of elephants in captivity can mimic those in the wild. This is possible, as demonstrated in this study by the lack of stereotypic behaviours observed in KSES's elephants compared to other captive elephant studies.

This study's contribution to elephant welfare and conservation

Understanding the diet, foraging ecology and behaviour of captive elephants living in semi-wild conditions can also contribute to wild elephant conservation efforts. Having a good knowledge of diet composition and foraging ecology of Thailand's elephants may help conservationists and wildlife managers in developing effective strategies to improve wildlife management.

Outlook

As this was the inaugural Biosphere Expeditions project in conjunction with Kindred Spirit Elephant Sanctuary in Thailand, further research is needed to ensure precision of collected data. As this was the first study investigating activity budgeting of semi-wild Asian elephants, the behavioural ethogram will be adjusted for the next expedition to incorporate knowledge acquired this year (ie. adding social-bathing and social-foraging as individual behaviours). As the elephants move to different areas of the forest throughout the study site, the forest composition differs, opening up new foraging opportunities, potentially adding species to the list of foraged plants. With future expeditions, data on the social behaviour of the elephants will be collected and analysed. Furthermore, in years to come, as the number of elephants under Kindred Spirit's care expands, the data sets can be expanded to incorporate more individual elephants in different age/sex classes.

Summary and action points for next expedition

Key findings of this expedition:

- A detailed description of the diets of elephants free-roaming in the forests of Northern Thailand
- A description of the behavioural patterns of four captive elephants free-roaming in the forest

Actions for next expedition and future research work:

- Complete elephant association data set
- Complete elephant activity budget data set with altered behavioural ethogram (including social bathing, social foraging, etc.)
- Publish foraging and activity budget data in a peer-reviewed journal and once published, create an elephant management guide to be distributed to elephant venues in Thailand and around the world
- If a beehive fencing project is set up (funding is being sought for this), create a new data set using camera trapping to monitor the effectiveness of the fences

2.5. Literature cited

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Appendix I: Expedition diary and reports



A multimedia expedition diary is available on <https://blog.biosphere-expeditions.org/category/expedition-blogs/thailand-2017/>.



All expedition reports, including this and previous expedition reports, are available on www.biosphere-expeditions.org/reports.