

THESIS

**ECOLOGY AND SEASONAL FORAGE OF THE PHAYRE'S LANGUR
(*Trachypithecus phayrei* Blyth, 1847) IN PHU KHIEO WILDLIFE SANCTUARY,
CHAIYAPHUM PROVINCE**

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the Requirements for the Degree of
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TABLE OF CONTENTS

	Page
TABLE OF CONTENTS	i
LIST OF TABLES	ii
LIST OF FIGURES	iii
INTRODUCTION	1
Objectives	2
LITERATURE REVIEW	3
Primate Characteristics	3
MATERIAL AND METHODS	10
Material	10
Methods	10
Study Site and Duration	16
RESULTS AND DISCUSSION	24
CONCLUSION AND RECOMMENDATION	53
Conclusion	53
Recommendation	56
LITERATURE CITED	57
APPENDIXES	60

LIST OF TABLES

Table	Page
1 Group composition and population dynamics of Phayre's langur (PA troop)	25
2 Percent usage of Phayre's langur's Food by number of individuals (N=1,673)	40
3 Number of individual of Phayre's langur (PA troop) were used the waters Termites and salt lick resources	44
Appendix Table	
1 List of Plant species at 4 sleeping sites sampling plots	61
2 List of IVI values of plant species at 1U 36 used by the Phayre's langur	64
3 List of IVI values of plant species at 1Z 45 used by the Phayre's langur	66
4 List of IVI values of plant species at G 52 used by the Phayre's langur	68
5 List of IVI values of plant species at K 44 used by the Phayre's langur	69

LIST OF FIGURES

Figure		Page
1	Differentiated in range of body size in Primates (Gorilla vs. Mouse Lemur)	3
2	Colobines monkey characteristics	5
3	Morphological characteristics of adult male Phayre's Langur	6
4	Tree plots system to reference the langur's position at the study site	11
5	Tree plots system to reference the langur's position	12
6	Map of Phu Kieo Wildlife Sanctuary	16
7	Map of Huay May Sot Yai within Phu Kieo Wildlife Sanctuary as the study site	17
8	Walter's climate diagram of Phu Khieo Wildlife Sanctuary from the year 1993 to 2003	20
9	Population Dynamics of the Phayre's langur	24
10	Phayre's langur home range size (yellow and cyan) and the core area (yellow) that were used through out a year	26
11	Home range size of the Phayre's langur in the dry season	28
12	Home range size of the Phayre's langur in the wet season	29
13	4 Plots of Phayre's langur's sleeping sites	30
14	Profile diagram and Crown cover of the Phayre's langur's sleeping sites at 1U 36	32
15	Profile diagram and Crown cover of the Phayre's langur's sleeping sites at 1Z 45	33
16	Profile diagram and Crown cover of the Phayre's langur's sleeping sites at G 52	35
17	Profile diagram and Crown cover of the Phayre's langur's sleeping sites at K 44	36
18	Parts of diet were used by the Phayre's langur in the wet season	37
19	Parts of diet were used by the Phayre's langur in the dry season	38

LIST OF FIGURES (Continued)

Figure		Page
20	Percent used of diet part used by the Phayre's langur compared between the dry and the wet season	38
21	Percent usage of Forage species by Phayre's langur from number of individuals (N = 1,673)	43
22	Vein's diagram of the diet species used by the Phayre's Langur	44
23	Salt lick at the G52 plot were used by the Phayre's langur (PA troop)	45
24	Young seed of <i>Afzelia xylocarpa</i> Craib which the most percent usage of Forage species by the Phayre's langur	45
25	Young seed of <i>Bauhinia saccocalyx</i> Pierre which the most percent usage of Forage species by the Phayre's langur	46
26	Percentage of daily activities of Phayre's langur from number of individuals (Adult N = 4,471, Juvenile N = 1,240, Infant N = 1,831)	48
27	Percentage of social behavior of Phayre's langur from number of individuals (Adult N = 830, Juvenile N = 168, Infant N = 644)	49
28	Percentage of adult's social behavior from number of individuals (N = 830)	50
29	Percentage of juvenile's social behavior from number of individuals (N = 168)	50
30	Percentage of infant's social behavior from number of individuals (N = 644)	50
31	Histogram of Phayre's langur from number of individuals	52

ECOLOGY AND SEASONAL FORAGE OF THE PHAYRE'S LANGUR (*Trachypithecus phayrei* Blyth, 1847) IN PHU KHIEO WILDLIFE SANCTUARY, CHAIYAPHUM PROVINCE

INTRODUCTION

In the past, the interrelationship between humans and wildlife apparently changed, since humans learned more and more how to trap and kill wildlife for foods and to train as labor in human activities. They learned to use wildlife for maximum benefits by unexpected the effect in the future, to breed animals, and settle down the domicile. They came to regard wildlife resources as useful in direct and indirect terms. Direct benefits accrue from foods and labors, whereas indirect benefits accrue through economics, recreation, science, genetic resources, or wildlife as factors of the ecosystem including social and political benefits.

Presently, human populations have greatly increased in number, thereby increasing the need to utilize wild lands and natural resources. These furthered activities were the cause of increasing wildlife and habitat destructions. Moreover, hunting had increased as well. Such deterioration of ecosystems and wildlife habitat affected the future of all humankind.

With the growing knowledge of environmental problems, humans have begun to find the ways to an appreciative use of their resources. They have started to pay attention to wildlife resource conservation. To this end, Wildlife Sanctuaries, National Parks, Non-hunting areas have been established to conserve wildlife habitat and ecosystems in Thailand. Such areas can also make use of environmental resources for sustainable yields under the principle of conservation and law enforcement.

Primates are one group of wildlife, which is under pressure of such human activities. Many species of the Primate in Thailand are decreasing in population size,

especially *Hylobates pileatus*, *H. agilis*, *Macaca assamensis*, *Presbytis femoralis*, and *Trachypithecus obscurus*. The causes of decreasing populations are both habitat destruction and poaching. If such trends should be stopped or even reversed, we must gain knowledge of the ecology and behavior of each species, in order to conserve and restore proper habitats. This applies equally to species such as *Hylobates lar* and *Trachypithecus phayrei*, which are supposed to a lower risk of threatening but with a trend of decreasing in population size and decreasing in distribution.

Too many years ago the illegal hunting on *Trachypithecus phayrei* is found. If habitat destruction and intensive hunting are continuing, these species would become critically endangered species in the future. That was the reason why the research was focused on the *Trachypithecus phayrei* will have been carried out.

Objectives

1. Study the characteristics of habitat used by the Phayre's langur.
2. Study the seasonal home range and diet of the Phayre's langur.
3. Study the social composition and behaviors of the Phayre's langur.

LITERATURE REVIEWS

Primate characteristics

Primates are one of the Order amongst the Class Mammalia. This Order is comprised of humans, apes, and monkeys together with the Prosimii. They differ from the other mammals in a number of traits such as for instance grasping hands and feet, improved binocular vision, and enlarged brains (Hill, 1972). Extant adult primates range in size from mouse lemurs and pygmy marmoset, with a body mass of less than 100 g, to male gorilla, with a body of mass more than 200 kg (Figure 1) (Fleagle, 1999).

Primates are extremely social animals. This sociality is evident, not only in the diverse types of social groups, but in the elaborate system of scent, postures, facial expression and vocalization, which primates have evolved to communicate with other individuals and groups (Fleagle, 1999).

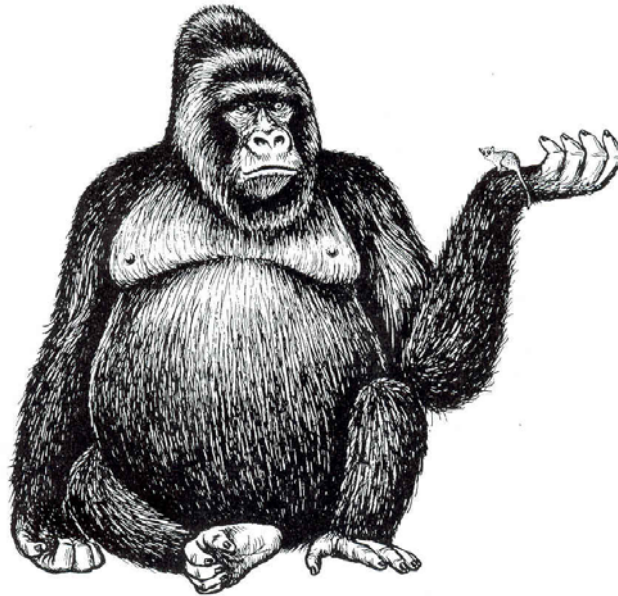


Figure 1 Differentiated in range of body size in Primates (Gorilla vs. Mouse Lemur).

Source: Fleagle (1999)

Fleagles (1999) noted that the social behavior of primates has evolved through natural selection. For the individuals, who make up primate groups, there are four possible advantages to group living such as: 1) greater protection from their predators; 2) improved access to food; 3) more access to mates; 4) assistance in caring for the young. The size and composition of the groups, in which primates live, is adapted to their daily activities and their methods used to explore the area of land.

Colobines

Old World monkeys, the superfamily Cercopithecoidea, include one family, Cercopithecidae that has in turn been subdivided into two subfamilies, the Cercopithecinae and the Colobinae. The Colobines are mostly arboreal, eat leaves and have sacculated stomachs (Ankel-Simons, 1983).

Colobines are leaf - eating monkeys. They are distinguished from Cercopithecines by their sharp-cusped cheek teeth and relatively narrow incisors. Their skulls have relatively short snouts, narrow nasal opening, broad interorbital bars and deep mandible. They have longer bodies than Old World monkeys, a short thumb, and no cheek pouches. One diagnostic feature is the stomach morphology. Colobines have a large, complex stomach, which several small chambers in their stomach. The fore stomach supports a bacterial fauna, which enables Colobines to digest fibrous foods such as leaves (figure 2) (Grzimek, 1972; Lekagul and McNeely, 1977; Fleagle, 1999).

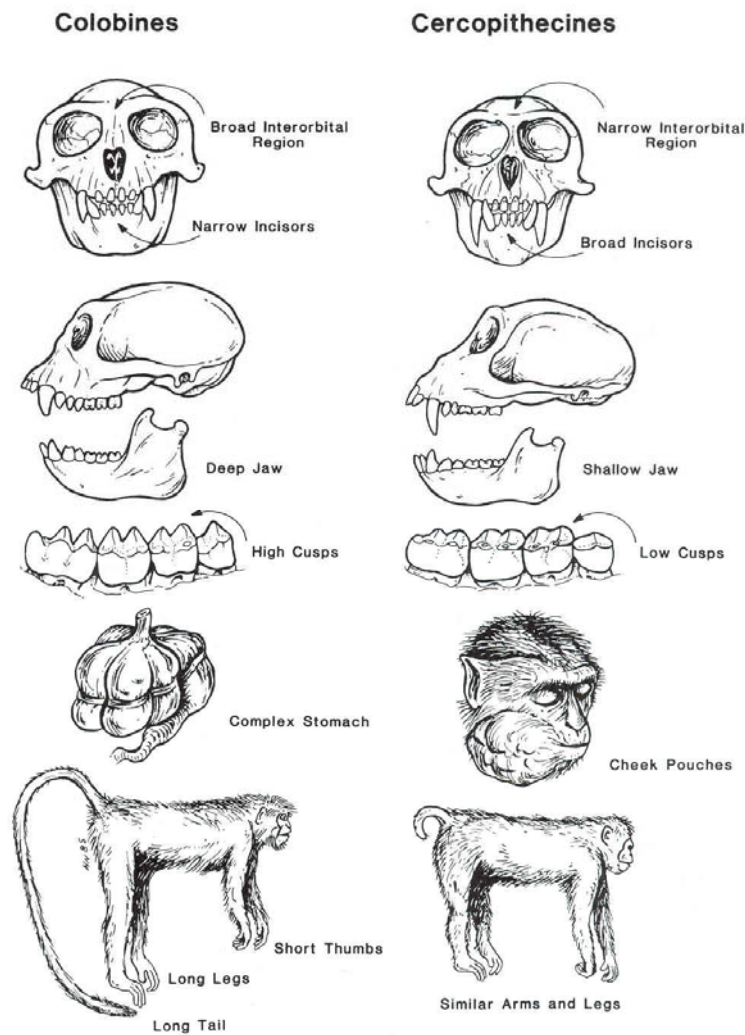


Figure 2 Colobines monkey characteristics.

Source: Fleagle (1999)

In general, the living Colobines are more arboreal and foliovorous than the Cercopithecines. There are two major groups of Colobines such as Colobus monkeys of Africa (African colobines) and the langurs or leaf monkeys of Asia (Asian Colobines) (Fleagle, 1999).

Species of langurs or leaf monkeys are the most widespread of Colobines and live across a wide range of Asia. At least fourteen different species (and more than eighty subspecies) have been proposed. Langurs are adapted to many different habitats

such as in the mountains, in rainforest, in mangrove thickets, in dry areas, and range into villages and towns (Ankel-Simons, 1983).

There are four species of Colobines can be found in Thailand such as Silvered Langur (*Trachypithecus cristata* (Raffles, 1821)), Banded Langur (*Presbytis femoralis* (Raffles, 1821)), Dusky Langur (*Trachypithecus obscura* (Reid, 1837)) and Phayre's Langur (*Trachypithecus phayrei* Blyth, 1847 (Wildlife Conservation Division, 1978; Lekagul and McNeely, 1977; Khobkate, 1976).

Phayre's langur Characteristics

Phayre's langurs (*Trachypithecus phayrei*) belong to the langurs or leaf monkeys of Asia (Asian Colobines). The fur color of the Phayre's langur varies across populations. Generally the upper body of adult is dark - brown to rusty – brown and gray. Moreover new born infant is golden's, at lower part of fur body are dark – gray or gray. Have a black or gray on the face, have white eyes ring on both eyes and a white muzzle. Some of individuals have long fur look like crest on the top of their head. This fur may be bends to the back. Hands and legs have a darker fur than other parts of the body (figure 3) (Lekagul and McNeely, 1977; Hill, 2001).



Figure 3 Morphological characteristics of adult male Phayre's Langur.

The lips and area around the eyes are white, while the ventral parts are whitish. Due to its distinctive lips and eyes, it is easily recognized in the field (Anwaruddin, 1994).

Size and Weight

Phayre's langur have a length of snout to vent as 520 – 620 mm, 32 – 36 mm of ears length, 170 – 180 mm of hind legs, 585 – 880 mm of the tail and have range of weight in 6 - 9 kg (Lekagul and McNeely, 1977).

Distribution

Phayre's langurs are one of the most widely distributed species of primates. They occur from Northeast India to the south of China down to the Indochina region including Myanmar, Thailand, Laos, and the northern part of Vietnam (Bhumpakphan, 1988).

Anwaruddin (1994) noted on in India Phayre's langur lives in semi-evergreen forest with abundant bamboos in low hills. It particularly these langurs favour habitat dominated by the shrub *Macaranga denticulata* and the herb *Alpinia allughas*. Such habitats are found at the junction of plains and hills.

In Thailand, they are can be found in the North, the North- east and the West. Phayre's langur and Dusky langur (*Trachypithecus obscurus*) are quite similar in morphological characteristics, *e.g.*, the eye rings and white muzzle are similar, but they differ in distribution. Dusky langurs live more to the south with an overlap at Rachaburi Province (Gairdner, 1915).

Ecology and Behavior

The habitat use by phayre's langur is not known in detail, but it occurs inhabit in the primary evergreen forest, dry evergreen forest, mixed deciduous forest and

bamboo forest. In addition, they can live above the cave, cliff and limestone-mountains (Bhumpakphan, 1988; Hunphrey and James, 1990). Sometime, especially on winter morning, they bathe in the sun at the top of canopy like Capped langur (*Presbytis pileatus*) and Hoolock gibbon (*Hylobates hoolock*) do (Anwaruddin, 1994).

They usually are living in group except the old langur, which may separate itself to live solitary. The size of group includes 2 – 30 members, but few data are available on the social structure. Thirteen individuals are formed the group at Wat Thum Pha Pu in Loei Province (Uicharoensak, 1993).

In Cachar, the langur lives with a range of 5 – 14 members. Sometime group were split into two groups during feeding, they become active shortly after dawn. After feeding they would travel to secluded and well-wooded hill-slopes and hilltops to rest and they would feed again in the afternoon at about 14.00 – 15.00 hours at the foot of hills (Anwaruddin, 1994).

Phayre's langurs are very shy and hardly vocalize, normally they stay in the top of the canopy for feeding, the forage consists of leaves and some fruit. Occasionally they climb down from the tree for drinking water on the ground (Lekagul and McNeely, 1977). Although the monkey is mostly arboreal, it was also observed on number of individuals on the ground, either moving about or feeding. This species can be observed from 10 – 15 m away without making them panic in Southern Cachar. However, they were alert and kept a watchful eye out (Anwaruddin, 1994).

Uicharoensak (1993) notes that their diet is composed of 41 species from 39 genera, 26 families and can be divided to 6 groups of diet species such as: 27 species of trees *i.e.* *Xylocarpus xylocarpa* Taub., *Holarrhena antidysenterica* Wall., *Pterocarpus macrocarpus* Kurz and *Polyalthia viridis* Craib; 6 species of climbers *i.e.* *Coccinia grandis* Voigt, *Cissus* sp., *Pterolobium integrum* Craib, *Acacia megaladena* Desv., *Desmos dumosus* Safford and *Dioscorea* sp.; 5 species of shrubs *i.e.* *Broussonetia papyrifera* Vent., *Strebus ilicifolius* Corner, *Capparis microcantha* DC., *Leucaena*

leucocephala de Wit and *Schefflera* sp. and only 1 species of palm is *Cocos nucifera* Linn., bamboo is *Dendrocalamus strictus* (Roxb.) and herb is *Musa sapientum* Linn.

In India they were observed feeding on bamboo shoots of the species *Melopcanna bambusoides*, figs of *Ficus hispida* and tender leaves of various trees and shrub. Flower of *Bombax ceiba* were also eaten (Anwaruddin, 1994).

In Chaiyaphum Province, they live in caves on inaccessible limestone cliffs. They are usually found high in the canopy, in the crown of the tallest trees, seldom coming as low as 15 meters through they may climb down from a tree to drink water (Lekagul and McNeely, 1977).

Threats

Every species of langurs were and is always hunted by humans for food and blood to make a medicinal wine mixture. In addition, habitat destruction by shifting cultivation for change to agricultural areas is directly affecting langurs, both practiced by local tribes. That is to say they are losing their habitat and optimal area for them to live their life (Lekagul and McNeely, 1977).

MATERIALS AND METHODS

Materials

1. Topographic map (1: 50,000) sheet number is 5341 IV
2. Hand held compass
3. Hand held Global Positioning System Receiver (GPS receiver)
4. Binoculars
5. Camera
6. Data sheet and field books
7. Stop watch
8. Marking equipment
9. Sampling plot equipment

Methods

Data collection

1. Habitat used: Preliminary survey in the study area and designed which the habituated group of *Trachypitecus phayrei*. There was only one group that was fully habituated named PA.

Borries *et al.* (2004) begun to habituate the group of Phayre's langur in October 2000. By January 2001 most adult and some immature individuals could be identified. In April 2001 all adult members of the group were completely recognized.

Planned to follow them and to observe until the home range size of their group was known. Observed the position where they lived by tree plots system in the 50 X 50 meters to mark the reference position or its location (figure 7 and figure 8). If the blue spots as the langur's position and the circles as the trees were marked as series number, the 1Z45 would be recorded like the plot of distribution.

From the Walter's climate diagram of Phu Khieo Wildlife Sanctuary (figure 6). The dry season and the wet season home range size could be identified from the observation periods and comparison of the langur's seasonal home range.

Their home range size could be approximately calculated from number of plot which the Phayre's langur had been used throughout the year as the total home range size, in the same way the dry season and wet season home ranges size were also calculated.

The sleeping sites of the Phayre's langur had been shown and decided the sampling plot for Plant community analysis at each sleeping site was usually used by the Phayre's langur.

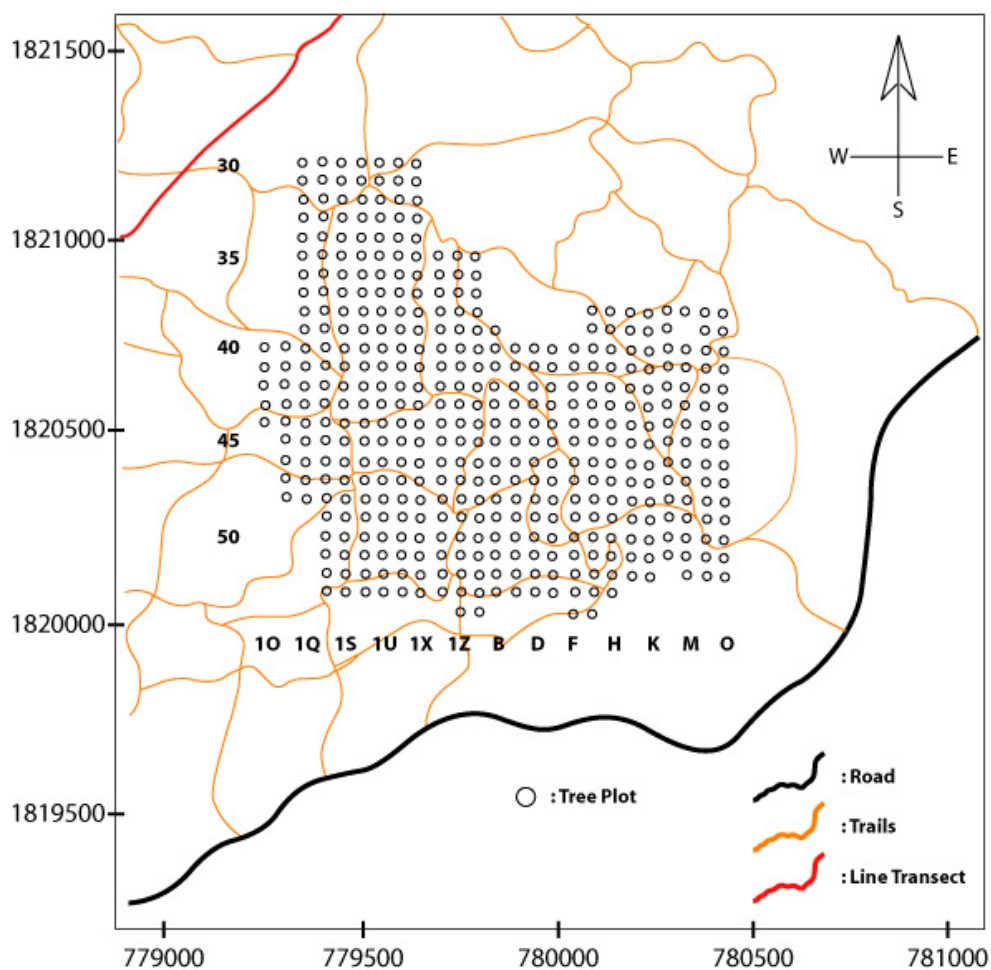


Figure 4 Tree plots system to reference the langur's position at the study site.

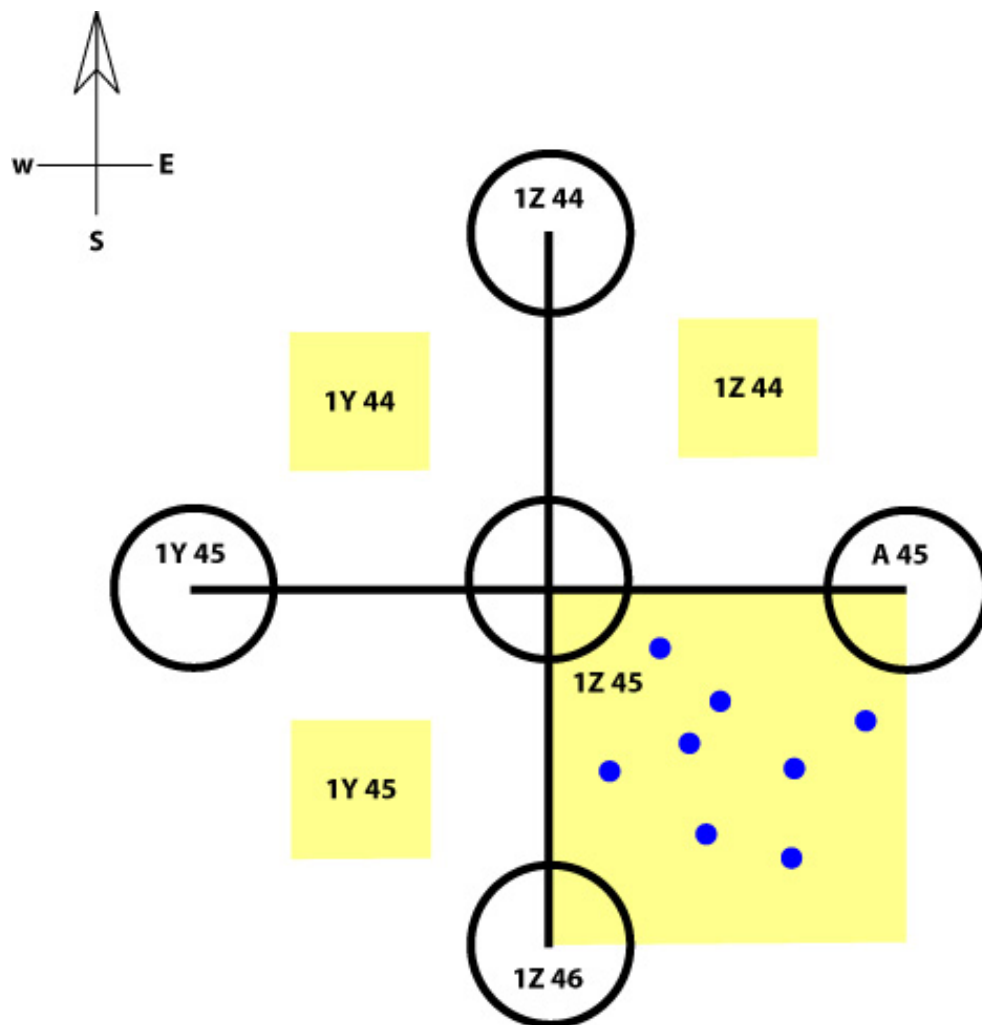


Figure 5 Tree plots system to reference the langur's position

2. Species of food plant and used factor: Observed situation finding out the food plant species which they used and eaten and in the observation units. Separated parts the diet species which the phayre's langur were used in dry season and wet season.

3. Daily activities: observed daily general activities of each individual within group trying to get information of as many individuals as possible such as

3.1 Feeding behavior: when actual ingesting, chewing, specify food plant's item.

3.2 Traveling behavior: when walking, moving, leaping.

3.3 Resting behavior: when sitting or lying and the eyes were closed.

3.4 Auto grooming: when grooming or scratching themselves.

3.5 Social behavior: when at least two individuals were interacting is was further, specified the states and the partners such as Grooming behavior, Body contact, Nipple contact, Sexual behavior.

3.6 Inactive stage: when not doing something or monitoring regardless of the object.

Detected and recorded their behaviors were observes via binoculars and walked along with them, the observation had been started since they were active in the morning until they were slept in the evening 05:00-19:00 hours and amount of the total times were observed is contacted time between 06:00-18:00 hours.

For this study, the activities observation were designed for 3 times per a hour, each 20 minutes is the interval of observation units and taken no more than 10 minutes for each units of observation.

Data analysis

1. Analyzed the home range size to compare between the dry season, the wet season and the core overlapping area which they used during both seasons. The sleeping sites of Phayre's langur were calculated by the term of quantitative characteristic of plant communities, calculated as the Importance Value Index (IVI), included Dominance from basal area, Frequency, Density, relative dominance (RDo),

relative frequency (RF) and relative density (RD) of trees species (Kutintara, 1990) such as:

$$\text{Dominance}_A (\text{Do}) = \frac{\text{Basal area of species A in sampling plots}}{\text{All of sampling plot area}}$$

$$\text{Density}_A (\text{D}) = \frac{\text{Number of species A have been found in sampling plots}}{\text{All of sampling plot area}}$$

$$\text{Frequency}_A (\text{F}) = \frac{\text{Number of plots which species A have been found}}{\text{Number of sampling plots}}$$

$$\text{Relative Dominance}_A (\text{RDo}) = \frac{\text{Dominance of species A x 100}}{\text{Dominance of all species in sampling plots}}$$

$$\text{Relative Density}_A (\text{RD}) = \frac{\text{Density of species A x 100}}{\text{Density of all species in sampling plots}}$$

$$\text{Relative Frequency}_A (\text{RF}) = \frac{\text{Frequency of A x 100}}{\text{Frequency of all species in sampling plots}}$$

After that the data can be calculate to Importance Value Index (IVI) by the term of $\text{IVI}_A = \text{RDo}_A + \text{RDA} + \text{RF}_A$ and the Importance value Index value were ordered refer to the amount values the Dominant trees of each sample plots.

2. Similarity index (IS) and dissimilarity index (ID) of each sample plots were calculated by the term of Sorrensen (1948 refer to Kutintara, 1975).

$$\text{IS}_s = \frac{2W}{A + B} \times 100$$

when IS_s = Similarity index
 A = number of species in plot A
 B = number of species in plot B
 W = number of species in plot A and B

And the dissimilarity index from

$$ID = 100 - IS$$

when ID = dissimilarity index
 IS = Similarity index

3. The data of seasonal forage species of *Trachypithecus phayrei*, were analyzed by the term of percent usage of each species by amount of individuals were detected per total of individuals were detected of all species. Calculated and compared groups of forage were categorized in 3 groups: the dry season, the wet season and the whole year.

4. The data of daily activities of *Trachypithecus phayrei* were analyzed by the term of percent of behavior for every age class included adult, juvenile, infant and the whole age class separated between the dry season and the wet season by amount of individuals of each behavior were detected per amount of individuals detected of all behavior characteristics.

Then the percentage behavior of each unit from observations have been taken to plot in histogram by the averaged of whole unit time series of total observation times.

Study Site and Duration

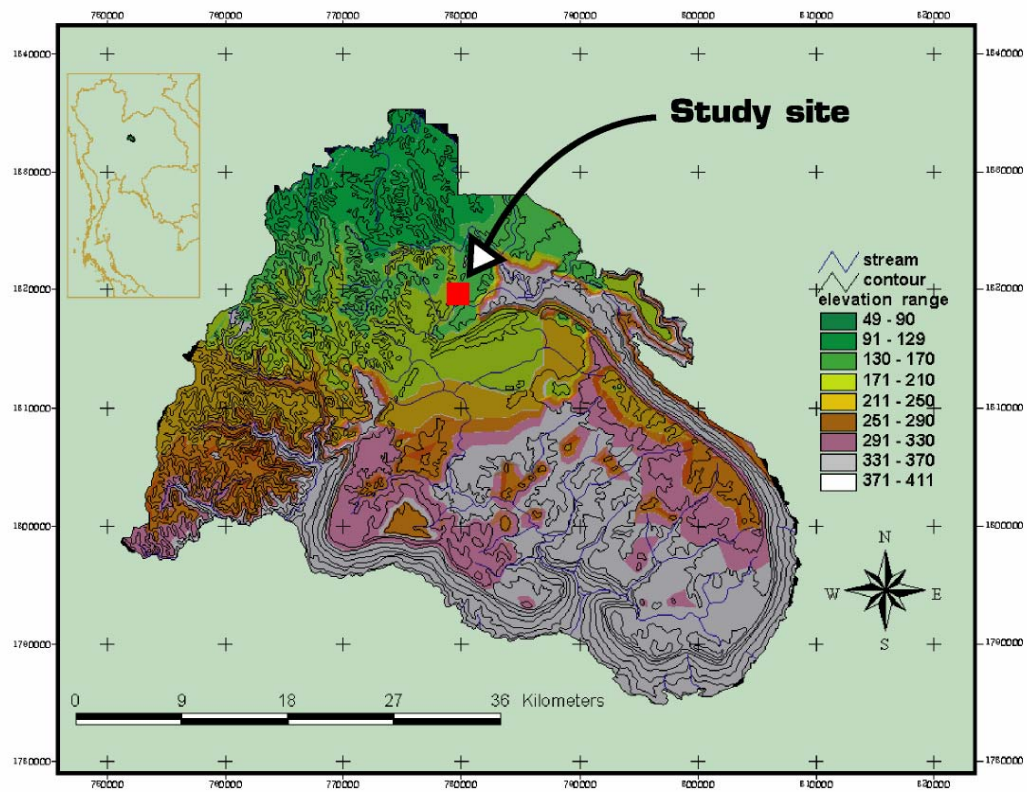


Figure 6 Map of Phu Kieo Wildlife Sanctuary.

Source: Western Forest Complex Ecosystem Management Project. (2004)

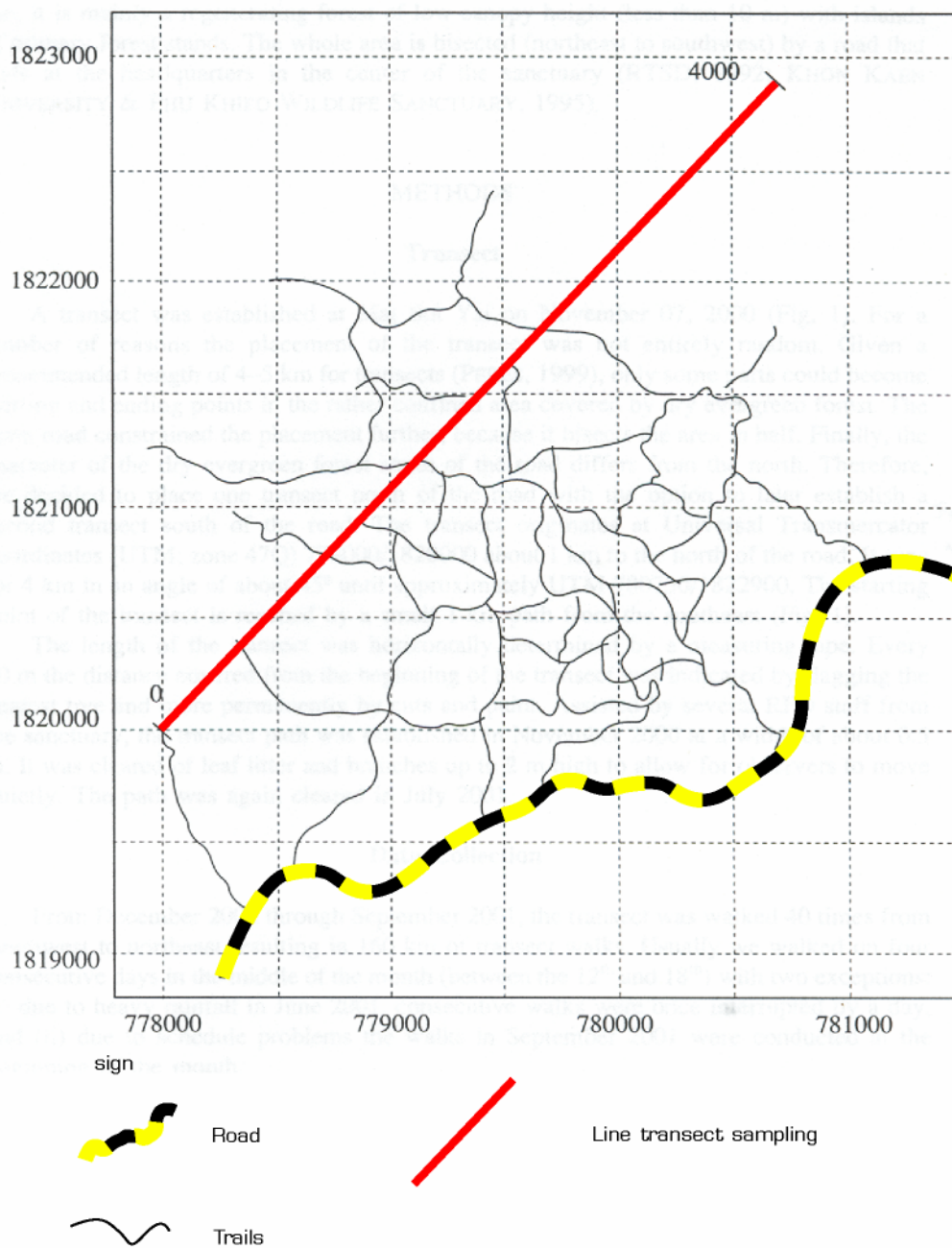


Figure 7 Map of Huay May Sot Yai within Phu Kieo Wildlife Sanctuary as the study site.

Source: Borries *et al.* (2002)

Study site

1. Background

Phu Kieo Wildlife Sanctuary was established in 1972 by the Thai government, following a revolutionary committee's notice. The area covers approximately 975,000 rai. It is located in Chaiyaphum Province. Due to the forest concession in the area, those areas had been encroached for agriculture and wildlife hunting subsistence by local peoples and settlements were found at Thung Kra Mung and Boung Mon. In 1972, all of 40 families from Thung Kra Mung and 100 families from Saraphrom areas were translocated to relocation sites. Some of them were resettled at Thung Lui Lai Area in Khonsan District, Chaiyaphum Province.

In 1979, the Thai Government added some more area into Phu Kieo Wildlife Sanctuary and migrated 304 families of privates at Ban Nong Rai Kai, Ban Phromsong, Ban Pha Pong and Ban Somtoei into Dong Larn Reserved Forest Development Project at Khonkhaen Province.

2. Location and connection

Phu Kieo Wildlife Sanctuary is located at Latitude between 16° 5' to 16° 35' N and Longitude 101° 20' to 101° 55' E, with a total area 1,573 square kilometer (983,175 rai). The sanctuary extends to Thung Lui Lai subdistrict Khonsarn district, Ban Yang, Ban Kha, Ban Boa subdistrict Kud Lao Kasetsoomboon district, Nang Dad, Hnong Wang, Hnong Boa Dange, Tham Woa Dange subdistrict, Hnong Boa Dange district, Chaiyaphum province. The area is connected with neighboring areas such as

North to the Juraphon Hydro Electric Dam and Nam Nao National Park, Khonsarn District Chaiyaphum Province and Muang District, Phetchaboon Province.

South to Ta – Boa Hui Yai Wildlife Sanctuary, Tham Woa Dange, Nang Dad, Hnong Woa Dange Subdistricts, Hnong Boa Dange District, Chaiyaphum Province.

East to Phu Some Pak Nam National Reserved Forest at the time but to day there are going to be Pha Pong Wildlife Sanctuary in Kua Lao, Ban Yang, Ban Boa, Hnong Kha Subdistricts Kasetsomboon District, Chaiyaphum Province.

West to Ta – Boa Huai Yai Wildlife Sanctuary and Tard Mog National Park, Muang District, Petchaboon Province.

3. Topography

The sanctuary covers altitudes ranging from 250 – 1,310 meter above mean sea level (MSL). The west and north side includes steep mountains and slope complexes, which are a part of the Petchaboon Range. They mostly have a steep slope at high elevations with rock outcrop soil. The east and the south are a cliff with the center of the area being a big plain and some part of this area was a lake, there were covered by several of forest types.

4. Climate

The climate of the Phu Khieo Wildlife Sanctuary is classified in Coppen's World Climate System as Tropical Savannah Climate: AW. At the upper plain of this area and the foot of the hill the climate and precipitation vary. The amounts of the rainfall mean throughout the year were 1,100 mm at Chaiyaphum Province and at Thung Kra Mung 1,500 mm. The lowest mean minimum air temperature is 17 ° C, while the highest mean maximum is 27 ° C. The mean of relative humidity is 90 percent. The dry season lasts from 5 months, November to March and the wet season lasts from 7 months, April to October (Figure 6).

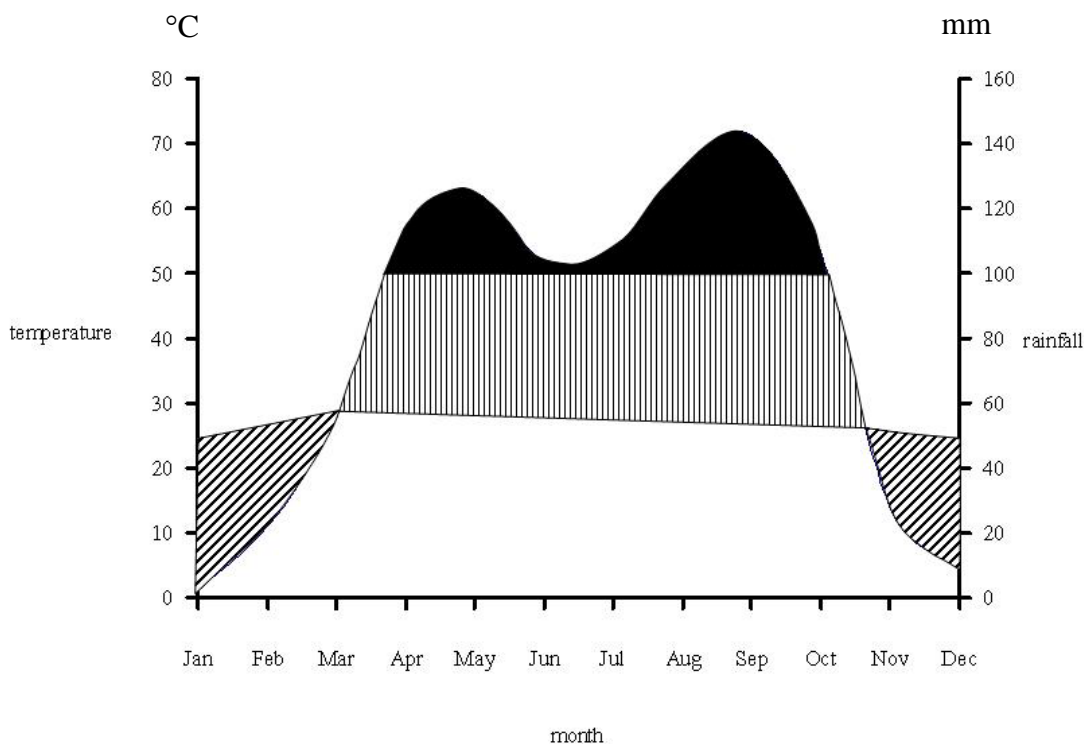


Figure 8 Walter's climate diagram of Phu Khieo Wildlife Sanctuary from the year 1993 to 2003.

Source: Computer Section, Climatology division, Meteorological department. (2003)

Based on the Walter's climate diagram of Phu Khieo Wildlife Sanctuary, the dry season (November 2003 – March 2004) and the wet season (April 2004 – October 2004) could be identified for the observation periods for the sizes and comparison of the langur's seasonal home range.

5. Vegetative covers

Phu Kieo Wildlife Sanctuary includes several different plant communities, which can be classified into 8 types of forest (Horata and Kreetiyutanond, 1997):

Hill Evergreen Forest: it prevails at more than 800 m., MSL. The mean of temperature is less than 24 °C, the humidity is much more than 90 percent. The

dominant tree species are *Quercus auricoma*, *Lithocarpus dealbatus*, *Aquilaria crassna*, *Cacrydium elatum* and *Cimocarpus longan*.

Dry Evergreen Forest: it prevails at less than 800 m., MSL. The temperature is higher than in the Hill Evergreen Forest, but it has less humidity especially in dry season. The dominant plant species are *Lagerstroemia calyculata*, *Azelia xylocarpa*, *Hopea ferrea*, *Memecylon geddesianum* and *Dendrocalamus strictus*.

Moist Evergreen Forest: it prevails at the riverside of ravines with more than 600 m., of altitude and a very high amount of humidity. Some parts of the area are flooded in the wet season. The important plant species are similar to Hill Evergreen Forest and comprise of *Baccaurea sapida*, *Livistona speciosa*, *Arenga siamensis*, and several species of rattans.

Dipterocarp Forest: It can be subdivided into 2 types, there were Deciduous dipterocarp forest and Mixed pine – Deciduous dipterocarp forest. The details are as follow:

- Deciduous dipterocarp forest: it prevails at the slope of the mountains, with a long dry season and a ainpoally hot weather. It includes the dominant plant species such as *Shorea obtusa*, *S. siamensis*, *Phyllanthus embrica* and *Phoenix acaulis*.

- Mixed pine - deciduous dipterocarp forest: it prevails at about 700 – 900 m. MSL. The temperature is less than 25 ° C through out the year. The areas are humid, have an intermediate slope and a good drainage. The dominant plant species are *Pinus kesiya*, *Dipterocarpus obtusifolius*, *Phyllanthus embrica* and *Quercus kerrii*.

Mixed Deciduous Forest: it prevails in the area of the north-east hill side, which is not more than 600 meter above sea level. Generally, it looks similar to

Dipterocarp Forest but does not have any Dipterocarpaceae. Often these areas contain bamboo. The dominant plant species are *Vitex peduncularis*, *Schleichera oleosa*, *Dalbergia nigrescans*, *Terminalia bellerica* and *Gigantochloa albociliata*.

Pine Forest: it prevails in the more upper parts of the area or the connected zone with Nam Nao National Park. The pine species that can be found is *Pinus kesiya* in the small area.

Bamboo Forest: it prevails in wide areas of the west of the mountains. It alternates with hill ever green forest at more than 35% of slope. Generally, the bamboo species is *Gigantochloa albociliata*.

Grassland: It can subdivide into 2 types, i.e., natural and man-made grassland:

- Natural Grassland: it prevails at hill sides with rock outcrop soil and strong winds. It is combined with small shrub and dominant plant species such as *Imperata cylindrica*, *Osbeckia* sp., *Ericocaulon* sp. and *Rhododendron lyi*.

- Man - made Grassland: it prevails in areas with previous agriculture area such as Thung Ka Mung, Bung Pan and Bung Ka. The dominant plant species are *Arundinaria pusilla* and *Cyperus* sp.

6. Wildlife resources

Phu Kieo Wildlife Sanctuary has too much biodiversity and area was connected with Nam Nao National Park, Tard Morg, Thabao Hui Yai Wildlife Sanctuary and Pha Pong Wildlife Sanctuary, that was the optimized habitat for several wildlife species.

Department of Forest Biology, Faculty of Forestry, Kasetsart University (0000) was noted on the number of discovered wildlife species as follow:

57 species of mammals such as *Elephas maximus*, *Panthera tigris*, *Macaca nemestrina*, *Ursus thibetanus* and *Cervus unicolor*.

Of the 356 species of birds, there are some interesting birds such as *Anorrhinus tickelli*, *Buceros bicornis*, *Anthracoceros albirostris*, *Upupa epops*, *Caracias benghalensis* and *Harpactes ereskius*.

There are 28 species of reptiles such as *Bungarus candidus*, *Ophiophagus hannah*, *Trimeresurus albolabris*, *Indotestudo elongata* and *Calotes emma*.

There are 15 species of amphibians such as *Bufo melanostictus*, *Phrynoglossus martensi*, *Rana pileata*, *Bufo macrotis*, *Rana nigrovittata*, *Rhacophorus verrucosus* and *Microhyla berdmorei*.

Also, 26 species of fishes including nature species such as *Neolissochilus blanci*, *Hampala macrolepidota* and alien species such as *Cyprinus carpio*, *Barbodes altus* and *Labeo rohita*.

Finally, endangered species found in the sanctuary are *Dicerorhinus sumatrensis*, *Panthera tigris*, *Elephas maximus* and *Cairina sculata* (Horata and Kreetiyutanond, 1997)

RESULTS AND DISCUSSION

From the twelve months of observation on the home range size, seasonal forage and behavioral ecology of the Phayre's langur was started from November 2003 until December 2004. Huay Mai Sot Yai at Phu Khieo Wildlife Sanctuary, Chaiyaphum Province was selected as study area because it has been used by the habituated group of Phayre's langur (named PA troop).

Firstly, there were between 14 and 17 in PA including 2 adult males, 5 adult females, 2 juvenile males, 2 juvenile females and 5 infants II and after observation had been done, there were fourteen individuals present. Several individuals disappeared from the group and several new individuals were added in group.

The group composition and population dynamics are shown in table, see figure 1. and table1. Four months later after the observation had been done, they were sixteen individuals. They had a new born and juvenile female added in group.

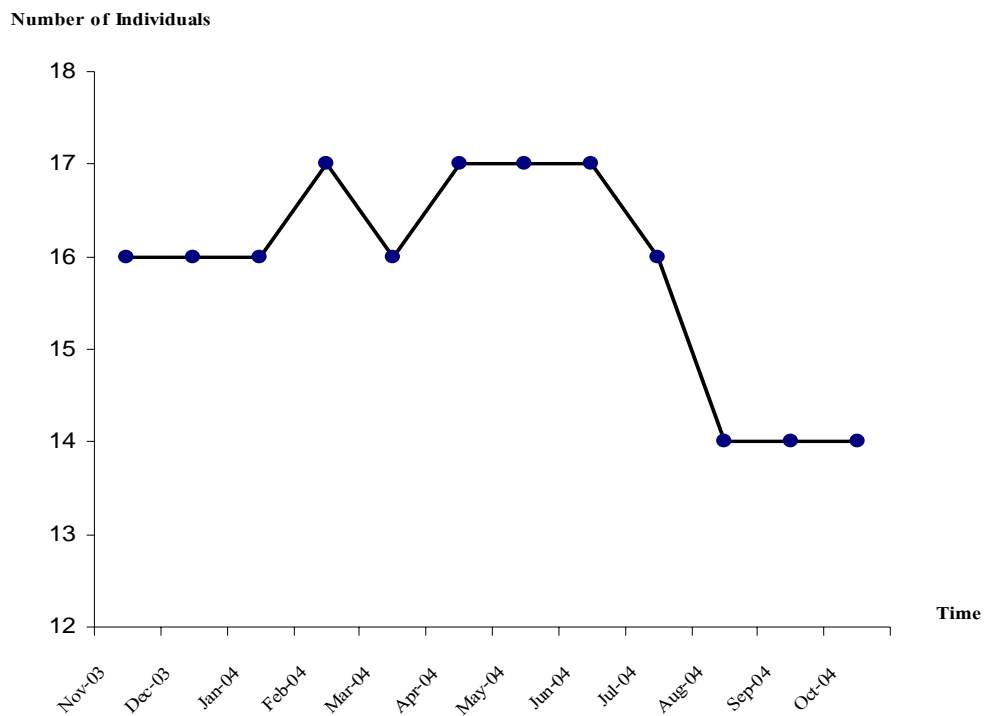


Figure 9 Population Dynamics of the Phayre's langur.

Table 1 Group composition and population dynamics of Phayre's langur (PA troop).

Month	Group composition						Group size	comments
	Adult male	Adult female	Juvenile male	Juvenile female	Infant male	Infant female		
November 03	2	5	2	2	2	3	16	
December 03	2	5	2	2	2	3	16	
January 04	2	5	2	2	2	3	16	
February 04	2	6	2	1	4	4	17	+ A 11.1 ¹
March 04	2	5	2	1	2	4	16	- A 10 ²
April 04	2	5	2	2	2	4	17	+ A 12 ³
May 04	2	5	2	2	2	4	17	
June 04	2	5	2	2	2	4	17	
July 04	2	5	2	2	1	4	16	- Am
August 04	2	3	2	2	1	4	14	10.1 ⁴
September 04	2	3	2	2	1	4	14	- A 4, A
October 04	2	3	2	2	1	4	14	5 ⁵

¹PA has a new born from A11 and A11 become adult female.

²Adult female absent.

³Juveniles female added in group.

⁴One infant (Am10.1) absent.

⁵Two adult (A4, A5) absent.

1. Habitat Used

During fourteen months in observation of home range for the habituated group of Phayre's langur (PA troop) at Huai Mai Sod Yai, PhuKhieo Wildlife Sanctuary had been done on October 2004 by 518 hours 10 minutes of contacted time from 557 hours 50 minutes of observation times. The result reflected that habitat used by Phayre's langur were Dry Evergreen Forest, Moist Evergreen Forest near the stream and Mixed Deciduous Forest.

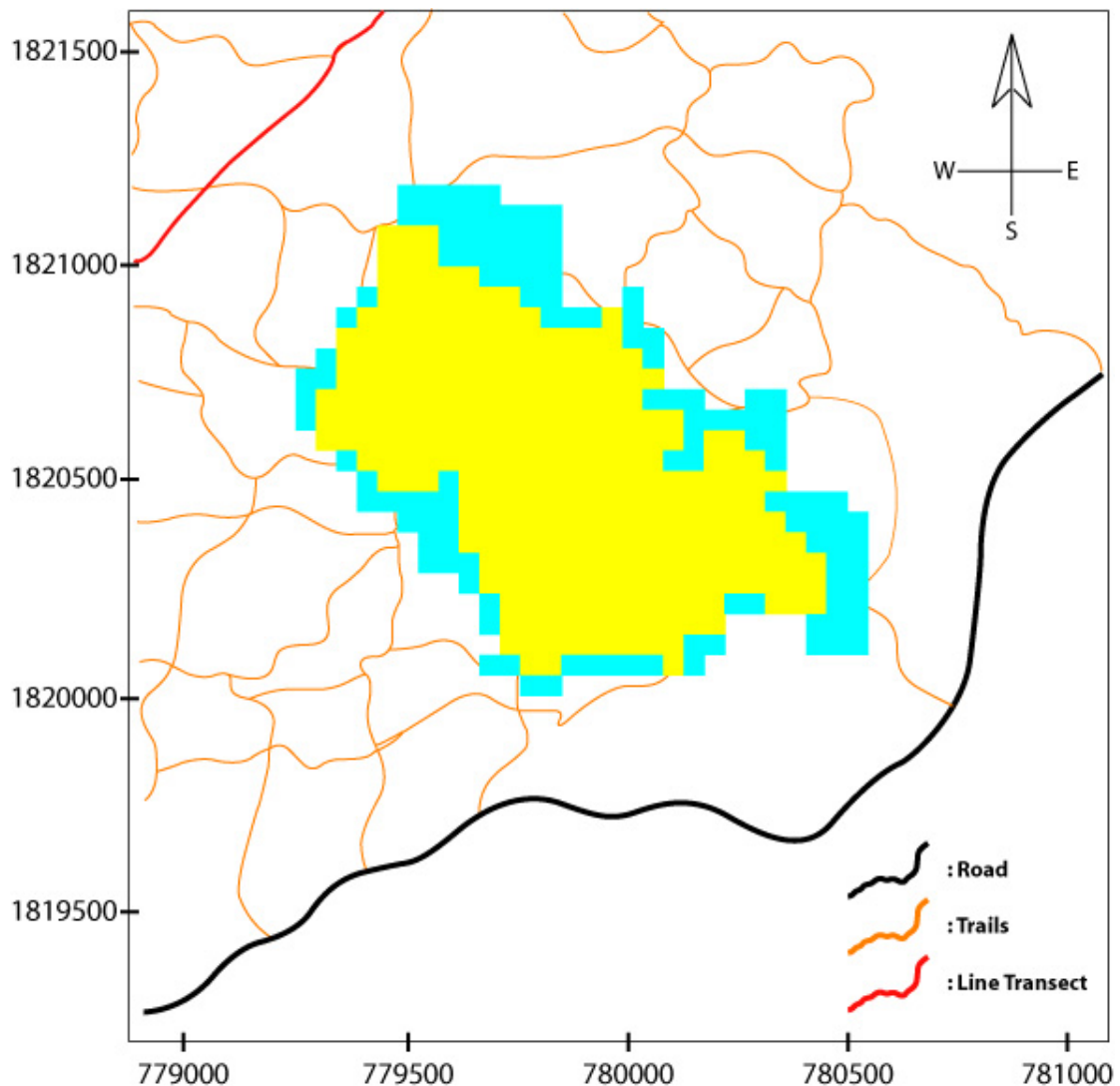


Figure 10 Phayre's langur home range size (yellow and cyan) and the core area (yellow) that were used through out a year.

Water sources and salt licks, it may have several reasons for support them to spend their time with such as in evergreen forest with continuous crown cover that the Phayre's could moved through easily. It was very comfortable to forage the food plant species including this area have many species of food plant that could be available though out the year such as *Azelia xylocarpa* Craib., *Pterocarpus macrocarpus* Kurz and *Pterocymbium tinctorium* (Blanco) Merr.

Moreover, there were many water sources and salt licks which were used by the Phayre's langur especially in the dry season which was extremely hot and dry period of the year. Then their habitat utilizations were found near the water sources and salt lick.

Pages *et al.* (2004) noted on the Phayre's langur in Phu Khieo Wildlife Sanctuary named PS which fully habituated and shared some part of habitat with PA troop at Huay Mai Sod Yai that on salt lick days, the Phayre's langur stopped to rest less often during travel than they did on non – salt lick day, and mentioned a more consist speed of travel.

From the observation through out 14 months long, there was 1.02 km² or 635.9 rai were used by the Phayre's langur (figure 10). In the dry season was 0.80 km² or 501.6 rai (figure 11) and the wet season was 0.94 km² or 585.9 rai (figure 12).

There was a little different in detail because in the dry season there were have limited forage species so they traveled in small group to the food plant tree which was available. But in the wet season, many food plant species were available that might effectively make the Phayre's langur spread the group more widely. Finally, both seasons (the core area) at least 0.72 km² or 451.6 rai were used by the Phayre's langur included the water sources and salt lick in this area.

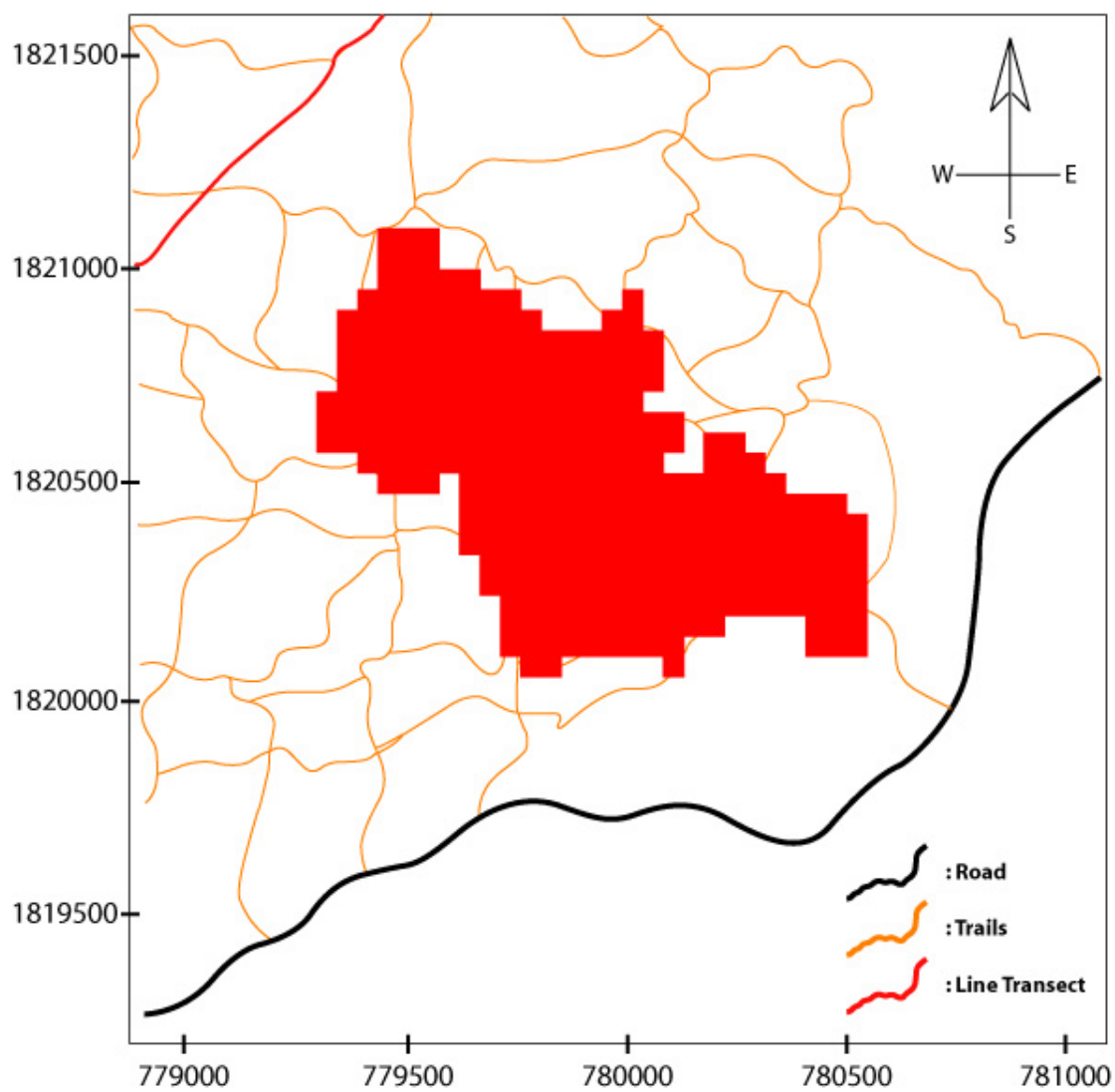


Figure 11 Home range size of the Phayre's langur in the dry season.

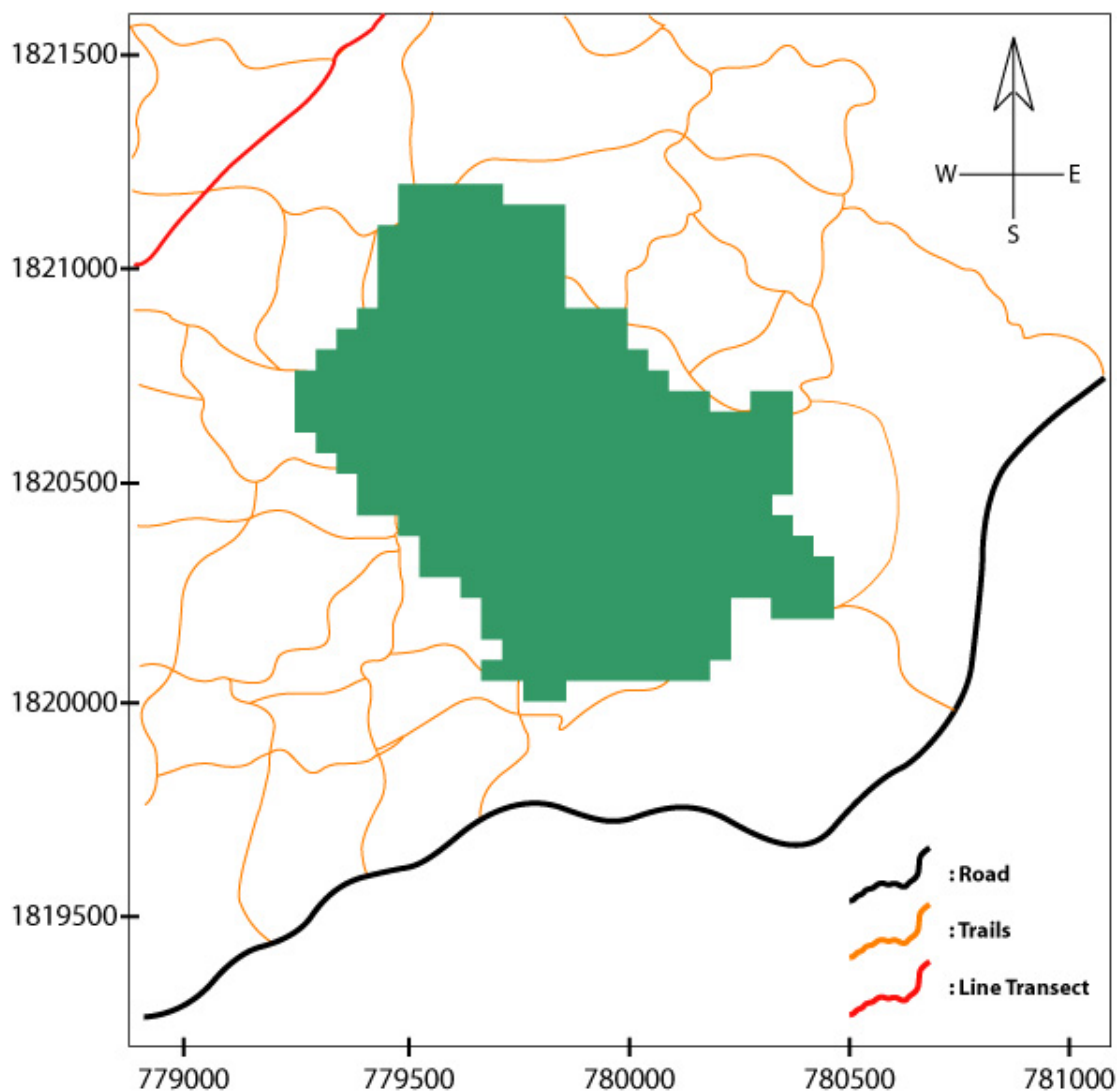


Figure 12 Home range size of the Phayre's langur in the wet season.

2. Sleeping sites plant community

From the habitat use observation PA was found to usually 4 sleeping sites such as 1U36 (31.48%), 1Z45 (33.33%), G52 (16.66%) and K44 (18.51%) percent from total observation times, see figure 13.

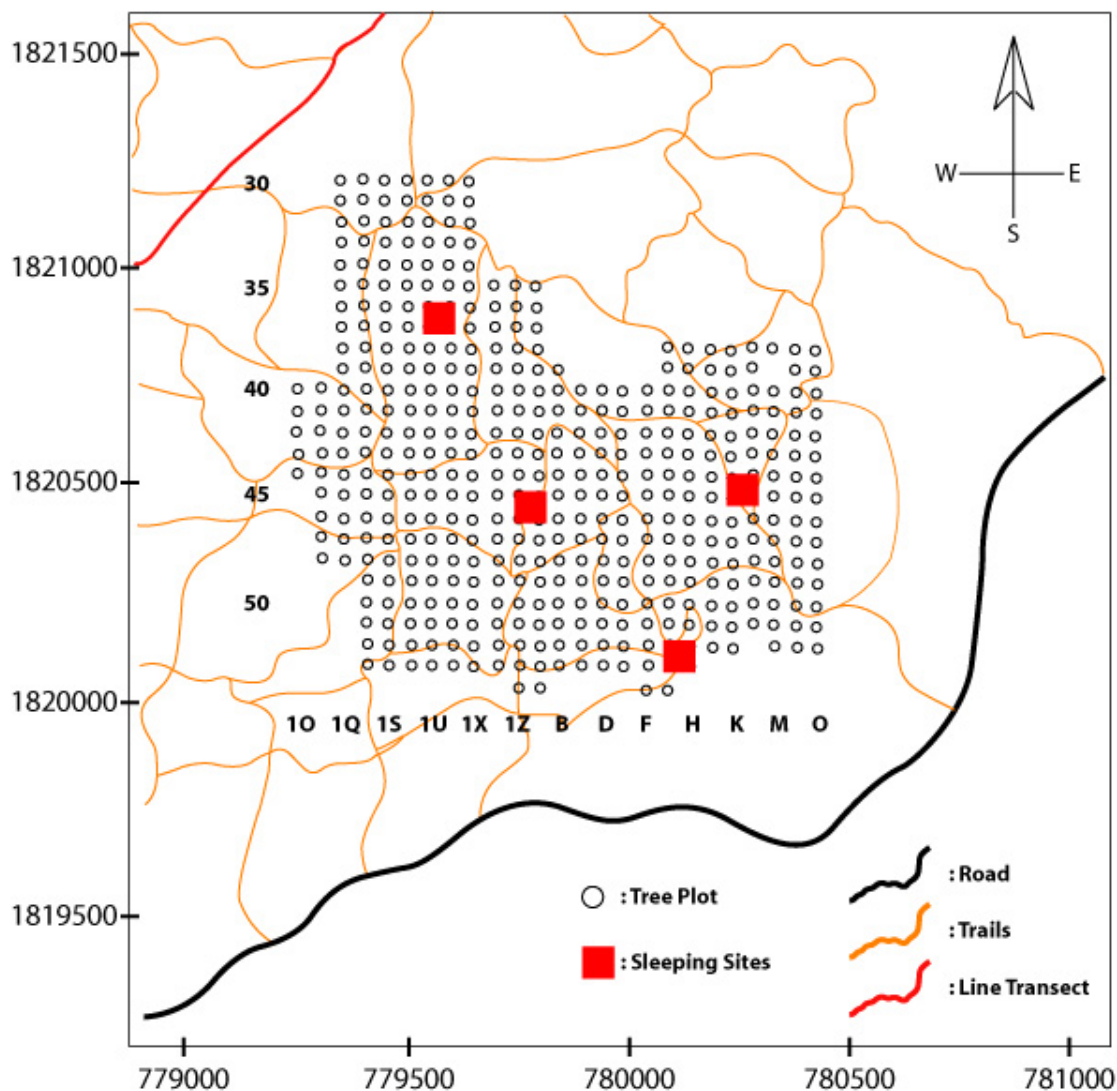


Figure 13 4 Plots of Phayre's langur's sleeping sites.

However there several plots were used by Phayre's langur were closely from sleeping sites. There were several cause effects for the group movement of the Phayre's langur such as weather situations, raining day, strong wind. Moreover food plant distribution or some periods have not enough food plant available its make them moving so far from sleeping sites, that makes them unable comeback before dark.

Normally, the Phayre's langur usually fed nearby the sleeping sites before the sunset but some time, there were rained all daylong that make them not to go anywhere but after the rain stopped they were moved quickly to sleeping site before there it became to dark.

1U 36: There was 75.33 % of crown cover. *Lagerstroemia calyculata* Kurz has the highest value of IVI. There was the most distribution in this site, included *Rhus* sp. Both species were suitable for Phayre's langur utilization because there were a lot of relative dominant that seem to be there were the big trees (figure 14 and appendixes table 2).

In addition, there were 3 layers of tree stratum included dominant trees, subdominant trees and undergrowth that might forages species in some periods such as *Mitrephora vandaeflora* Kurz., *Glyptopetalum sclerocarpum* M.A.Lawson and *Eriobotrya bengalensis* Hook.f.

1Z 45: There was 67.33 % of crown cover, *Ficus retusa* L. var. *retusa* is the highest value of IVI. Subdominant tree such as *Rhus* sp., *Azelia xylocarpa* Craib and *Quercus glabricupula* Barrett. There were a few numbers of trees but with big branches which were suitable for Phayre's langur to use (figure 15 and appendixes table 2).

In addition, this plot was very important characteristics because had been in the center of home range. Phayre's langur could be chosen the several ways for fed every direction and near the stream. Especially there was *Azelia xylocarpa* Craib, which could be eaten by Phayre's though out the year either young seeds or leaves or flowers.

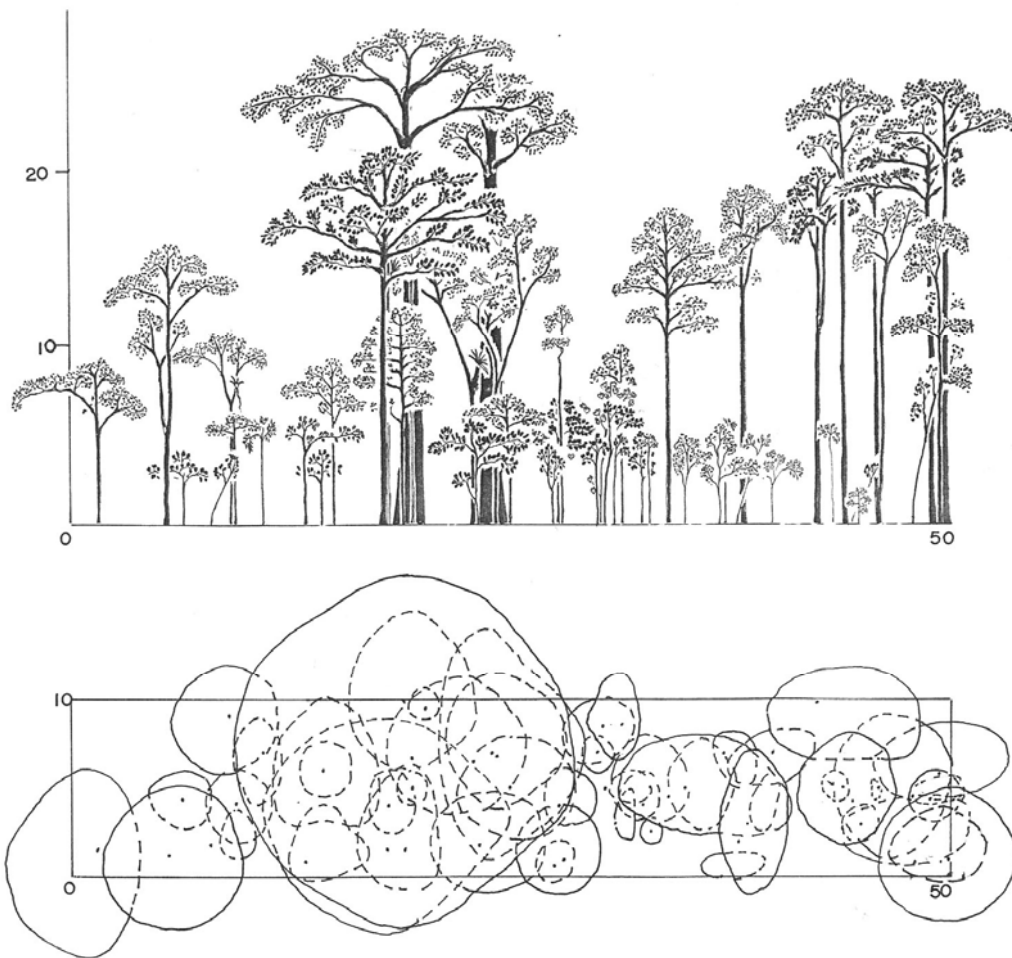


Figure 14 Profile diagram and Crown cover of the Phayre's langur's sleeping sites at 1U 36.

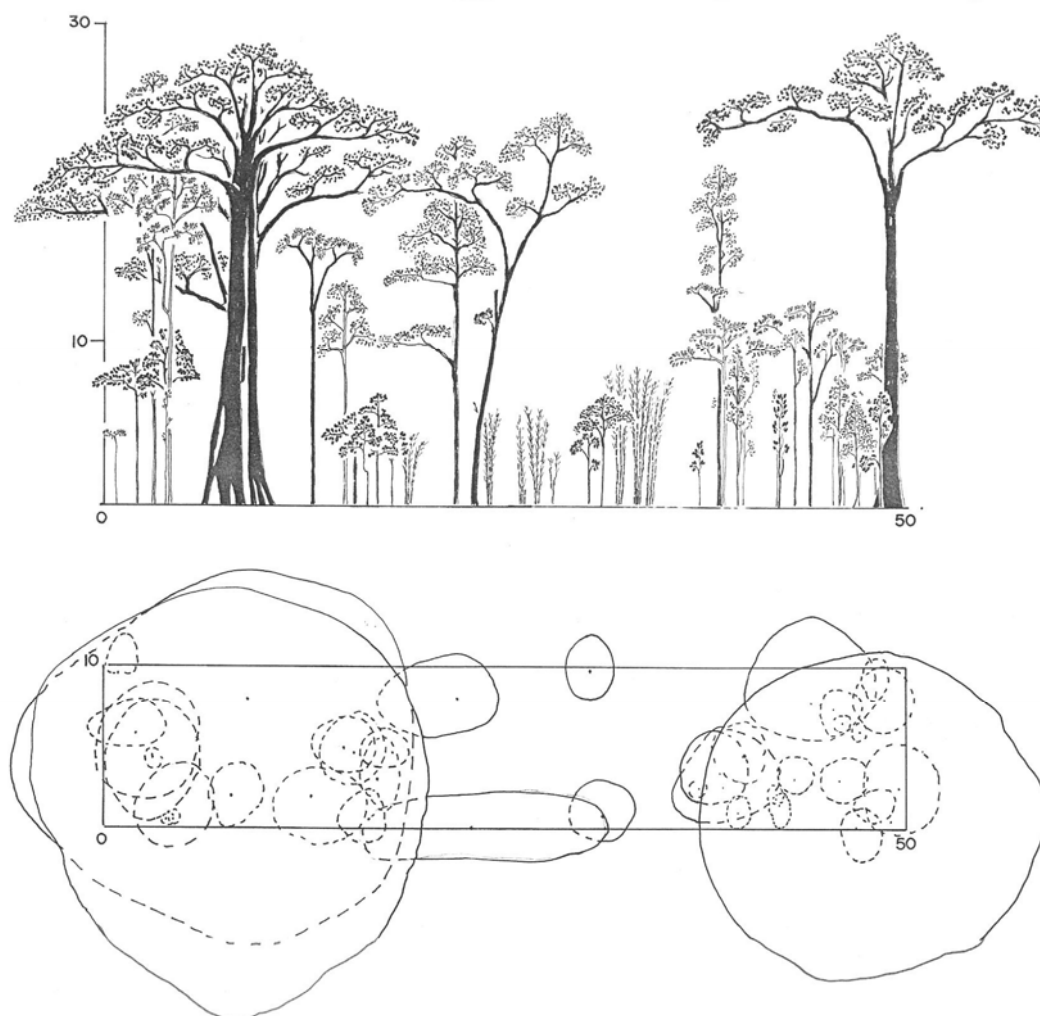


Figure 15 Profile diagram and Crown cover of the Phayre's langur's sleeping sites at 1Z 45.

G 52: There was 84.13 % of crown cover, *Hopea ferrea* Lanessis the highest value of IVI. There was the most distribution in this site, *Drypetes hainanensis* Merr. and *Lagerstroemia duperreana* Pierre ex Gagnep. were the subdominant trees (figure 15). There were density and continuous crown cover and about the under growth were *Drypetes hainanensis* Merr., *Memecylon geddesianum* Craib, *Pterocymbium*

tinctorium (Blanco) Merr. spreaded the most of sample plot (figure 16 and appendixes table 2).

Specific characteristics were have several food plant species such as *Gigantochloa cochinchinensis* A. Camus were used by Phayre's langur in the wet season, and there was nearby the stream and salt lick.

K 44: There was 94.53 % of crown cover with *Memecylon myrsinoides* Blume and *Hopea ferrea* Laness. were the highest IVI value. There was the least used by Phayre's langur from the first three plots. There were located at slope valley, covered by mostly subdominant trees and had a few large trees such as *Lagerstroemia calyculata* Kurz, but there was used by Phayre's langur at the daytime more than nighttime (figure 17 and appendixes table 2).

At undergrowth layer comprised by *Drypetes hainanensis* Merr., *Eriobotrya bengalensis* Hook.f., *Atalantia monophylla* Correa and *Lagerstroemia duperreana* Pierre ex Gagnep.

Both of the highest IVI values were different in relative density and relative dominant, *Memecylon myrsinoides* Blume was the most covered species, but *Hopea ferrea* Laness. was the most relative dominant. That the point that suitable for Phayre's sleeping sites was not depended on highest IVI value species, but depended on structure of community, canopy characteristics, and food sources and specify ecological niches.

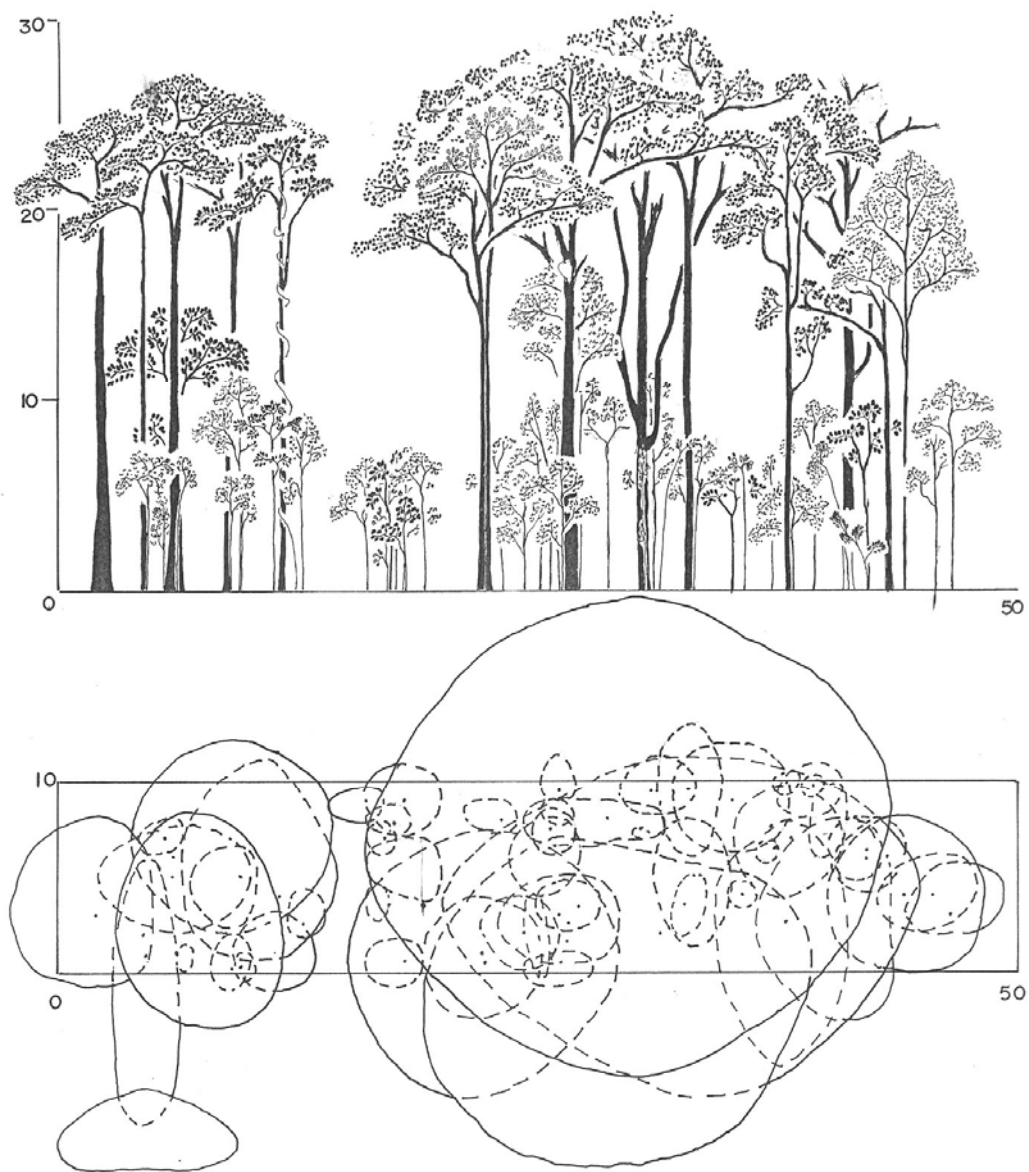


Figure 16 Profile diagram and Crown cover of the Phayre's langur's sleeping sites at G 52.

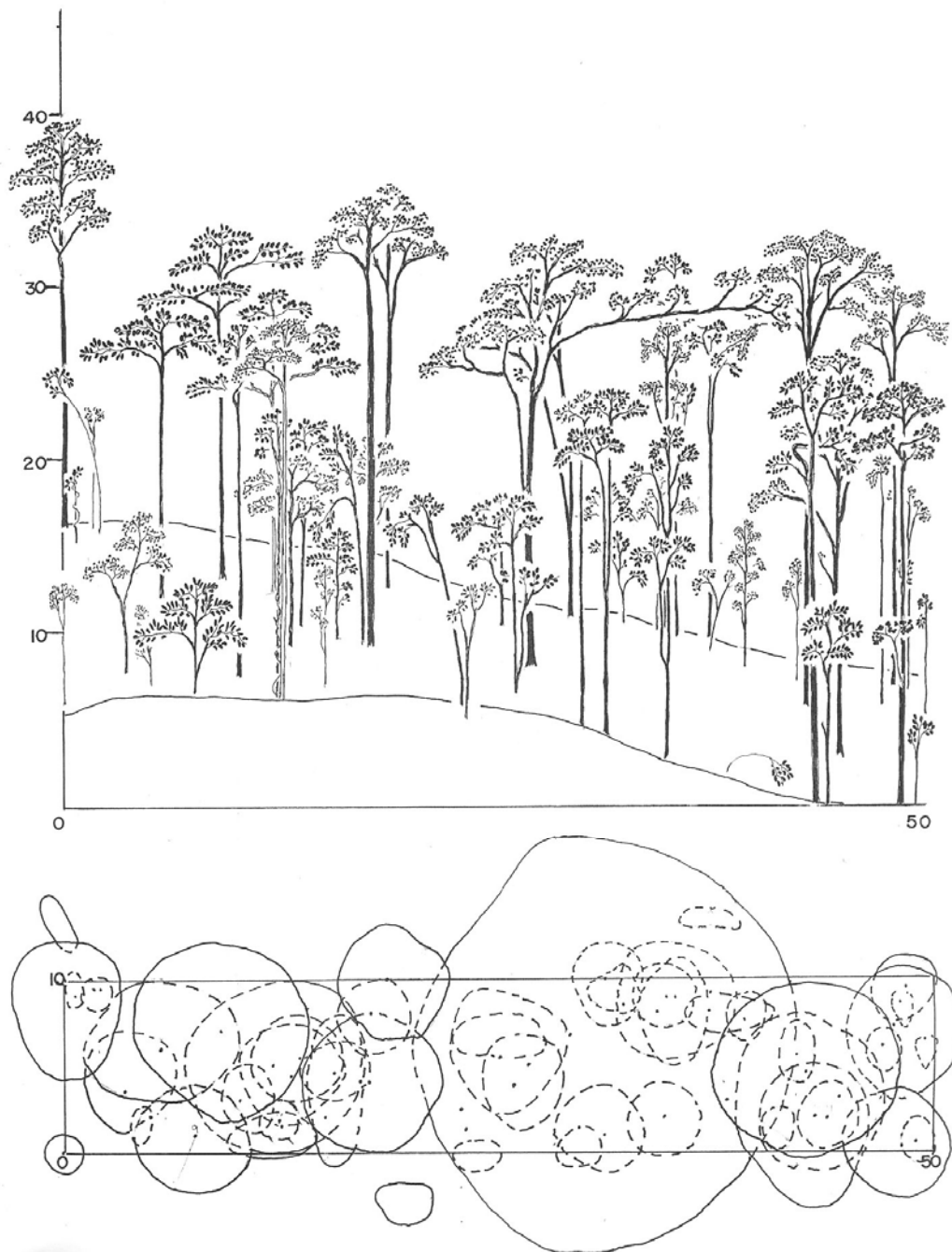


Figure 17 Profile diagram and Crown cover of the Phayre's langur's sleeping sites at K 44.

3. Seasonal Forage

The forage species used by Phayre's langur for the whole year were 46 species in which 20 species were used in the wet season, 10 species were used in the dry season and 16 species were used throughout the year. Most of the diet in the wet season was young seed (29.17 %) and in the dry season was young seed too (27.85). The most commonly used was *Azelia xylocarpa Craib* (11.42 % usage from all number of individuals, N=1,673), there are many part of this species were use as forage such as young seed, young leaf and flower (Table 2). There are twelve times at water source and three times at salt lick were used by the Phayre's langur.

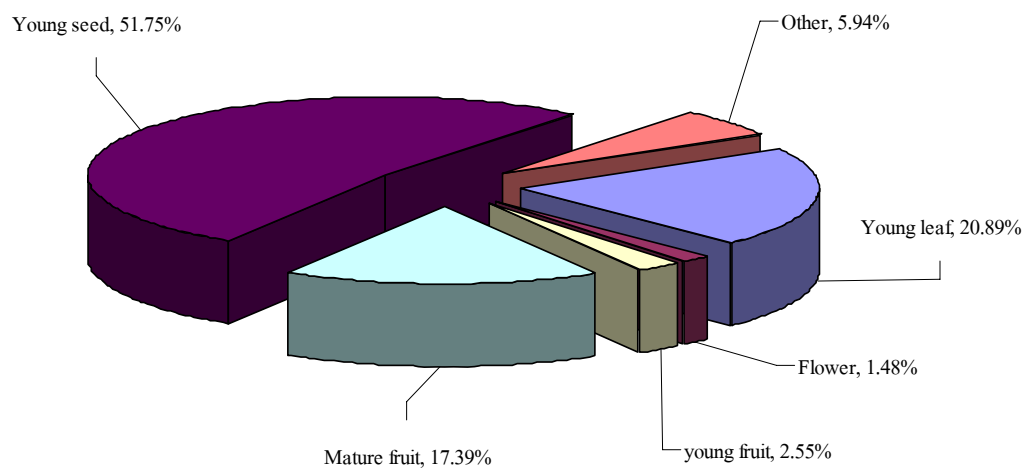


Figure 18 Parts of diet were used by the Phayre's langur in the wet season.

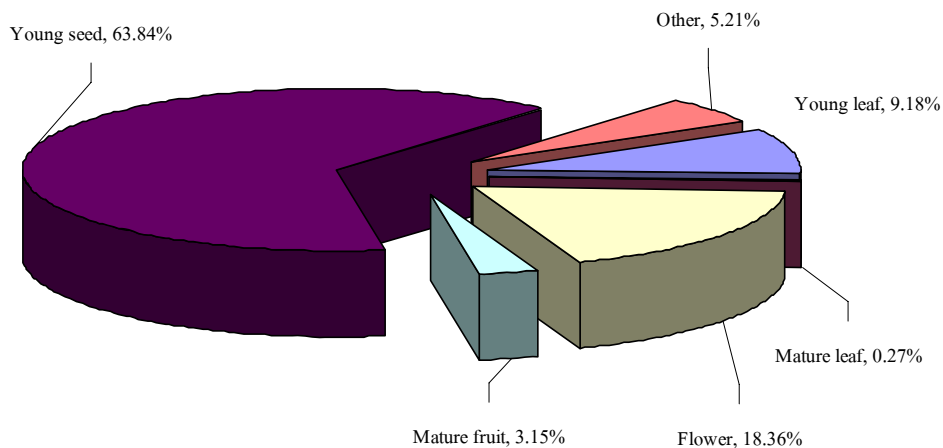


Figure 19 Parts of diet were used by the Phayre’s langur in the dry season.

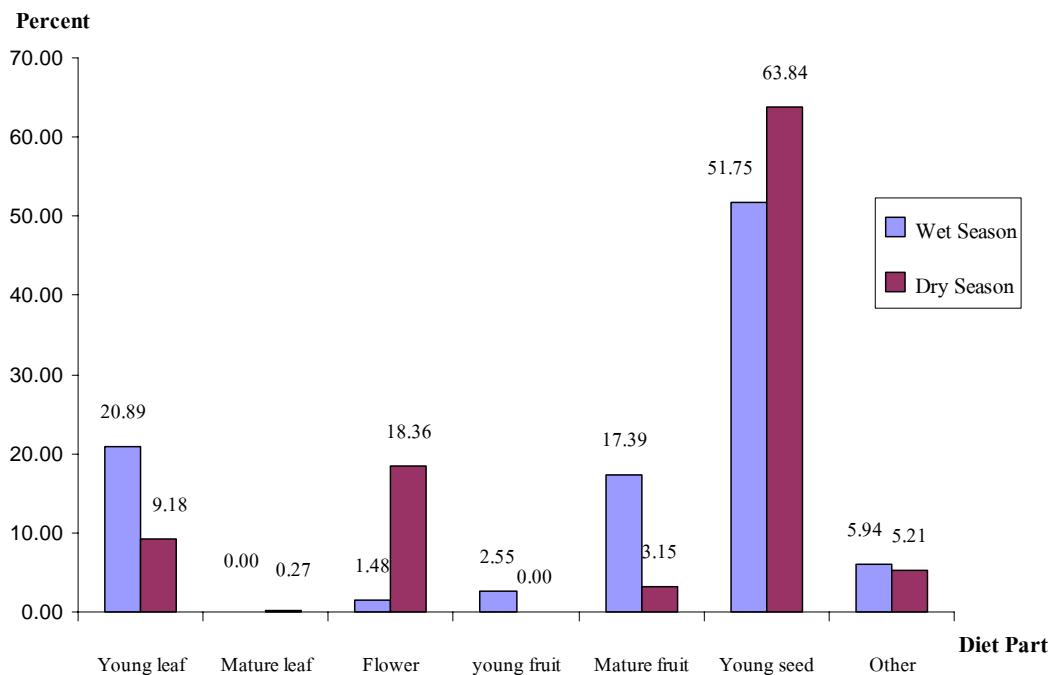


Figure 20 Percent used of diet part used by the Phayre’s langur compared between the dry and the wet season.

From the table 2, percent usage of forage species were shown that 46 species from 42 genera, 28 families used by the Phayre’s langur, in the dry season there were

10 species were used such as *Pterocymbium tinctorium* (Blanco) Merr., *Acer oblongum* Wall. ex DC. In the wet season 20 species were used such as *Canthium glabrum* Blume, *Peltoporum dasyrachis*, and 16 species were used by Phayre's langur both dry and wet season such as *Afzelia xylocarpa* Craib, *Bauhinia saccocalyx* Pierre, *Mitrephora vandaeflora* Kurz, *Pterocarpus macrocarpus* Kurz and *Millettia leucantha* Kurz var. *leucantha*.

There were differed from Uicharoensak (1993) notes on their forage species are composed of 41 species from 39 genera, 26 families such as *Xylia xylocarpa* Taub., *Holarrhena antidysenterica* Wall., *Pterocarpus macrocarpus* Kurz and *Polyalthia viridis* Craib.

The most part of food plant they used was young seed in the wet season (29.17 %) and in the dry season young seed is still the most of food plant's part was used by Phayre's langur (27.85%). But there are different in the forage species (Figure 21). In the wet season, *Canthium glabrum* Blume and *Peltophorum dasyrachis* Kurz were used but in the dry season *Pterocymbium tinctorium* (Blanco) Merr. and *Chukrasia tabularis* A.Juss. were used by the Phayre's langur.

Table 2 Percent usage of Phayre's langur's Food by number of individuals (N=1,673)

Forage Species	Wet Season					Dry Season					Percent usage						
	Leaf		Flower	Fruit		Seed		Other	Leaf			Flower	Fruit		Seed		
	Young	Mature		Young	Mature	Young	Mature		Young	Mature			Young	Mature	Young	Mature	
<i>Azelia xylocarpa</i>																	
Craib						134			12		44				1		11.42
<i>Bauhinia saccocalyx</i>																	
Pierre															136		9.09
<i>Mitrephora vandaeflora</i> Kurz							114				6						7.17
<i>Canthium glabrum</i> Blume																	6.69
<i>Pterocarpus macrocarpus</i> Kurz															71		5.62
<i>Peltophorum dasyrachis</i> Kurz																	5.56
<i>Millettia leucantha</i> Kurz var. <i>leucantha</i>	25								54		14						5.56
Acacia sp. Terrestrial Herbaceous Vegetation															65		4.00
<i>Pterocymbium tinctorium</i> (Blanco) Merr.																	3.95
<i>Eriobotrya bengalensis</i> Hook.f.															64		3.83
<i>Gmelina arborea</i> Roxb.															57		3.71
<i>Gigantochloa cochinchinensis</i> A. Camus	20										26						2.75
																43	2.57

Table 2 Cont'd.

Forage Species	Wet Season										Dry Season					Percent usage	
	Leaf		Flower	Fruit		Seed		Other	Leaf		Flower	Fruit		Seed			Other
	Young	Mature		Young	Mature	Young	Mature		Young	Mature		Young	Mature	Young	Mature		
<i>Chukrasia tabularis</i> A.Juss.											2			41		2.57	
<i>Atalantia monophylla</i> Correa	38															2.27	
<i>Schefflera elliptica</i> Harms										37						2.21	
<i>Abrus precatorius</i> Linn.	23			12												2.09	
<i>Adenantha pavonina</i> Linn.						34										2.03	
<i>Artocarpus lakoocha</i> Roxb.				28												1.67	
<i>Quercus glabricupula</i> Barrett.						27										1.61	
<i>Ficus</i> spp.								13							12	1.49	
<i>Ocyceros</i> sp.				2								23				1.49	
<i>Acer oblongum</i> Wall. ex DC.															22	1.32	
<i>Quercus semiserrata</i> Roxb.						18										1.08	
<i>Hopea ferrea</i> Laness.			14							3						1.02	
<i>Beilschmiedia</i> sp.													15			0.90	
<i>Dalbergia oliveri</i> Gamble	7												7			0.84	
<i>Albizia lebbeck</i> Benth.						11							1			0.72	
<i>Dalbergia dongnaiensis</i> Pierre	9												1			0.60	
<i>Quercus semiserrata</i> Roxb.						9										0.54	
<i>Vitex peduncularis</i> Wall. ex Schauer				9												0.54	
<i>Apodytes dimidiata</i> E. Mey. ex Arn.				8												0.48	
<i>Milium lineata</i> Alston					8											0.48	
<i>Ulmus lancifolia</i> Roxb.													6			0.36	

Table 2 Cont'd.

Forage Species	Wet Season								Dry Season								Percent usage
	Leaf		Flower	Fruit		Seed		Other	Leaf		Flower	Fruit		Seed		Other	
	Young	Mature		Young	Mature	Young	Mature		Young	Mature		Young	Mature	Young	Mature		
<i>Jasminum scandens</i> Vanl	5															0.30	
<i>Suregada multiflorum</i> Baill.						4								1		0.30	
<i>Mangifera caloneura</i> Kurz				5												0.30	
<i>Sandoricum koetjape</i> Merr.	3															0.18	
<i>Cinnamomum porrectum</i> Kosterm.				2												0.12	
<i>Oroxylum indicum</i> Vent.	2															0.12	
<i>Schleichera oleosa</i> Merr.	2															0.12	
<i>Pavetta</i> sp.										2						0.12	
<i>Glyptopetalum sclerocarpum</i> M.A.Lawson	1															0.06	
<i>Gardenia sootepensis</i> Hutch.										1						0.06	
<i>Cinnamomum iners</i> Bl.										1						0.06	
<i>Symplocos longifolia</i> Fletch.									1							0.06	
Total	197	0	14	24	164	488	0	56	67	2	134	0	23	466	0	38	100.00
Percent	11.78	0.00	0.84	1.43	9.80	29.17	0.00	3.35	4.00	0.12	8.01	0.00	1.37	27.85	0.00	2.27	

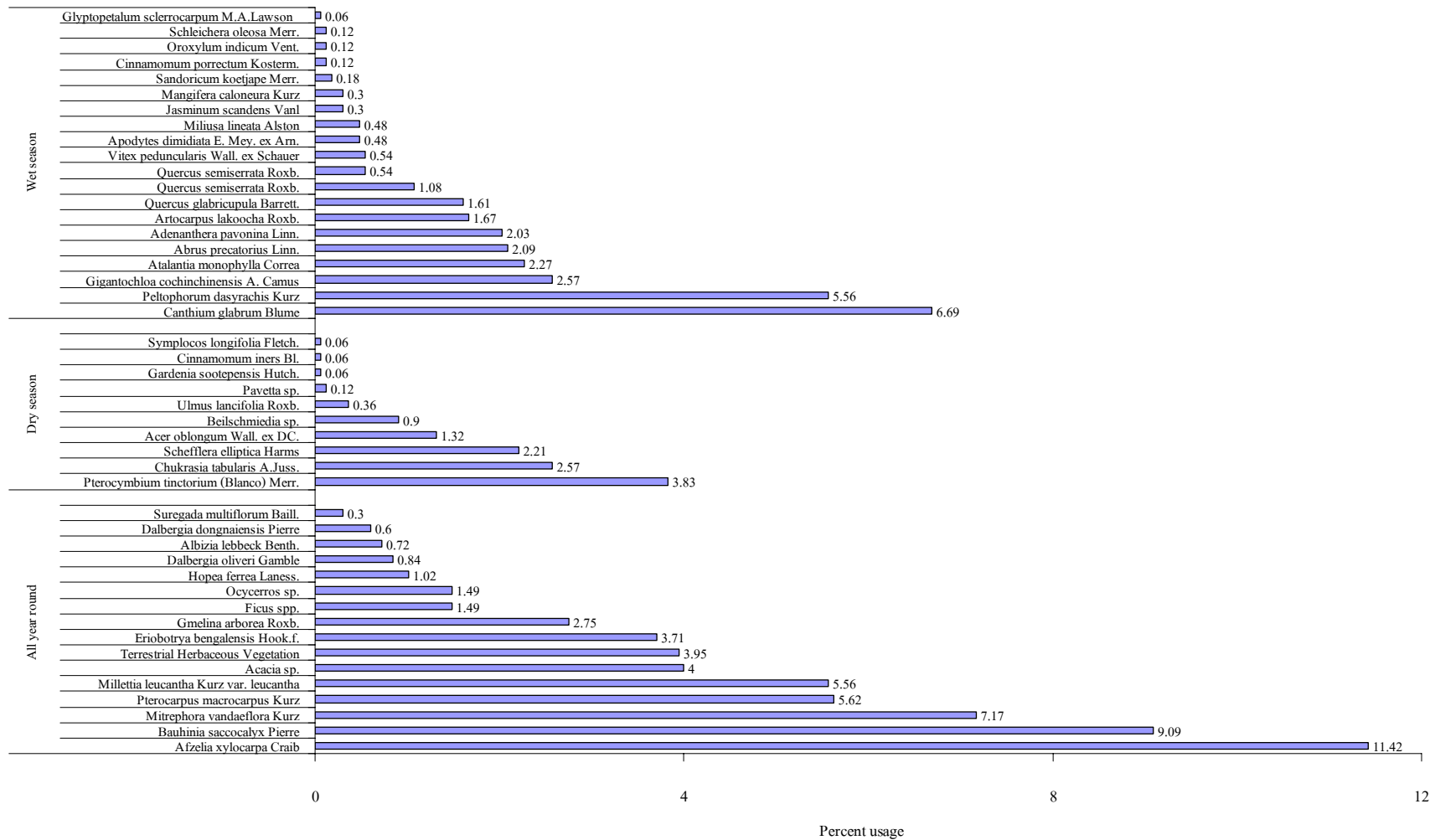


Figure 21 Percent usage of Forage species by Phayre's langur from number of individuals (N = 1,673).

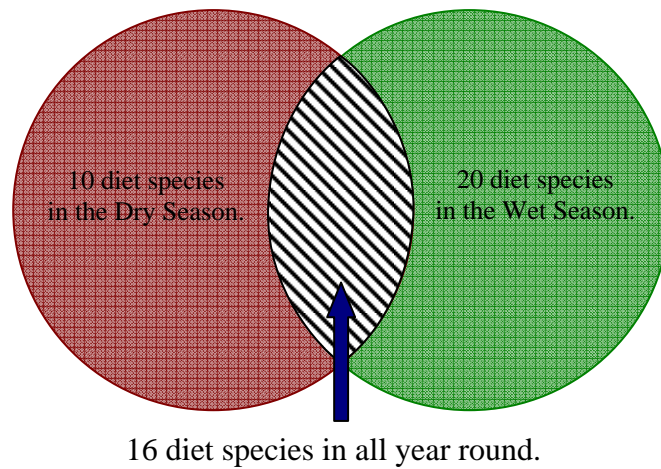


Figure 22 Vein's diagram of the diet species used by the Phayre's Langur.

Table 3 Number of individual of Phayre's langur (PA troop) were used the waters Termites and salt lick resources.

Date	Water	Termite	Salt lick
23-Feb-04	4		2
26-Mar-04	5		
27-Mar-04	10		
28-Mar-04	7		
29-Mar-04	9		
25-Apr-04	2		
24-May-04		1	
19-Jun-04		1	
26-Jul-04	1		
22-Aug-04		1	
24-Sep-04			2
25-Sep-04	4	1	
27-Sep-04		2	
27-Oct-04	5		
Total (Times)	9	5	2



Figure 23 Salt lick at the G52 plot were used by the Phayre's langur (PA troop).



Figure 24 Young seed of *Afzelia xylocarpa* Craib which the most percent usage of Forage species by the Phayre's langur.



Figure 25 Young seed of *Bauhinia saccocalyx* Pierre which the most percent usage of Forage species by the Phayre's langur.

4. Daily activities and Histogram

4.1 Daily activities

The daily activities of Phayre's langur were analyzed from scan sampling, separated by age class of group included Adult, Juvenile and infant. The behavioral data were described to feeding, traveling, resting, auto grooming, and social behavior and inactive. The behavioral data were calculated to percentage of behaviors by numbers of individuals (Figure 26).

Percentage of adult's behaviors were 21.63 % of feeding, 26.40 % of traveling, 16.62 of resting, 3.11 % of auto grooming, 17.91 % of social behavior and 14.33 % of inactive, percentage of juvenile's behaviors were 24.93 % of feeding, 25.61 % of traveling, 16.48 of resting, 3.27 % of auto grooming, 12.80 % of social behavior and 16.92 % of inactive and percentage of infant's behaviors were 17.94 %

of feeding, 25.80 % of traveling, 9.39 of resting, 1.62 % of auto grooming, 34.86 % of social behavior and 10.38 % of inactive.

From the diagram below, trend of daily activities were in the same trends such as traveling behavior, feeding behavior and resting. Percentage of each age class between Adult and Juvenile are similar but they were different a little bit from infant's activities in detail such as social behavior.

In the part of social behavior was identified to many stages such as body contact, grooming behavior, nipple contact, sexual behavior, aggressive behavior and playing in infants. There were different in detail between each age class (Figures 28, 29, and 30).

Adult's social behaviors were 6.51 % of body contact, 53.98 % of grooming, 30.84 % of nipple contact, 5.30 % of sexual behavior and 3.37 % of aggressive behavior. In juvenile's social behaviors were 10.12 % of body contact, 77.98 % of grooming, 4.76 % of sexual behavior, 1.19 % of aggressive behavior and 5.95 % of playing behavior. And infant's social behaviors were 8.54 % of body contact, 39.75 % of nipple contact 30.28 % of grooming and 21.43 % of playing behavior.

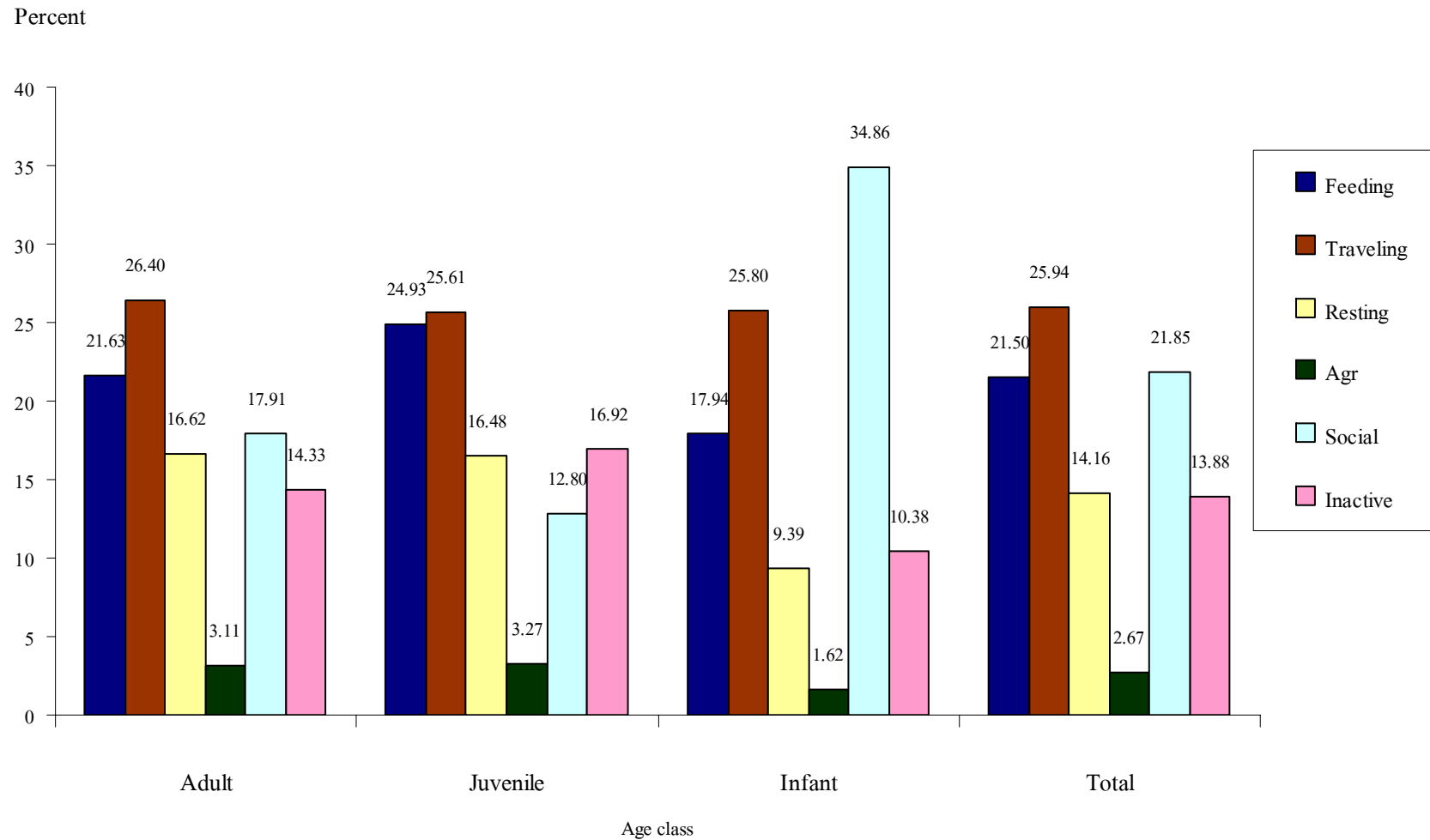


Figure 26 Percentage of daily activities of Phayre's langur from number of individuals (Adult N = 4,471, Juvenile N = 1,240, Infant N = 1,831).

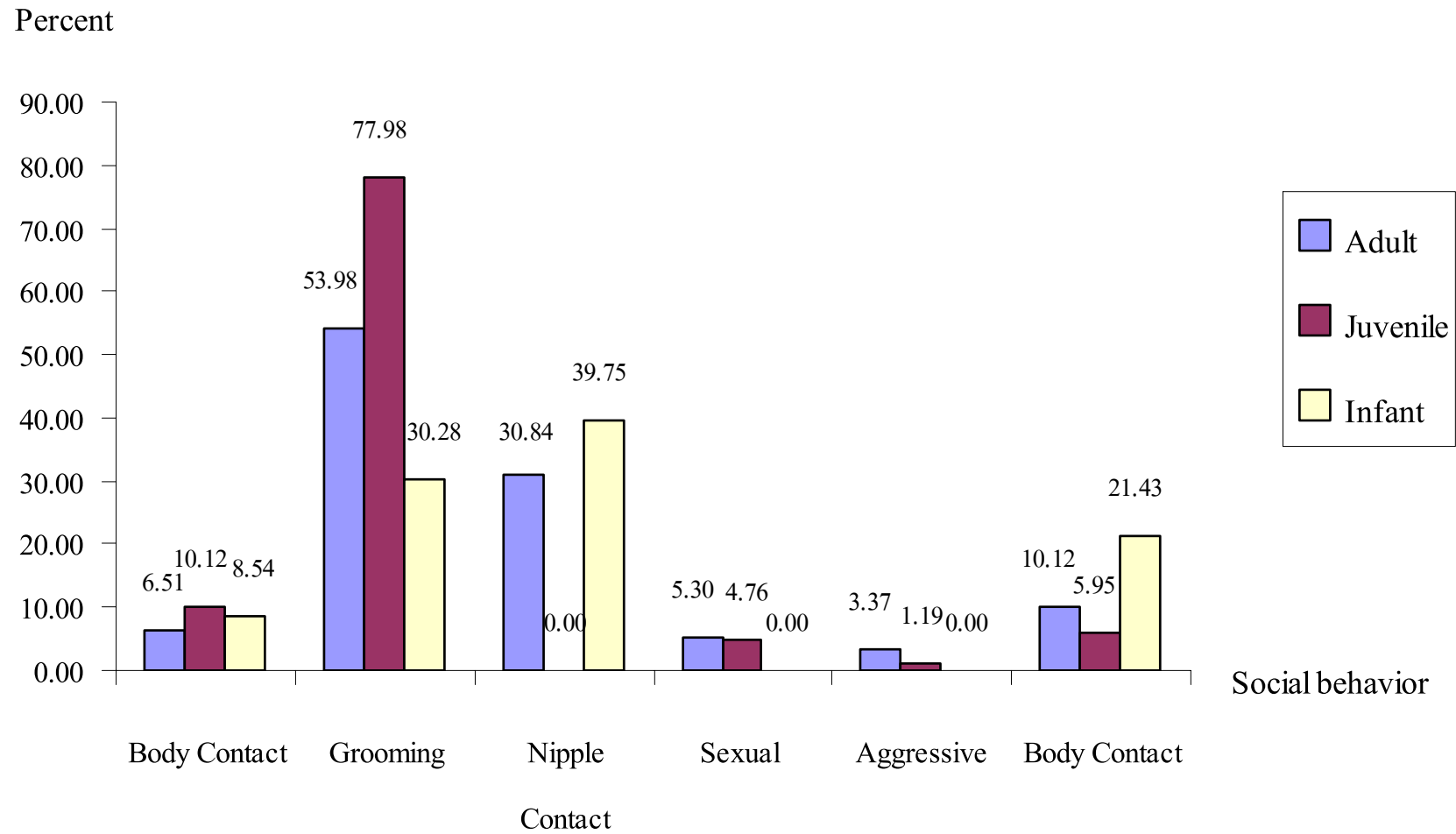


Figure 27 Percentage of social behavior of Phayre's langur from number of individuals (Adult N = 830, Juvenile N = 168, Infant N = 644).

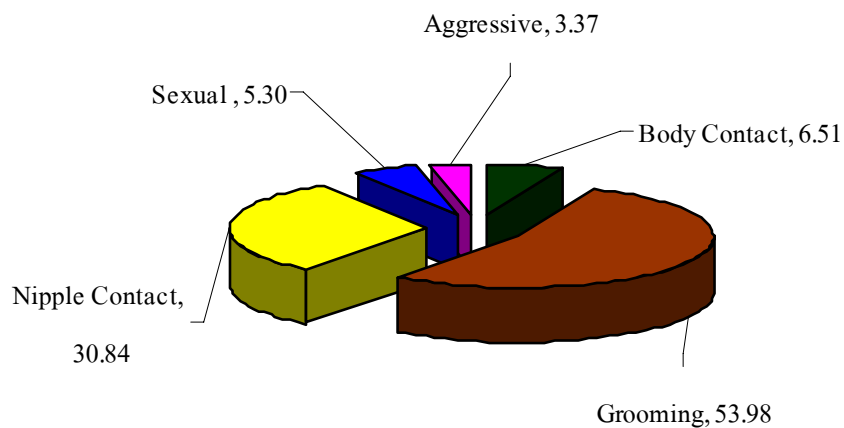


Figure 28 Percentage of adult's social behavior from number of individuals (N = 830).

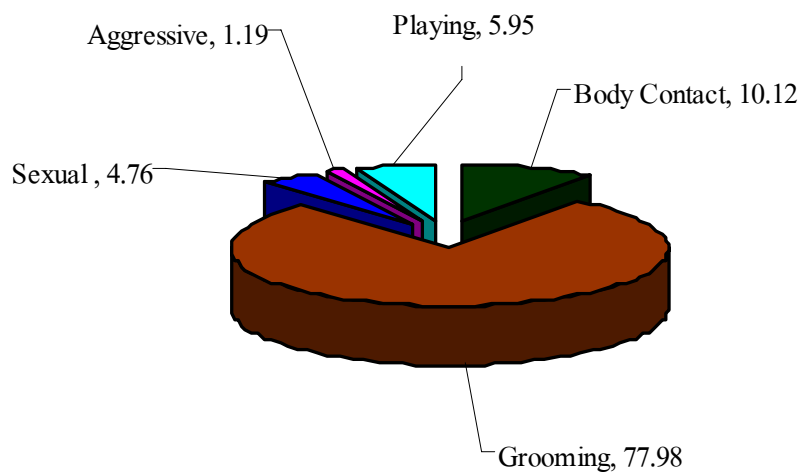


Figure 29 Percentage of juvenile's social behavior from number of individuals (N = 168).

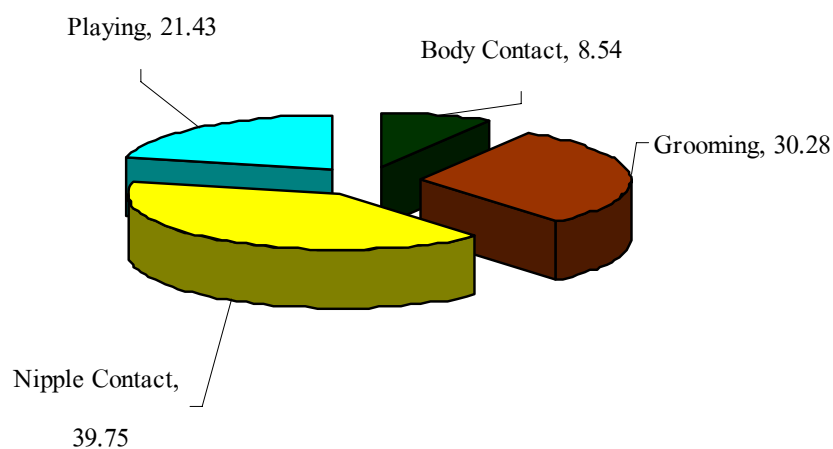


Figure 30 Percentage of infant's social behavior from number of individuals (N = 644).

From the figures 27 was shown, there were highly percentage of grooming behavior in juvenile's social behavior because they were always detected with adults or infants, then the diagram had shown in highly percentage of grooming behavior. In playing behavior between juveniles with infants and infants with infants were shown in a highly percentages of playing behaviors but there were not shown in adult's social behaviors. Nipple contact behavior there were only shown in adults and infants but there were not detected in juveniles.

4.2 Percentage of behavioral Types

From the diagram had shown below (Figure 31), the daily activities of the Phayre's Languet were activated at early morning (06:00) until early evening (08:40-19:00), the activities of each age classes were the same trend. The Traveling are active in the same way as feeding behavior because mostly, both behaviors were detected together, then the histogram had shown from all individuals of PA group (N=7,542) most percentage of each behavior were feeding and traveling behavior, they were activated in many times such as at 06:00-07:20, 08:40-10:20, 11:20-12:00 and 15:20-18:00.

They were used a lot of time to feeding in several times 06:40-08:00, 11:20-12:00, and 17:20-18:00, then after the feeding behavior finished, they were used to taken some rest for digestion process and at this time the another behaviors were detected such as resting and social behavior are the same trend, there were detected in several times such as at 07:40-08:20, 10:40-11:00, 12:20-15:00. Other behaviors such as auto grooming had been detected in several times (maximum at 08:40) and inactive had been detected several times too (maximum at 06:00).

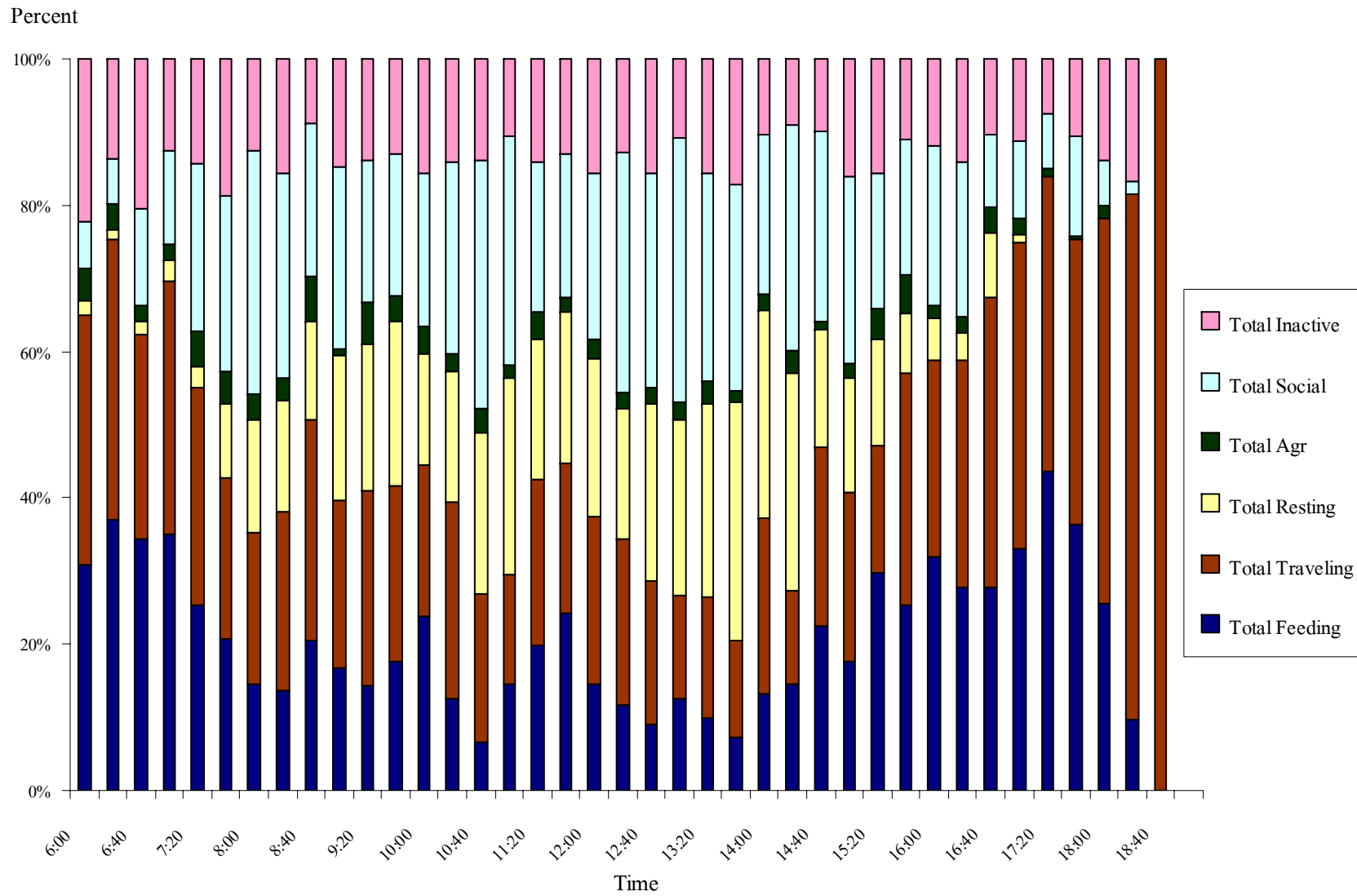


Figure 31 Histogram of Phayre's langur from number of individuals.

CONCLUSION AND RECOMMENDATION

Conclusion

1. Group Structure

14 - 17 habituated individuals of PA troop had been found at Huay Mai Sod Yai, included 2 adult males, 5 adult females, 2 juvenile males, 2 juvenile females and 5 infants II and after 14 months observation had been done, there are fourteen individuals detected included 2 adult males, 3 adult females, 2 juvenile males, 2 juvenile females and 5 infants II. There were many individuals were disappeared or lost from the group and many individuals were added in group.

2. Habitat used

Habitats used by the Phayre's langur were Dry Evergreen Forest, Moist Evergreen Forest near the stream, Mixed Deciduous Forest. Mostly of habitat used by Phayre's langur were Dry Evergreen Forest, Mixed Deciduous Forest included water sources and salt licks.

From although the observation time, there are 1.02 kilometer square or 635.9 rai were used by the Phayre's langur. In the dry season was 0.80 kilometer square or 501.6 rai and the wet season was 0.94 kilometer square or 585.9 rai. There were a little different in detail because in the dry season there were have limited forage species so they were fed in a little group at the food plant tree which can be available but in wet season there were many food plant species could be available that may effectively to make the Phayre's langur spread the group wildly. Finally, in both seasons (the core area) 0.72 kilometer square or 451.6 rai were used by Phayre's langur included the water sources and salt lick in this area.

3. Sleeping sites and plant community

From the habitat use observation had been found 4 sleeping sites were usually used by Phayre's langur such as 1U36 (31.48 %), 1Z45 (33.33 %), G52 (16.66 %) and K44 (18.51 %). Suitable for Phayre's langur sleeping sites was not depended on highest IVI value species, but depended on structure of community, canopy characteristics, and food sources and specify ecological niches such as water resources and salt licks.

4. Seasonal Forage

The forage species used by Phayre's langur for the whole year were 46 species in which 20 species were used in wet season, 10 species were used in dry season and 16 species were used although the year. Most of the forage used in wet season was young seed (29.17 %) and in dry season was young seed of forage species. The most forage species was used by Phayre's langur was *Afzelia xylocarpa* Craib (11.42 % usage from all number of individuals, N=1,673), there are many part of this species were use as forage such as young seed, young leaf and flower (Table 2). There are twelve times at water source and three times at salt lick were used by Phayre's langur.

5. Daily activities

The daily activities of the Phayre's langur were analyzed from scan sampling, separated by age class of group included Adult, Juvenile infant I and infant II. The behavioral data were described to feeding, traveling, resting, auto grooming, and social behavior and inactive. The behavioral data were calculated to percentage of behaviors by numbers of individuals.

Percentage of adult's behaviors were 21.63 % of feeding, 26.40 % of traveling, 16.62 of resting, 3.11 % of auto grooming, 17.91 % of social behavior and 14.33 % of inactive, percentage of juvenile's behaviors were 24.93 % of feeding, 25.61 % of traveling, 16.48 of resting, 3.27 % of auto grooming, 12.80 % of social

behavior and 16.92 % of inactive and percentage of infant's behaviors were 17.94 % of feeding, 25.80 % of traveling, 9.39 of resting, 1.62 % of auto grooming, 34.86 % of social behavior and 10.38 % of inactive.

6. Social behavior

Adult's social behaviors were 6.51 % of body contact, 53.98 % of grooming, 30.84 % of nipple contact, 5.30 % of sexual behavior and 3.37 % of aggressive behavior. In juvenile's social behaviors were 10.12 % of body contact, 77.98 % of grooming, 4.76 % of sexual behavior, 1.19 % of aggressive behavior and 5.95 % of playing behavior. Infant's social behaviors were 8.54 % of body contact, 39.75 % of nipple contact 30.28 % of grooming and 21.43 % of playing behavior.

The histogram had shown from all individuals of PA group (N=7,542) most percentage of each behavior were feeding and traveling behavior , they were activated in many times such as at 06:00-07:20, 08:40-10:20, 11:20-12:00 and 15:20-18:00. The Traveling was active in the same way as feeding behavior because mostly, both behaviors were detected together.

Resting and social behavior are the same trend, there were detected in several times such as at 07:40-08:20, 10:40-11:00, 12:20-15:00. Other behaviors such as auto grooming had been detected in several times (maximum at 08:40) and inactive had been detected several times too (maximum at 06:00).

Recommendation

Recommendation for future work

1. Study of the diet species is only the part of plant used by the Phayre's langur, in the future, phenology of diet species should be done for related between distribution pattern of the Phayre's langur and phenology of diet species.
2. Study of the Phayre's langur at Mai Sod Yai in Phu Khieo Wildlife Sanctuary is only one group. In the future should have been compared between the other groups nearby.
3. The relation between individuals should be done such as kin relationship, social behaviors, behaviors of each individuals that who are they related with.
4. This study there were many individuals were absented, disappeared and dispersal, for the future should be investigated which group were their added.
5. The result of this study found that the mostly habitat used by the Phayre's langur is Dry Evergreen Forest, the conservation of this forest type could increase the opportunities for the Phayre's langur distribution.

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APPENDIXES

Appendix table 1 List of Plant species at 4 sleeping sites sampling plots.

No.	Habits	Family name	Botanical name
1	T	Aceraceae	<i>Acer oblongum</i> Wall. ex DC.
2	T	Anacardiaceae	<i>Buchanania aborescens</i> (Blume) Blume
3	T	Anacardiaceae	<i>Spondias pinnata</i> (Linn.f.) Kurz
4	T	Anacardiaceae	<i>Rhus</i> sp.
5	C	Annonaceae	<i>Desmos cochinchinensis</i> Lour.
6	ST	Annonaceae	<i>Xylopiya malayana</i> Hook.f. et Th.
7	ST	Annonaceae	<i>Polyalthia lateriflora</i> (Blume) King
8	T	Annonaceae	<i>Mitrephora vandaeflora</i> Kurz
9	T	Annonaceae	<i>Cananga latifolia</i> Finet & Gagnep.
10	T	Annonaceae	<i>Meiogyne hainanense</i> (Merr.) Ban
11	T	Araliaceae	<i>Brassaiopsis</i> sp.
12	T	Caesalpinaceae	<i>Afzelia xylocarpa</i> Craib
13	S/ST	Celastraceae	<i>Glyptopetalum sclerocarpum</i> M.A.Lawson
14	T	Dipterocarpaceae	<i>Hopea ferrea</i> Laness.
15	S/ST	Ebenaceae	<i>Diospyros ferrea</i> Bakh.
16	ST	Ebenaceae	<i>Diospyros pilosula</i> (A.DC.) Hiern
17	T	Ebenaceae	<i>Diospyros variegata</i> Kurz
18	T	Ebenaceae	<i>Diospyros bejaudii</i> Lecomte
19	T	Ebenaceae	<i>Diospyros montana</i> Roxb.
20	S/ST	Euphorbiaceae	<i>Suregada multiflorum</i> (A.Juss.) Baill.
21	S/ST	Euphorbiaceae	<i>Croton kongensis</i> Gagnep.
22	T	Euphorbiaceae	<i>Sapium insigne</i> Benth.
23	T	Euphorbiaceae	<i>Drypetes hainanensis</i> Merr.
24	T	Fagaceae	<i>Quercus glabricupula</i> Barrett.
25	T	Flacourtiaceae	<i>Casearia grewiaefolia</i> Vent. var. <i>gelonioides</i> (Blume) Sleumer
26	B	Gramineae	<i>Gigantochloa cochinchinensis</i> A. Camus

Appendixes table 1 (Cont'n)

No.	Habits	Family name	Botanical name
27	T	Lythraceae	<i>Lagerstroemia calyculata</i> Kurz
28	T	Lythraceae	<i>Lagerstroemia duperreana</i> Pierre ex Gagnep.
29	T	Melastomataceae	<i>Memecylon geddesianum</i> Craib
30	ST	Meliaceae	<i>Aglaia odorata</i> Lour
31	T	Meliaceae	<i>Aglaia silvestris</i> (M.Roem.) Merr.
32	T	Meliaceae	<i>Chukrasia tabularis</i> A.Juss.
33	T	Meliaceae	<i>Aglaia argentea</i> Blume
34	S	Memecylaceae	<i>Memecylon myrsinoides</i> Blume
35	T	Moraceae	<i>Ficus retusa</i> L. var. <i>retusa</i>
36	T	Myrtaceae	<i>Syzygium cumini</i> (L.) Skeels
37	T	Myrtaceae	<i>Syzygium limnaea</i> (Ridl) var. <i>glacilior</i> (Craib)
38	T	Myrtaceae	<i>Syzygium claviflorum</i> (Roxb.) A.M. Cowan & Cowan
39	T	Oleaceae	<i>Chionanthus sutepensis</i> (Kerr) P.S.Green
40	T	Papilionaceae	<i>Dalbergia oliveri</i> Gamble
41	T	Papilionaceae	<i>Erythrina subumbrans</i> Merr.
42	T	Papilionaceae	<i>Pterocarpus macrocarpus</i> Kurz
43	T	Papilionoideae	<i>Millettia leucantha</i> Kurz var. <i>leucantha</i>
44	T	Rosaceae	<i>Eriobotrya bengalensis</i> Hook.f.
45	S/ST	Rubiaceae	<i>Tarennoidea wallichii</i> (Hook.f.) Tirveng. & Sastre
46	S/ST	Rubiaceae	<i>Catunaregum longispina</i> (Roxb. ex Link.) Tirveng.
47	T	Rubiaceae	<i>Canthium glabrum</i> Blume
48	S/ST	Rutaceae	<i>Acronychia pedunculata</i> (L.) Miq.
49	S/ST	Rutaceae	<i>Murraya paniculata</i> Jack
50	ST	Rutaceae	<i>Atalantia monophylla</i> Correa
51	S/ST	Sapindaceae	<i>Arytera littoralis</i> Blume

Appendix table 1 (Cont'n)

No.	Habits	Family name	Botanical name
52	T	Sapindaceae	<i>Guioa diplopetala</i> (Hassk.) Radlk.
53	T	Sapindaceae	<i>Harpullia</i> sp.
54	T	Sterculiaceae	<i>Pterospermum cinnamomeum</i> Kurz
55	T	Sterculiaceae	<i>Pterocymbium tinctorium</i> (Blanco) Merr.
56	T	Sterculiaceae	<i>Pterospermum diversifolium</i> Blume
57	ST	Stilaginaceae	<i>Antidesma thwaitesianum</i> Muell. Arg.
58	S/ST	Symplocaceae	<i>Symplocos cochinchinensis</i> ssp. <i>laurina</i>

Appendixes table 2 List of IVI values of plant species at 1U 36 used by the Phayre's langur.

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
1	<i>Lagerstroemia calyculata</i> Kurz	52.41	0.02	0.20	52.05	2.20	2.60	56.85
2	<i>Rhus</i> sp.	24.56	0.01	0.10	24.40	1.10	1.30	26.80
3	<i>Diospyros pilosula</i> (A.DC.) Hiern	3.75	0.12	0.80	3.73	12.08	10.39	26.19
4	<i>Mitrephora vandaeflora</i> Kurz	3.93	0.06	0.50	3.91	6.59	6.49	17.00
5	<i>Xylopia malayana</i> Hook.f. et Th.	0.45	0.09	0.40	0.45	8.79	5.19	14.44
6	<i>Diospyros variegata</i> Kurz	2.95	0.05	0.40	2.93	5.50	5.19	13.60
7	<i>Glyptopetalum sclerocarpum</i> M.A.Lawson	1.14	0.06	0.40	1.13	6.59	5.19	12.92
8	<i>Eriobotrya bengalensis</i> Hook.f.	0.20	0.04	0.40	0.20	4.40	5.19	9.80
9	<i>Meiogyne hainanense</i> (Merr.) Ban	2.28	0.03	0.30	2.26	3.30	3.90	9.46
10	<i>Drypetes hainanensis</i> Merr.	1.00	0.04	0.30	1.00	4.40	3.90	9.29
11	<i>Aglaia silvestris</i> (M.Roem.) Merr.	0.45	0.04	0.30	0.44	4.40	3.90	8.73
12	<i>Chionanthus sutepensis</i> (Kerr) P.S.Green	0.80	0.03	0.30	0.80	3.30	3.90	7.99
13	<i>Syzygium claviflorum</i> (Roxb.) A.M. Cowan & Cowan	0.66	0.03	0.30	0.70	3.30	3.90	7.89
14	<i>Symplocos cochinchinensis</i> ssp. <i>laurina</i>	0.11	0.03	0.30	0.11	3.30	3.90	7.30
15	<i>Polyalthia lateriflora</i> (Blume) King	0.10	0.03	0.30	0.10	3.30	3.90	7.30
16	Unknown # 1	0.43	0.02	0.20	0.43	2.20	2.60	5.22
17	<i>Brassaiopsis</i> sp.	0.38	0.02	0.20	0.40	2.20	2.60	5.20
18	<i>Tarennoidea wallichii</i> (Hook.f.) Tirveng. & Sastre	0.09	0.02	0.20	0.10	2.20	2.60	4.90
19	<i>Quercus glabricupula</i> Barrett.	0.06	0.02	0.20	0.10	2.20	2.60	4.90
20	<i>Buchanania aborescens</i> (Blume) Blume	1.97	0.01	0.10	1.96	1.10	1.30	4.35
21	<i>Syzygium limnaea</i> (Ridl) var. <i>glacilior</i> (Craib)	0.07	0.02	0.10	0.07	2.20	1.30	3.56
22	Unknown NO. 164	0.89	0.01	0.10	0.90	1.10	1.30	3.30

Appendixes table 2 (Cont'n).

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
23	<i>Canthium glabrum</i> Blume	0.49	0.01	0.10	0.50	1.10	1.30	2.90
24	<i>Diospyros bejaudii</i> Lecomte	0.27	0.01	0.10	0.27	1.10	1.30	2.66
25	<i>Acronychia pedunculata</i> (L.) Miq.	0.13	0.01	0.10	0.15	1.10	1.30	2.55
26	<i>Casearia grewiaefolia</i> Vent. var. <i>gelonioides</i> (Blume) Sleumer	0.10	0.01	0.10	0.10	1.10	1.30	2.50
27	<i>Harpullia</i> sp.	0.04	0.01	0.10	0.10	1.10	1.30	2.50
28	<i>Aglaia argentea</i> Blume	0.04	0.01	0.10	0.10	1.10	1.30	2.50
29	<i>Chukrasia tabularis</i> A.Juss.	0.05	0.01	0.10	0.10	1.10	1.30	2.50
30	<i>Guioa diplopetala</i> (Hassk.) Radlk.	0.05	0.01	0.10	0.10	1.10	1.30	2.50
31	<i>Catunaregum longispina</i> (Roxb. ex Link.) Tirveng.	0.03	0.01	0.10	0.10	1.10	1.30	2.50
32	<i>Suregada multiflorum</i> (A.Juss.) Baill.	0.05	0.01	0.10	0.10	1.10	1.30	2.50
33	<i>Murraya paniculata</i> Jack	0.06	0.01	0.10	0.10	1.10	1.30	2.50
34	<i>Acer oblongum</i> Wall. ex DC.	0.03	0.01	0.10	0.10	1.10	1.30	2.50
35	<i>Pterospermum cinnamomeum</i> Kurz	0.03	0.01	0.10	0.03	1.10	1.30	2.43
		100.07	0.97	7.70	100.00	100.00	100.00	300.00

Appendixes table 3 List of IVI values of plant species at 1Z 45 used by the Phayre's langur.

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
1	<i>Ficus retusa</i> L. var. <i>retusa</i>	2.47	0.10	0.10	1.09	1.54	38.27	40.90
2	<i>Diospyros pilosula</i> (A.DC.) Hiern	0.15	2.30	0.80	25.00	12.31	2.38	39.69
3	<i>Rhus</i> sp.	1.29	0.10	0.10	1.09	1.54	20.01	22.63
4	<i>Diospyros variegata</i> Kurz	0.06	1.10	0.60	11.96	9.23	0.86	22.05
5	<i>Mitrephora vandaeflora</i> Kurz	0.16	0.70	0.50	7.61	7.69	2.44	17.74
6	<i>Quercus glabricupula</i> Barrett.	0.61	0.20	0.20	2.17	3.08	9.41	14.66
7	<i>Drypetes hainanensis</i> Merr.	0.07	0.50	0.50	5.43	7.69	1.12	14.24
8	<i>Azelia xylocarpa</i> Craib	0.71	0.10	0.10	1.09	1.54	11.03	13.65
9	<i>Diospyros bejardii</i> Lecomte	0.03	0.60	0.40	6.52	6.15	0.51	13.19
10	<i>Meiogyne hainanense</i> (Merr.) Ban	0.04	0.50	0.40	5.43	6.15	0.65	12.24
11	<i>Xylopiya malayana</i> Hook.f. et Th.	0.02	0.50	0.40	5.43	6.15	0.23	11.82
12	<i>Aglaiya odorata</i> Lour	0.02	0.40	0.40	4.35	6.15	0.33	10.84
13	Unknown # 2	0.50	0.10	0.10	1.09	1.54	7.71	10.34
14	<i>Tarennoidea wallichii</i> (Hook.f.) Tirveng. & Sastre	0.08	0.30	0.30	3.26	4.62	1.22	9.10
15	<i>Chionanthus sutepensis</i> (Kerr) P.S.Green	0.02	0.30	0.20	3.26	3.08	0.36	6.70
16	<i>Guioa diplopetala</i> (Hassk.) Radlk.	0.05	0.20	0.20	2.17	3.08	0.84	6.09
17	<i>Hopea ferrea</i> Laness.	0.01	0.20	0.20	2.17	3.08	0.12	5.38
18	<i>Desmos cochinchinensis</i> Lour.	0.00	0.20	0.20	2.17	3.08	0.05	5.30
19	<i>Aglaiya silvestris</i> (M.Roem.) Merr.	0.06	0.10	0.10	1.09	1.54	0.91	3.54
20	<i>Canthium glabrum</i> Blume	0.04	0.10	0.10	1.09	1.54	0.69	3.32
21	<i>Antidesma thwaitesianum</i> Muell. Arg.	0.03	0.10	0.10	1.09	1.54	0.51	3.14
22	<i>Suregada multiflorum</i> (A.Juss.) Baill.	0.01	0.10	0.10	1.09	1.54	0.17	2.79
23	<i>Harpullia</i> sp.	0.00	0.10	0.10	1.09	1.54	0.07	2.70

Appendixes table 3 (Cont'n).

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
24	Unknown # 1	0.00	0.10	0.10	1.09	1.54	0.04	2.67
25	<i>Eriobotrya bengalensis</i> Hook.f.	0.00	0.10	0.10	1.09	1.54	0.03	2.66
26	F. Annonaceae	0.00	0.10	0.10	1.09	1.54	0.02	2.65
		6.45	9.20	6.50	100.00	100.00	100.00	300.00

Appendixes table 4 List of IVI values of plant species at G 52 used by the Phayre's langur.

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
1	<i>Hopea ferrea</i> Laness.	1.85	1.20	0.80	13.04	15.38	41.16	69.59
2	<i>Drypetes hainanensis</i> Merr.	0.24	4.10	1.00	44.57	19.23	5.30	69.10
3	<i>Lagerstroemia duperreana</i> Pierre ex Gagnep.	0.87	0.50	0.40	5.43	7.69	19.40	32.53
4	<i>Memecylon geddesianum</i> Craib	0.02	0.60	0.50	6.52	9.62	0.34	16.48
5	<i>Ficus retusa</i> L. var. <i>retusa</i>	0.51	0.10	0.10	1.09	1.92	11.40	14.41
6	<i>Memecylon myrsinoides</i> Blume	0.06	0.40	0.40	4.35	7.69	1.20	13.24
7	<i>Pterocymbium tinctorium</i> (Blanco) Merr.	0.09	0.40	0.30	4.35	5.77	2.10	12.22
8	Unknown # 3	0.26	0.20	0.20	2.17	3.85	5.74	11.76
9	<i>Diospyros bejaudii</i> Lecomte	0.17	0.30	0.20	3.26	3.85	3.85	10.96
10	<i>Sapium insigne</i> Benth.	0.30	0.10	0.10	1.09	1.92	6.70	9.71
11	<i>Catunaregum longispina</i> (Roxb. ex Link.) Tirveng.	0.01	0.30	0.20	3.26	3.85	0.13	7.24
12	<i>Cananga latifolia</i> Finet & Gagnep.	0.05	0.10	0.10	1.09	1.92	1.14	4.15
13	<i>Diospyros variegata</i> Kurz	0.02	0.10	0.10	1.09	1.92	0.40	3.41
14	<i>Arytera littoralis</i> Blume	0.01	0.10	0.10	1.09	1.92	0.24	3.25
15	<i>Atalantia monophylla</i> Correa	0.01	0.10	0.10	1.09	1.92	0.20	3.21
16	<i>Diospyros ferrea</i> Bakh.	0.01	0.10	0.10	1.09	1.92	0.20	3.21
17	<i>Murraya paniculata</i> Jack	0.00	0.10	0.10	1.09	1.92	0.10	3.11
18	<i>Erythrina subumbrans</i> Merr.	0.00	0.10	0.10	1.09	1.92	0.10	3.11
19	<i>Spondias pinnata</i> (Linn.f.) Kurz	0.00	0.10	0.10	1.09	1.92	0.10	3.11
20	<i>Diospyros montana</i> Roxb.	0.00	0.10	0.10	1.09	1.92	0.10	3.11
21	<i>Millettia leucantha</i> Kurz var. <i>leucantha</i>	0.00	0.10	0.10	1.09	1.92	0.10	3.11
		4.49	9.20	5.20	100.00	100.00	100.00	300.00

Appendixes table 5 List of IVI values of plant species at K 44 used by the Phayre's langur.

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
1	<i>Memecylon myrsinoides</i> Blume	0.38	4.20	1.00	36.21	16.13	12.70	65.04
2	<i>Hopea ferrea</i> Laness.	1.17	1.10	0.90	9.48	14.52	39.38	63.38
3	<i>Drypetes hainanensis</i> Merr.	0.06	1.50	0.60	12.93	9.68	2.04	24.64
4	<i>Lagerstroemia calyculata</i> Kurz	0.45	0.20	0.20	1.72	3.23	15.06	20.00
5	<i>Atalantia monophylla</i> Correa	0.03	0.80	0.50	6.90	8.06	0.99	15.95
6	<i>Eriobotrya bengalensis</i> Hook.f.	0.05	0.60	0.50	5.17	8.06	1.84	15.08
7	<i>Lagerstroemia duperreana</i> Pierre ex Gagnep.	0.28	0.10	0.10	0.86	1.61	9.37	11.84
8	<i>Dalbergia oliveri</i> Gamble	0.03	0.40	0.30	3.45	4.84	1.11	9.40
9	<i>Catunaregum longispina</i> (Roxb. ex Link.) Tirveng.	0.01	0.40	0.30	3.45	4.84	0.28	8.57
10	<i>Diospyros bejaudii</i> Lecomte	0.06	0.40	0.20	3.45	3.23	1.87	8.54
11	<i>Sapium insigne</i> Benth.	0.15	0.10	0.10	0.86	1.61	4.95	7.43
12	<i>Pterocarpus macrocarpus</i> Kurz	0.11	0.10	0.10	0.86	1.61	3.76	6.24
13	<i>Memecylon geddesianum</i> Craib	0.03	0.30	0.10	2.59	1.61	0.98	5.18
14	<i>Chukrasia tabularis</i> A.Juss.	0.04	0.10	0.10	0.86	1.61	1.47	3.94
15	<i>Diospyros variegata</i> Kurz	0.04	0.10	0.10	0.86	1.61	1.22	3.70
16	<i>Suregada multiflorum</i> (A.Juss.) Baill.	0.00	0.20	0.10	1.72	1.61	0.14	3.48
17	<i>Erythrina subumbrans</i> Merr.	0.03	0.10	0.10	0.86	1.61	1.00	3.47
18	Unknown # 1	0.02	0.10	0.10	0.86	1.61	0.64	3.12
19	Unknown # 5	0.01	0.10	0.10	0.86	1.61	0.44	2.91
20	<i>Pterospermum diversifolium</i> Blume	0.01	0.10	0.10	0.86	1.61	0.25	2.72
21	Unknown # 1	0.00	0.10	0.10	0.86	1.61	0.14	2.61
22	<i>Diospyros ferrea</i> Bakh.	0.00	0.10	0.10	0.86	1.61	0.10	2.57
23	<i>Cananga latifolia</i> Finet & Gagnep.	0.00	0.10	0.10	0.86	1.61	0.08	2.56
24	<i>Croton kongensis</i> Gagnep.	0.00	0.10	0.10	0.86	1.61	0.07	2.55

Appendixes table 5 (Cont'n).

No.	Botanical Name	DO	D	F	Rdo	Rd	Rf	IVI
25	<i>Spondias pinnata</i> (Linn.f.) Kurz	0.00	0.10	0.10	0.86	1.61	0.07	2.54
26	<i>Acronychia pedunculata</i> (L.) Miq.	0.00	0.10	0.10	0.86	1.61	0.05	2.52
		2.97	11.60	6.20	100.00	100.00	100.00	300.00