INTERACTION OF SUMATRAN ORANGUTAN (*Pongo abelii*) AND HUMAN IN SEMI-WILD CONDITION AT BUKIT LAWANG, GUNUNG LEUSER NATIONAL PARK, SUMATERA

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by

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ABSTRAK

Kajian ini bertujuan untuk mengkaji tingkahlaku dan penggunaan ruang tempat memberi makan orangutan Sumatera di Bukit Lawang, Taman Nasional Gunung Leuser, Sumatera, Indonesia terhadap bilangan pengunjung dan renjer. Penilitian ini juga mengkaji tahap persepsi, kepuasan dan kesedaran pengunjung terhadap kebajikan orangutan Sumatera di tempat memberi makan orangutan di Bukit Lawang. Kajian tingkahlaku telah dijalankan dari bulan September 2014 hingga Mac 2015 dan data pengunaan ruang tempat memberi makan oleh orangutans telah dikumpul dari September 2013 hingga Mac 2015. Jumlah jam memerhati kajian tingkahlaku orangutan adalah 25 jam di dalam hutan dan 11 jam dan 40 minit di tempat memberi makan. Dalam kajian penggunaan ruang tempat memberi makan, orangutan muncul 9 jam dan 30 minit di tempat memberi makan 1. Di tempat memberi makan 2, orangutan muncul 8 jam dan 16 minit. Kombinasi kaedah *focal sampling* dan *scan sampling* dalam sekala selang 10 minit dijalankan dalam kajian ini. Data kajian tahap persepsi, kepuasan dan kesedaran pengunjung dikumpul pada September 2014. Soal selidik untuk mengkaji tahap persepsi, kepuasan dan kesedaran pengunjung dihasilkan dan diedarkan kepada pengunjung yang telah melawat tempat memberi makan orangutan di Bukit Lawang. Hasil penilitian menunjukan orangutan Sumatera cenderung untuk bertindak balas apabila jumlah renjer dan pengunjung tinggi di dalam hutan dan di tempat memberi makan. Kajian

menunjukkan perbezaan ketara pada visual, vokal dan posisi orangutan Sumatera dalam hutan dan di tempat memberi makan mengunakan kolerasi Pearson test. Hasil kajian tindak balas tingkah laku orangutan di dalam hutan menunjukkan orangutan memandang pengunjung (r_s=0.170, p=0.038) dan renjer (r_s=0.199, p=0.014), orangutan mengabaikan renjer (r_s=0.238, p=0.003), vokal "grumph" terhadap renjer (r_s=0.208, p=0.010), bunyi "hoot lembut" terhadap renjer (r_s=0.425, p<.0001) dan pegunjung (r_s=0.330, p<.0001), posisi menhadap renjer (r_s=0.217, p=0.008) dan posisi sembunyi daripada renjer (r_s=-0.167, p=0.041). Di tempat memberi makan, orangutan memandang renjer (r_s=-0.278, p=0.020), orangutan mengabaikan renjer (r_s=0.240, p=0.045), bunyi "ciuman-ciuman" terhadap pengunjung (r_s=0.392, p=0.001), posisi menghadap pengunjung (r_s=0.367, p=0.002), posisi membelakangi renjer (r_s=-0.277, p=0.020) dan pengunjung (r_s=-0.309, p=0.009). Tiada perbezaan yang ketara terdapat pada pergerakan dan isyarat orangutan. Dengan mengunakan Principal Component Analysis (PCA) untuk menganalisis data, hasil kajian mengindikasikan orangutan Sumatera di Bukit Lawang mengubah kedudukannya di tempat memberi makan mengikut jumlah pengunjung dan renjer. Ruang yang kerap digunakan oleh orangutan di tempat memberi makan 1 adalah pagar (54%), dikuti dengan pentas (34%), tempat duduk renjer (8%) dan yang paling kurang digunakan ialah pintu masuk (4%). Di tempat memberi makan 2, orangutan kerap duduk di pentas (48%), tempat duduk pengunjung (23%), pagar (18%) dan tempat duduk renjer (11%). Tambahan lagi, pengunjung yang kembali mengunjung ke Bukit Lawang lebih memilih untuk melibatkan diri dalam aktiviti pemuliharaan orangutan dan pengumpulan dana dibandingkan dengan pengunjung yang pertama kali datang ke Bukit Lawang (Kruskal Wallis Test; χ^2=3.853, df = 1, p=0.050). Dari pelbagai aspek, pengunjung yang pertama kali datang dan pengunjung yang kembali ke Bukit

Lawang berpuas hati dengan kemudahan yang disediakan di tempat memberi makan orangutan, Bukit Lawang. Majoriti dari semua pengunjung sedar bahawa polisi Indonesia yang menyokong penukaran hutan kepada ladang kelapa sawit telah pun memusnahkan habitat orangutan. 13 orang responden "teramat bersetuju" bahawa polisi Indonesia yang menyokong penukaran hutan kepada ladang kelapa sawit telah pun memusnahkan habitat orangutan, didikuti dengan 10 orang responden "tidak bersetuju" dan tahap yang paling rendah sekali ialah "amat tidak bersetuju" dengan jumlah responden 2 orang sahaja. Dengan atau tanpa memberi suplemen makanan, seperti kera besar yang lain, tindak balas orangutan adalah fleksibel mengikut perubahan antropogenik. Walaupun ekopelancongan bukan satu-satunya jalan penyelesaian untuk memulihara primat, namun, mengekalkan kepuasan pengunjung menikmati ekopelancongan dapat meningkatkan kesedaran pemuliharaan dan dapat meraihkan pemberi dana untuk pemuliharaan orangutan. Untuk kajian masa depan, saintis perlu bulat suara tentang kepentingan makanan suplemen untuk orangutan yang tinggal dihabitat yang terganggu.

INTERACTION OF SUMATRAN ORANGUTAN (*Pongo abelii*) AND HUMAN IN SEMI-WILD CONDITION AT BUKIT LAWANG, GUNUNG LEUSER NATIONAL PARK, SUMATERA

ABSTRACT

This study aimed to investigate the Sumatran orangutans' behavioural responses and Sumatran orangutans' space use toward number of tourists and rangers at forest and feeding site in Bukit Lawang, Gunung Leuser National Park, Sumatera, Indonesia. This research also seeks to investigate tourists' perception, satisfaction and awareness of Sumatran orangutans' welfare at Bukit Lawang feeding site. The behavioural study was done from September 2014 until March 2015 and the data of spatial uses of orangutans were collected from September 2013 until March 2015. The behavioural study was performed 25 hours in the forest and 11 hours 40 minutes at the feeding site. In space use study, orangutans only appeared and were observed within 9 hours and half at feeding site 1. At site 2 the orangutan appeared for 8 hours and 16 minutes. The combination of focal sampling and scan sampling within 10 minutes interval methods were used in this study to determine whether behavioural responses and space use of Sumatran orangutans depend on the number of tourists and rangers in the forest and at the feeding site. The data for tourists' perception, satisfaction and awareness was collected on September 2014. A questionnaire was designed and distributed to the tourists of Bukit Lawang to investigate tourists' perception and satisfaction of Sumatran orangutans welfare at Bukit Lawang feeding site. The result indicated that Sumatran orangutans respond particularly to high number of rangers and tourists in the forest as well as at the feeding site. There is a

significant difference on Sumatran orangutans's visual, vocal and reposition behaviour in forest and at feeding site using Pearson test correlation. The result of orangutan's behavioural response in forest showed that visual glance toward tourists (r_s=0.170, p=0.038), visual glance toward rangers (r_s=0.199, p=0.014), visual ignore toward rangers (r_s=0.238, p=0.003), duration of "grumph" toward rangers (r_s=0.208, p=0.010), "soft hoot" toward rangers (r_s=0.425, p<.0001), "soft hoot" toward tourists (r_s=0.330, p<.0001), reposition toward rangers (r_s=0.217, p=0.008) and hide toward rangers (r_s=-0.167, p=0.041). At feeding site, visual glance toward number of rangers (r_s=-0.278, p=0.020), visual ignore toward rangers (r_s=0.240, p=0.045), "kiss squeak" toward tourists (r_s=0.392, p=0.001), reposition toward tourists (r_s=0.367, p=0.002), reposition away from rangers (r_s=-0.277, p=0.020) and reposition away from tourists (r_s=-0.309, p=0.009). No significant differences were shown on the duration of gestural and locomotion. By using Principal Component Analysis (PCA), the result indicated that Sumatran orangutans at Bukit Lawang shifted their space use at feeding site in response to different size of tourists and rangers. The most space used at feeding site 1 was at the fence (54%) and the least at entrance (4%). The second largest was orangutans stayed at platform (34%) followed with ranger bench (8%). At feeding site 2, the orangutans were more likely stayed at platform (48%), visitor bench (23%), fence (18%) and ranger bench (11%). Returning tourists had more intention to be involved in Sumatran orangutans conservation and funding compared to first time tourists (Kruskal Wallis Test; χ^2=3.853, df = 1, p=0.050). In every aspect, first time and returning tourists found that the facilities at Bukit Lawang feeding site was satisfying. Majority of the tourists are aware that Indonesia country's policy for forest conversion to oil palm plantation had rampantly destroyed the habitat of orangutans. Most of the respondents "very strongly agree" (N = 13)

that Indonesia's policy on oil palm plantation had rampantly destroyed the habitat of orangutans, followed by "disagree" (N = 10). The lowest bar level is "strongly disagree" (N = 2). With or without food provisioning, like other great apes, orangutans are known for their behavioural flexibility in response to anthropogenic change. Even though ecotourism is not a panacea to primate conservation, the need to maintain tourists' satisfaction is important to raise public conservation awareness as well as to gain donors. For future direction, scientists should unanimously pledge about the implement of supplementary feeding for orangutans that live in anthropogenic landscapes.

CHAPTER 1

INTRODUCTION

1.1 Current Status of Sumatran Orangutan (*Pongo abelii*)

Orangutans, chimpanzee, gorilla and human belong to the family Hominidae. Generally, orangutans, chimps and gorilla share similar 24 pairs of chromosomes for each individual, while human have 23 pairs of chromosomes. Molecular studies place orangutan divergence from humans at 9-13 million years ago, gorilla and human at 6-8 million years ago and chimpanzee and human diverged at ~4 million years ago (Glazko et al., 2003; Hobolth et al., 2011). Gorilla and chimps originated from South Africa while orangutans can only be exclusively found at two Asia countries which are Indonesia and Malaysia. There are three species of apes that live in Sumatra Island and Borneo Island which is Sumatran orangutans (*Pongo abelii*), Tapanuli orangutans (*Pongo tapanuliensis*) and Bornean orangutans (*Pongo pygmaeus*) (Ancrenaz et al., 2016; Nater et al., 2017; Singleton et al., 2015).

Since many years ago, orangutans were known to live in lower population densities at high elevation up to 1500m (4921 ft), primarily tropical rainforest and mixed dipterocarp forest, including peat swamp forest (Galdikas, 1988). Orangutans are known to have varied behaviour and responses to adapt in the different environment and habitat (van Schaik et al., 2009). In 2004, Sumatran orangutans populations is estimated around 6,500 individual (Wich et al., 2008). In 2015, the new transect survey studies revealed that 8113 more individuals of Sumatran orangutans were found over ranges that not surveyed previously such as at the west of Toba Lake, over peat swamp forest and at higher elevation of mountain.

The three species orangutans is the only living non-human apes as well as the iconic species in Asia are all listed under ‘Critically Endangered’ (IUCN, 2017). Due to their arboreal behavior, habitat and feeders, the forest destruction put orangutans at the brink of extinction. Within 15 years, 25.27 % of forest in North Sumatra has been deforested (Basyuni et al., 2018). Deforestation due to logging is the major threat of the loss habitat of orangutans followed by forest fire and conversion for plantation (Supriatna et al., 2017).

More crucially, due to large body size and slow moving, orangutans are always become poacher easy targets (Lange, 2014). Often, female orang-utans were killed to get the babies so it can be traded as pet. Consequently, this situation has endangered the orang-utans population, since the orang-utans reproduce slowly only once every eight to ten years (Russon, 2000; Stiles et al., 2016; Wich et al., 2004).

1.2 Coexistence of Human and Non-human Apes

Historically, orangutans and humans have coexist with each others from around half a million years ago (mya). Scientists discover the remains of orangutans and early human *Homo erectus* mingled together (Caldecott et al., 2005). Every day, humans have potential to encounter with orangutans in the forest, yards, orchards, rehabilitation center, sanctuary or zoo as tourists, researchers, villagers, rangers, zoo keepers, caretakers, poachers or hunters. Tourists, researchers, caretakers and rangers perceived orangutan as an enormous, loving and thoughtful creature that needs extra protection (Miles, 1993; Russon, 2000). In contrast, villagers often perceived orangutans as pests to their crops and threats (Campbell-Smith et al., 2011a; Campbell-Smith et al., 2010), while, poachers or hunters found orangutans as their profit (Stiles et al., 2016).

Since 1970s, researchers have studied on visitor density, visitor noise, visitor activity, visitor behaviour and attitudes to animals in captive, semi-wild and wild environment (Birke, 2002; Bitgood et al., 1988; Davey, 2007; Fernandez et al., 2009; Hosey, 2005; Morgan et al., 2007; Wells, 2005). In zoo and rehabilitation program, animals fully depend on their caretaker and regularly exposed to human visits. Without proper management, human interaction towards animals can cause abnormal behaviour, can alter time budgets, cause human imprinting and conflicts (Birke, 2002; Bitgood et al., 1988; Choo et al., 2011; Davey, 2007; Dellatore, 2007a, 2007b; Fernandez et al., 2009; Grundmann, 2006; Morgan & Tromborg, 2007; Smith, 2009; Wells, 2005). Consequently, animals that undergo rehabilitation program cannot be released to the wild unless their contact toward human can be reduced (Russon, 2009). In Smith (2009) study, caretakers were recommended to avoid unnecessary contact to reduce animal dependency. Visitors also were recommended to practice good behaviour such as not making any noise and distancing themselves from the animals (Birke, 2002).

Furthermore, animals that live near to human settlements may be involved in human provisioning. Often, irresponsible tourists or guides took advantages by feeding the wildlife. Long terms provision of food especially to wildlife could result in alternation of natural behaviour patterns and population's level, increasing the animal's dependency on the human provided food and their habituation to human contact, causing intra- and inter-species aggression and negatively impacting on wildlife health (Asquith, 1989; Dellatore, 2007b; Hosey, 2000a; Orams, 2002). Therefore, it is important to follow and practice guidelines in order to conserve animal's wellbeing in the wild (Macfie et al., 2010).

1.3 The Importance of Orangutan in Ecosystem

Orangutans start their day earlier around sunrise and end their day about an hour before sunset. They spend most of their day time travelling to locate food and to find sex partner (Morrogh-Bernard et al., 2009). Orangutans play an important role in the demography of peat forest land as seed dispersers via their long-distance travelling (Tarszisz et al., 2017). While travelling, orangutans spit large seeds on the ground as well as excrete seeds in their dung will result in germination for some plants (Corlett, 2017; Nielsen et al., 2011; Tarszisz et al., 2017).

Furthermore, orangutans are primarily frugivore whom consume up to 400 different items including young leaves, sap, flowers, honey, shoots, stems, seeds, nuts, bamboo, fungus, pith, bark, soil, termites, ants, eggs, and invertebrates (Russon, 2000). The fruit seeds that orangutans consumed and excrete will be disperse away from the parent plants results in increasing food availability in the forest which will beneficing other animals and also human (Caughlin et al., 2015).

Forest plays a key role in Earth's climate by releasing oxygen for living things to breathe and absorbing greenhouse gas carbon dioxide through photosynthesis (Bello et al., 2015). Large arboreal primates like orangutans rely on the forest for making life. While, millions of people across the tropic depend on forest's good and service. Ever-increasing population and global economic activity on tropical forest has negatively affects ecosystem service and function (Bello et al., 2015; Wright, 2005).

The human-caused and natural disasters that imperiling endangered species like orangutans consequently affect other ecosystem in distant location. For example, illegal logging of timber contributes to natural disasters such as landslides and flash floods as has happened in recent years in Bahorok, Besitang to Southeast Aceh local

communities (Ellis et al., 2006; Lubis, 2017). In 2015, El Nino weather pattern had accelerated the spread of fire due to slash and burn practices in Southern Kalimantan and western Sumatra has threatened orangutans and people's life in the affected countries (Shawki et al., 2017). Thus, saving orangutans would simultaneously save humans and their livelihood assets.

Finally, orangutans are the closest cousin to human compared to other great apes (Grehan et al., 2009; Hobolth et al., 2011). As their closest relatives, orangutans could act as a connective device to learn the artificial divide of nature and culture (Sowards, 2006). Presently, researchers reveal that orangutan that received regular provisioning will be able to adapt behaviorally as a response to current habitat degradation and population loss (Hockings et al., 2015; Peters, 2015). To support these findings, the study of orangutan's response toward disturbed environment in their habitat for example with the irregular tourists presence, presence of rangers, with provisioned and without provisioned environment as well as different types of habitat is crucial to assure the survival of future orangutans.

1.4 Objectives of Study

The objectives of this study are as follows:

(i) To study orangutans behavior patterns according to human presence in forest and feeding site.

(ii) To investigate orangutans spatial uses according to human presence at feeding site.

(iii) To determine first time tourists and returning tourists' perception, information and awareness on Bukit Lawang orangutans feeding site.

1.5 Thesis Structure

Each chapter is written as a standalone chapter, there might be repetitions in the information written.

Chapter	Descriptions
Chapter 1	Provides the introduction and objectives of the study. A general look of orangutans taxonomy, distribution and current issues as well as the background of orangutans-human interaction was presented.
Chapter 2	Contains literature review. The orangutan's general description, taxonomy and distribution, habitats and feeding behavior were discussed. It also contains visitor effects and space design effects on primate's behavior, food provisioning and orangutans' foraging skills. Gestural, visual contacts, vocalization and locomotion were also covered. Lastly, the topic of threats to orangutans was elaborated.
Chapter 3	Comprises the methodology of Chapter 4, 5 and 6. The background of the study site was also included in this chapter.
Chapter 4	Presents the first working chapter of this thesis which is behavior patterns of orangutans towards the numbers of tourists and rangers.
Chapter 5	Focus on the study of orangutans space use towards the numbers of tourists and rangers.

Chapter 6	Evaluates first time tourists and returning tourists' perception, information and awareness on Bukit Lawang orangutans feeding site.
Chapter 7	Contains conclusion of the whole findings in this study. Recommendations for future research were also discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 General Descriptions of Orangutan

The size of orangutans brain is about 350cc (cubic centimeter), compared to humans (whose brain size is about 1,400cc) (Morris et al., 2009). Their average skeletal height is about 120 centimeters (Morris & Parker, 2009; Payne, 2013). Male and female of orangutans are highly sexually dimorphic. Males weigh on average forty-five to one hundred kilograms and female weighing about thirty five to fifty kilograms (Mackinnon, 1974). However, in zoos, orangutans weight may increase due to a steady supply of food and minimum exercise (Payne, 2013). Adult have cheek pads, a great drooping throat pouch, long, shaggy hair that appear like dreadlocks and a distinctive "long call" (Russon, 2000). Long call may help to co-ordinate the movements of the dispersed sub-group, to attract females and to achieve spacing between adult males (Mackinnon, 1974).

Apes have big brains so they can cope with the mutable social relations that exist among their group and with the constantly changing food supply to which they must adapt with their foraging behavior (Mackinnon, 1974). Orangutan's strength is legendary, almost eight times as great as a single man's (Russon, 2000). The life span of orangutan is thirty five to forty years but researchers found that captive orangutans can reach sixty years old (Russon, 2000).

Female orangutans have their menstrual cycle at approximately monthly intervals (Mackinnon, 1974). Orangutan's menstrual cycle average is about thirty

days (Russon, 2000). Mating activity is slightly more common in the mid-month period. When female became pregnant, they tend to be aggressive to their partner (Mackinnon, 1974). Their pregnancies duration is about nine months long (230-260 days) and gives birth to a single infant at a time. Female orangutans bear their offspring only once every eight to ten years (Russon, 2000).

2.2 Taxonomy and Distribution of Orangutan

Order: Primates

Sub-order: Haplorhini

Family: Hominidae

Genus: Pongo

Species: *Pongo abelli*

Species: *Pongo tapanuliensis*

Species: *Pongo pygmaeus*; **Subspecies**: *Pongo pygmaeus pygmaeus*,

Pongo pygmaeus morio,

Pongo pygmaeus wurmbii

In 1932, the first fossil of orang-utan teeth found from China by C.C. Young revealed that orangutans are dispersed throughout Southeast Asia, from Southern China in the North to Java in the South during Pleistocene (Hooijer, 1948; von Koenigswald, 1982). Currently, orangutans can only be found on the islands of Sumatra and Borneo (Wich et al., 2008). In Sumatra, Sumatran orangutans (*Pongo*

abelli) are only found in the northern part of the island, including northern part of Acheh, Leuser ecosystem and Batang Toru. While Tapanuli orangutans (*Pongo tapanuliensis*) originated at mountainous region of Tapanuli atBatang Toru, Sumatra (Figure 2.1). There are three subspecies of Bornean orangutans which are localized at different parts of the island. *Pongo pygmaeus pygmaeus* is distributed in Sarawak and Northwest Kalimantan, while *Pongo pygmaeus morio* can be found in Sabah and East Kalimantan. *Pongo pygmaeus wurmbii* which is the most abundant population of orang-utan subspecies are primarily dispersed in Southern west Kalimantan and Central Kalimantan (Payne, 2013; Wich et al., 2008) (Figure 2.2).

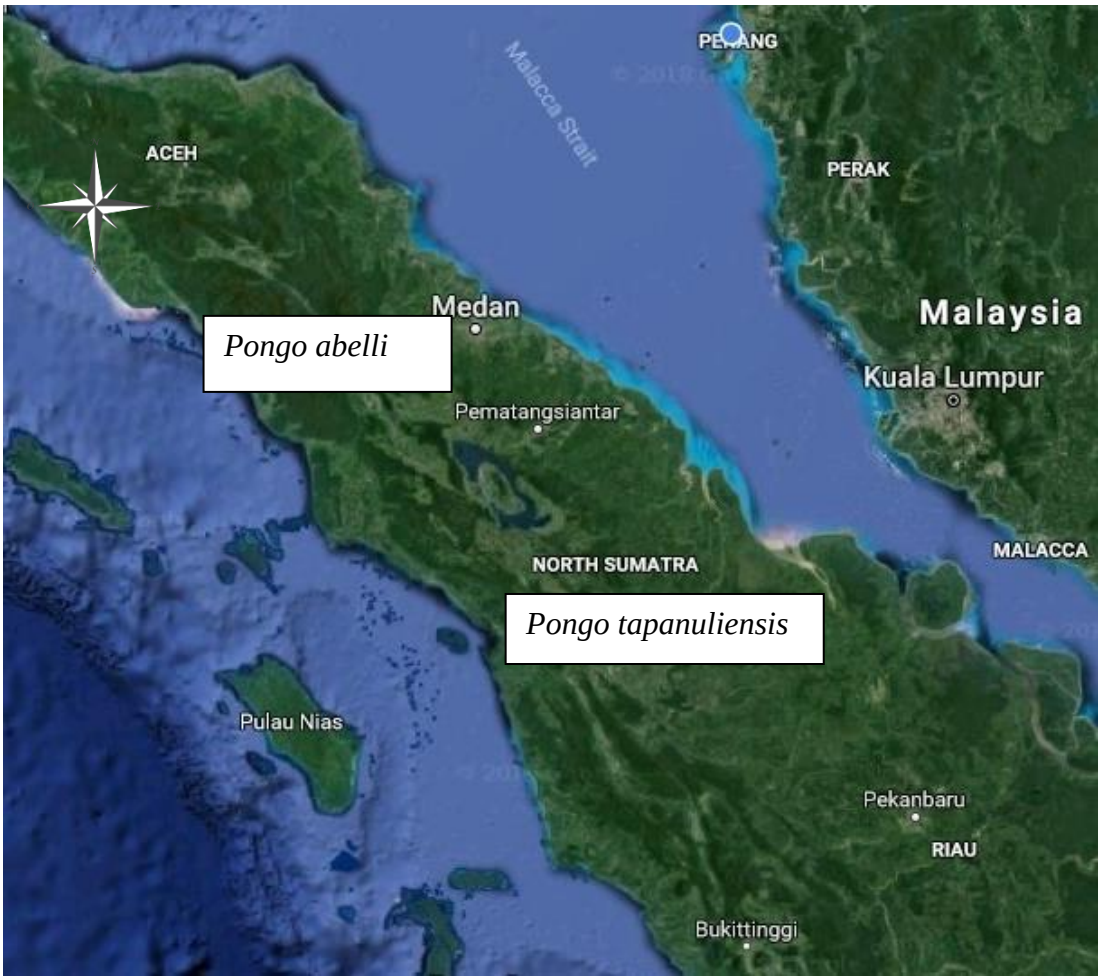

Figure 2.1: *Pongo abelii* and *Pongo tapanuliensis* locations in North Sumatra.

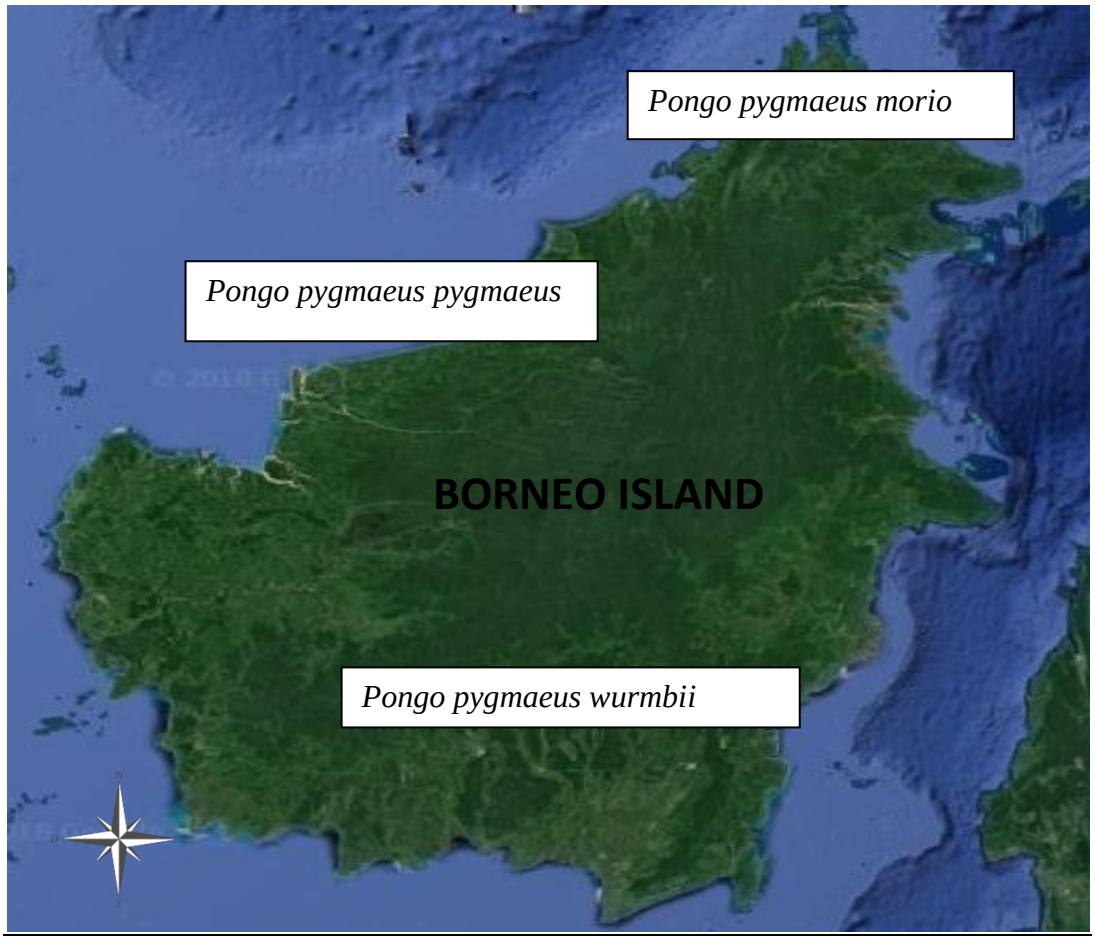

Figure 2.2: Bornean orangutans species locations in Borneo Island.

Sumatran, Tapanuli and Bornean orangutans can be distinguished by their different genetics, origins and also their different physical appearances. The red-orange hair of Sumatran orangutan is paler than their Bornean relatives, with longer body, longer face and thinner body (Courtenay et al., 1988). The wild orangutans are difficult to spot in the jungle due to their orange colour that blended well with sunlight. Their body resembled tree branches/deadwood in the sunlight, high above in the canopy. Orangutans have longer arms compared to their legs, and their shoulders are wider than their hips. These features are designed for true tree-dwelling similar to gibbons (Russon, 2000).

2.3 New Species of Tapanuli Orangutan

Molecular studies place orangutan divergence from humans at 9-13 million years ago, gorilla and human at 6-8 million years ago and chimpanzee and human diverged at ~4 million years ago (Glazko & Nei, 2003; Hobolth et al., 2011). Approximately 3.38 million years ago, genetic separation from the Sumatran orangutan occurred. About 674 thousand years ago, Tapanuli orangutans diverge from the Bornean orangutans (Nater et al., 2017).

In 2017, the third species of orangutans had officially named as *Pongo tapanuliensis*. The Tapanuli orangutan is named after the Tapanuli districts where the species found. Pongo tapanuliensis population is distributed in fragmented forests of Batang Toru in the districts of Tapanuli (Nater et al., 2017). A Tapanuli district is located at the southernmost range of North Sumatra province in Sumatra, Indonesia after Lake Toba (Figure 2.3). Batang Toru ecosystem contains an exclusive mosaic of forest types that range in elevation from 150-1800 meters above sea level (Ricciardi, 2014). However, this new species has listed as critically endangered species by IUCN Red List in instant (Nowak et al., 2017). Only 800 individuals Tapanuli orangutans live in the wild (Nater et al., 2017).

Figure 2.3: The map of North Sumatra, Indonesia.

33 adult male orangutans holotype were studied and compared with the complete skeleton of Batang Toru adult male orangutans that died from wound in 2013. At the same developmental stage, this investigation revealed that the type skull of Tapanuli orangutans is significantly smaller than all extant orangutans. Tapanuli orangutan also differs specifically from its extant species in the structure of their bigger canine and number of cranio-mandibular measurements (Nater et al., 2017).

Moreover, the external morphological of Tapanuli orangutan is more similar to Bornean species. The hair of Tapanuli orangutan is thicker and frizzier (Figure 2.4). While male Tapanuli orangutan has a moustache and protruding beard with

flatter cheek pads, covered indowny hair. Unlike female Sumatran orangutan, female Tapanuli orangutans have beard (Nater et al., 2017). Behaviorically, the long call emits from Tapanuli orangutans has a higher maximum frequency range of the roar pulse type compared to Bornean and Sumatran orangutans long call (Nater et al., 2017).

Figure 2.4: *Pongo abelii, Pongo tapanuliensis* and *Pongo pygmaeus* descriptions.

2.4 Orangutan Habitat

Orangutans live in lower population densities at high elevation up to 1500m (4921 ft), primarily tropical rainforest and mixed dipterocarp forest, including peat swamp forest, grasslands, cultivated fields, gardens, young secondary forest and shallow lakes (Galdikas, 1988). Orangutans are known to have varied behaviour and responses to adapt in the different environment and habitat(van Schaik et al., 2009).Sumatran forests provide more favourable environment in terms of their

habitat and food availability for orangutans as compared with Bornean forests (Marshall et al., 2009).

Orangutans that live in mixed dipterocarp forest spent less time travelling and feeding during their active period compared to those that live in peat swamp forest. This is because fruit availability at peat swamp forests is more regular (Morrogh-Bernard et al., 2009). However, orang-utans diet is not affected by fruit availability in certain forests that have large strangler figs and crop size such as Ketambe in many parts in north Sumatra forest (Marshall et al., 2009; Morrogh-Bernard et al., 2009). Furthermore, high fruit availability also positively supports orang-utan population density (Marshall et al., 2009).Flanged males of Sumatran orang-utans rarely travel on the ground to avoid their main predator, Sumatran tiger (*Panthera tigris sumatrae*) (Thorpe et al., 2009).

2.5 Feeding Behaviour of Orangutan

Orangutans have a wide diet to fill their huge caloric needs to determine their large size and social organization, thus, most of their time is spent for foraging (Miles, 1993; Russon, 2000). Orangutans are truly frugivore with 50-60 percent of their diet consisting of fruits. Even though some fruits or flowers are seasonally available such as Durian (*Durio zibethinus*) and Rambutan, (*Nephelium lappaceum*),orangutans does not depend on any single food (Galdikas, 1988).They consume up to 400 different food items including young leaves, sap, flowers, honey, shoots, stems, seeds, nuts, bamboo, fungus, pith, bark, soil, termites, ants, eggs, and invertebrates (Galdikas, 1988; Mackinnon, 1974; Rijksen, 1978; Russon, 2000). Inner tree bark are considered as fallback foods for *Pongo pygmaeus wurmbii* since

ficus species trees have less variety in Borneo forests compared to Sumatra forests (Marshall et al., 2009; Vogel et al., 2014).

It was once recorded that an adult female Sumatran orangutan hunted, killed and ate slow loris (*Nycticebus coucang*) (Russon, 2000; Utami et al., 1997). In other cases, two adult Sumatran Orangutans were observed cannibalizing on the remains of their infant's body (Dellatore et al., 2009). Orangutans drank water from streams, swamp puddles and holes in trees, or licked rainwater from leaves or from the hairs of their arms (Galdikas, 1988; Rijksen, 1978). Figs also known as a keystone species for many frugivorous forest primates because *Ficus* sp. tends to fruit asynchronously, producing fruits several times in a year (Cowlishaw, 2000). Studies show that orangutan diets depend primarily on figs when non-figs fruits are low (Wich et al., 2006). Orangutans will form aggregations sitting and feeding on the same fruiting figs crops for long periods of time (Utami et al., 1997).

Individual orangutans feed more efficiently on large fruiting fig trees. In clumped resources, the formation of aggregation can result in contest competition between dyads. Dominant orangutans tend to displace other subordinate in or around large fruit trees. However, female-female dyads are more tolerant towards each other compared to the male-male dyads. Adult males can still reenter the fig trees with or without the dominant female still in the fig trees. Comparatively, males only reentered after the adult males left the fig trees. Scramble competition are absent and contest competition only occur on subordinate individuals (Utami et al., 1997).

Orangutans will travel more when non-figs fruits are plentiful to search for their preferred fruits (Morrogh-Bernard et al., 2009). During fruit abundance period, orangutans diet consists of 100% of fruits. Orangutans have the ability to maximize

caloric intake by storing their excess energy as fats to adapt during low fruit periods (Knott, 1998). Large bodied adult male orangutans move less and foraged more efficiently as compared to small bodied adult females and sub-adult males. Orangutans also move less and foraged more efficiently in a fig with large fruit, for example *Ficus drupacea* (Utami et al., 1997).

2.6 Visitor Effects' on Primates Behaviour

Visitor effects' on animal can be stressful, neutral or enriching (Choo et al., 2011). Stress in animals can be detected by their abnormal behaviour, reduced resistance to disease and affect population performance (Millspaugh et al., 2004). Animal behaviour can also interpret animal health which can be used to assess animal welfare (Dawkins, 2004). Since 1970s, researchers have studied on the visitor influence on animal behaviour such as visitor density, visitor noise, visitor activity, visitor behaviour, proximity to animals and how visitors interact with animals in captive and semi-captive (Birke, 2002; Bitgood et al., 1988; Davey, 2007; Fernandez et al., 2009; Hosey, 2005; Morgan & Tromborg, 2007; Wells, 2005).

Orangutan behaviour changes are associated with active visitors rather than passive visitors(Choo et al., 2011). Animal activity, size, proximity and visibility, the presence of an animal infant and a simulated behaviour increased the length of visitors viewing time (Bitgood et al., 1988). Studies suggest that rehabilitant orangutans may remain oriented to humans and thus more prone to have conflicts with human and caused human imprinting on orang-utans (Grundmann, 2006; Smith, 2009). In the close proximity with human, time spent on activity budgets of free-ranging orang-utans showed more interaction with human such as watching human

and waiting to be fed (Dellatore, 2007a). Similarly, captive orangutans play behaviour significantly decreased and looked more at the visitors when the visitors were in close proximity (Choo et al., 2011). During low visitor density, captive gorillas spend more time resting. In contrast, high visitor density increases intra group aggressions, stereotypies and self grooming in gorillas (Wells, 2005). High visitor density also decreased chimpanzees' foraging, object-using, grooming and play activity (Wood, 1998). Orangutans respond particularly when confronted with crowd size and high noise level from human visitors such as loud shouting or screaming (Birke, 2002).

As big arboreal primates, orangutans might not visibly display their stress condition to the human visitors compared to the smaller species which are more reactive with avoidance and defensive behaviours (Sade, 2013). When visitors are present, small arboreal and terrestrial primates are more active than the larger species. However, large species are more likely to interact with the visitors. Male mandrill pays more attention to higher visitors' density. During high visitors frequency, sleeping and resting activity are absent because mandrills are more likely watching the visitors or showing a genital display (Chamove et al., 1988).

Physiologically, scientists also detect stress in animal through their fecal glucocorticoid interpretations (Millspaugh & Washburn, 2004; Muehlenbein et al., 2012; Sheriff et al., 2010). Fecal glucocorticoid metabolite concentrations increase on the day after the wild habituated and unhabituated Bornean Orangutans received many tourist visitations compared to the samples taken before or during tourist visitation. Habituated animals that are used for tourism have lower fecal glucocorticoid metabolites (Muehlenbein et al., 2012).

2.7 Space Design Effects on Primates Behaviour

Space use patterns can provide critical information about animals' requirements, preferences and internal cares to meet the animal's needs (Ross et al., 2006 & 2009; Traylor-Holzer et al., 1985). Zoos focused to provide more naturalistic and stimulating environments to meet species-specific behavioural needs (Tingey, 2012). This type of space design effect studies is mostly done in captive or zoo environment. Zoo environment are defined in terms of three dimensions which are:(1) receiving unfamiliar human visitation regularly, (2) restricted space and (3) being managed (Hosey, 2005; Morgan & Tromborg, 2007). Space reduction can increase animal aggressions. Bitgood (1988) suggested that increasing spaces in great ape exhibits will result in reduce proximity of visitors crowd. Since orangutans are primarily solitary, increased exhibit size has resulted in decrease in aggressive behaviours (Maple et al., 1987; Tingey, 2012). For the close up view of the animals, the exhibits may be screened or blocking the animals' view of visitors to reduce stress (Bitgood et al., 1988).

Furthermore, preference animals within single facility depend on the availability of the facilities (S. R. Ross et al., 2009). In natural environment, chimpanzees (*Pan troglodytes*) and lowland gorillas (*Gorilla gorilla gorilla*) were more likely to avoid open areas. However, both species are seen to use space adjacent to keeper-occupied spaces where caretakers-animal interaction occurred such as feeding, training, playing and informal interactions (S. R. Ross & Lukas, 2006). Three captive orang-utans which were relocated into a new and more naturalistic enclosure fosters more positive behavioural towards conspecific. Orangutans become more active and showed increased exploratory behaviour in the new exhibit (Tingey, 2012). Camouflage netting placing between zoo visitors and

gorilla creates more relaxation and quieter environment between visitor and gorillas' behaviour (Blaney et al., 2004).

2.8 Food Provisioning

There are advantages and disadvantages of provisioning. Without proper management and control, the audience feeding the primates can cause stress to the animal (Hosey, 2000b). Long terms provision of food especially to wildlife would cause an alteration of natural behaviour patterns and population's level, increase animals dependency on the human provided food, their habituation to human contact, intra- and inter-species aggression and impact on wildlife health (Asquith, 1989; Dellatore, 2007a; Hosey, 2000b). Hosey (2005) reviewed that provisioning in captive primate will decrease their foraging and feeding time, cause pre-feeding agonism, and may lead to obesity. Whilst, provisioning in non-captive primates will cause greater agonism, more time resting and less time feeding which will result in changes in social behaviour.

Primates that are born into provisioned group may adopt their parent practices and experience difficulties during food shortages since they have not learned to explore and exposed to find the edible foods (Asquith, 1989; Dellatore, 2007a). Alternatively, Hosey (2000b) reported that somehow, audience throwing food towards some species in captive gave an enriching or positive effect. Zoo chimpanzees are more likely to interact with men carrying objects (usually the caretakers) to obtain foods (Cook et al., 1995). Some orangutans would immediately visually interact and showed begging behaviour at visitors who were holding foods (Choo et al., 2011).

2.9 Foraging Skills of Orangutan

Foraging in non provisioned animals is higher than in provisioned animals (Altmann et al., 1988). Orangutan diets depend primarily on figs when non-figs fruits are low and will travel more when non-figs fruits are plentiful (Morrogh-Bernard et al., 2009; Wich et al., 2006). An infant orangutan starts to consume solid food after one year old. An infant will beg by holding its hand to the mother's mouth or directly take foods from the mother's hands (Van Noordwijk, 2009). Begging behaviour of infants will consistently decline with age (Jaeggi et al., 2008). Unweaned immatures predominantly co-foraged with their mother.

Immatures started to reduce co-foraging with the mother when their mother is being consorted by males, which will increase mother-latter offsprings conflicts (Jaeggi et al., 2010; Jaeggi et al., 2008). This is because young orangutans obtain affordness and nutritional value of food items with their mother diets (Jaeggi et al., 2008). Unweaned immatures will still refer to their mother's choices when encountered with new novel foods by watching and goal-directed practice (Jaeggi et al., 2010). More individual of orangutans feed more efficiently on large fruiting fig trees. Competitions are absent and can only occur on subordinate individuals (Utami et al., 1997). The study on spatial memory of zoo gorilla determined that gorilla collect food regularly at the same sites. They also tend to avoid visiting food sites that have been previously depleted by other gorillas (Gibeault et al., 2000).

2.10 Gestural of Orangutan

Gesture study in great apes can link us to how human communication evolved from millions of years ago. Gesture is a communicative function expressed

by hands, foot or limbs that contain specific meaning or message. It is demonstrated by the sender to the recipient, and the recipient must be able to understand the signal (message) (Gibbon, 2009; Kendon, 2004; McNeill, 2000; Pollick et al., 2007). Seyfrath and Cheney (2003) derived meaning into two types; which are functional meaning and intentional meaning. Most signals have some functional meaning. For example; when you smile at the bar, and the people think that you are being polite to them and that is it. If the signaler send a signal to the recipient and intent the recipient to achieve or complete the signaler's goal or task (which the recipient extract from the signal send by the sender), the signal sent is analyze as intentional meaning (Cartmill et al., 2010).

Orangutans use extraordinary number of signals including tactile and visual gestures, as well as several complex actions. Orangutans also produced few facial expressions. However, no auditory gestures are produced by orangutans (Liebal et al., 2006). Previous research comparing human infants to language-enculturated chimpanzees and bonobos revealed that multimodal expressions of communicative intent (gesture or visual gaze followed with vocalization) were normative in human infants but rare in apes. This research illustrates on how multimodal expression of communicative intent may have supported the evolution of language from our human ancestors (Gillespie-Lynch et al., 2014).

Individual captive orangutan showed a high degree of variability signal repertoires with respect to the kind of signals used by each individual (Liebal et al., 2006). The variability of the repertoires used within group and between groups of orangutans was equal as they lived in an individual-based fission-fusion system (Delgado et al., 2000; Liebal et al., 2006). Signal repertoires used by orangutans are flexible on the functional contexts they were used for. Tactile gestures are the most

flexibly used signal category, while the highest variety of signals was used within a play context and followed by the ingestion context (Liebal et al., 2006).

Juvenile orangutans use higher visual gestures and actions to initiate play, which adults are less likely to engage in playing behavior. While, adult orangutans more often engage in agonistic encounters or sexual interactions using particular signals (Liebal et al., 2006).According to Smith study (2009) as orangutans grow older, their orientation with human may serve to negative behaviour rather than positive interaction with humans.

2.11 Visual Contacts of Orangutan

Besides body gestures, the role of eye contact is to accommodate the social interaction (Tomasello et al., 2007). Sociologically, eye contacts can be informative, regulate interaction, express intimacy, exercise social control and facilitate service and task goals (Gómez, 1996; Kleinke, 1986; Tomasello et al., 2007). Similar to human, eye contact in great apes has evolved into an ostensive behavior which is delivering their intention to someone without being acknowledge, expressing something (Gómez, 1996). Eye gazing is very important to locate foods or to detect predators from the environment. An infant orangutans use eye gazing to beg for food from the mother by shifting gaze to the mother's eyes and the food item (Kaplan et al., 2002).

Moreover, a captive dominant male orangutan was trained to use a novel foraging method. The well-trained captive orangutan performed a novel foraging method in the presence of his group member. After that, the group member allowed to forage until they succeeded to retrieve the food. The group member then becomes

a model to the next individual. This experiment revealed that orangutans watch and copy others to complete a novel task. Extraordinarily, they are capable to spread the learned technique to other individuals in a population (Dindo et al., 2010).

Eye gazing was commonly used by bonobos, chimpanzees and gorillas for social interaction, but very restricted in orangutans (Gómez, 1996). Perhaps, it is due to solitary organization and behavior of orangutans. Orangutans avoid direct gaze toward their conspecific (Kaplan & Rogers, 2002). Kaplan and Rogers' (2002) study showed gazing patterns of captive orangutans are restricted compared to semi wild orangutans. This situation may be caused by their depression, stereotypy or other aberrations due to their long periods in captivity. Juveniles are more likely to be involved in social visual contact. The juvenile staring is focused at the limb of the adult orangutans. Thus, juveniles might understand adults signaling by the limbs and body movements as well as face expression for extension (Kaplan & Rogers, 2002).

2.12 Vocalization of Orangutan

Sound and vocalization (calls) were invented in population and subsequently spread through social learning (Wich et al., 2012). Below is an updated list of call descriptions from Mackinnon (1974) and Rijksen (1978) by Hardus et. al (2009).

Table 2.1: Comparison of call types of the orang-utan repertoire.

Described call types	Short-, middle-, or long-distance communication