

# Behavior and Food of Reintroduced Bornean Orangutan (*Pongo pygmaeus wurmbii*) at Feeding Site and Forest Area in Lamandau Wildlife Sanctuary

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## ABSTRACT

The Bornean orangutan (*Pongo pygmaeus wurmbii*) is a Critically Endangered large Asian primate. Reintroduction had been implemented to recover their population in the wild. The research was conducted in February-April 2021 at Lamandau Wildlife Sanctuary, aimed to identify behavior differences at the feeding site and forest, composition and preferences for additional and natural feed by following 6 reintroduced Bornean orangutans. The total observation duration was 219 hours using focal animal sampling and instantaneous records. Feed preferences data analysis using Neu index then categorized as rank, and Jacobs's index then categorized as highly preferred, preferred, less preferred, not preferred, and uncategorized. The additional feed had little effect on the reintroduced orangutan's arrival to the feeding location, hence their stay in the forest was longer than at the feeding site. The highest daily activities by age class and gender were foraging (32%) by adult female, resting (44%) by adolescent female, and moving (25%) by adult male and female. The part of plant that consumed were fruit (51%), young leaves 25%, and other parts of vegetation (15%). The first rank additional feed preference is banana (*Musa* sp.), and second is papaya (*Carica papaya*). The natural feed preferences of highly preferred were papung (*Sandoricum ermarginatum*, Di 0.73) and kumpang darah (*Knema conferta*, Di 0.66). Other categories are 9 species preferred, 7 species less preferred, 16 species not preferred, and 8 species uncategorized.

**Keywords:** Bornean orangutan, Daily activities, Feed preferences, Feeding site, Lamandau nature sanctuary.

## 1. INTRODUCTION

Orangutan are great primates in Asia, and their current distribution includes Sumatra and Kalimantan rainforests [1]. Threats had been monitored include land conversion, destructive activities, habitat fragmentation [2, 3], and illegal hunting [4, 5]. The Bornean orangutan (*P.p. wurmbii*) listed in Appendix I of the CITES and had the Critically Endangered status (CR) in IUCN [6]. One of the implemented programs is the reintroduction program, which aims to find orangutan populations in their natural habitats, reduce direct contact with humans, and increase the interaction of rehabilitated orangutan with their natural habitats [7, 8].

Reintroduced Bornean Orangutan (*P.p. wurmbii*) has several changes in behaviour and feed composition as long as rehabilitation process, it caused by the human intervention [9, 10]. Therefore, in the reintroduction program using the soft release method, they treat with additional feed for anticipation of several possibilities, like the lack of feed availability and the limited ability of reintroduced orangutan to recognize and obtain their feed in nature.

In previous research, Bornean orangutan has been successful in 20% to 50% reintroduced to Borneo natural forest [4]. Therefore, One of the ways to see the success of reintroduction is by monitoring in the wild [11]. Knowledge of differences in the daily activity of reintroduced orangutan is important in the monitoring

and evaluation steps of the orangutan reintroduction program in Lamandau Wildlife Sanctuary. Data for the survival rate of orangutan can be used as a success indicator for 20%-80% reintroduction programs [11]. Thus, as a form of the development of research related to the behaviour of orangutan when they are not in their natural habitat. The research aimed to identify the differences between reintroduced Bornean orangutan behaviour, the composition and preferences of additional and natural feed.

**2. METHOD**

The research was conducted in the Lamandau Wildlife Sanctuary, Central Kalimantan from February to April 2021. There was 6 introduced Bornean orangutan from 4 categories, namely Maya (adult female), Jonson (adult female, Sugih (adolescent female), Pegi (adolescent female), Okto (adolescent male), and Brian (sub-adult male). Behavior data were collected for 219 hours, by focal animal sampling method, and Instantaneous recording with 5-minute intervals. One subject used 3 repetitions/day.

$$activity\ (\%) = \frac{length\ of\ activity\ (minute)}{total\ of\ activity\ (minute)} \times 100 \quad (1)$$

Data on the proportion of orangutan activity at the feeding site and forest were analyzed by Fisher's test. The tested hypotheses are:

- $H_0$  = additional feed did not affect the presence of orangutan in feeding site (if  $P < \alpha = 0,05$ ).
- $H_1$  = additional feed affect on the presence of orangutan at the feeding site (if  $P > \alpha = 0,05$ ).

Multiple Regression Analysis test, to determine the effect of independent variables on the arrival of reintroduced Bornean orangutan to the feeding site:

- Y = Frequency of reintroduced Bornean orangutan to the feeding site.
- $X_1$  = How long orangutan had been reintroduced into the wild.
- $X_2$  = Reintroduction age.

Type and composition of feed recording the type and composition of additional and natural feed, and it was divided into seven categories, namely fruit (Fr), young leaves (Yl), old leaves (Lv), flowers (Fl), vegetation/other plant parts (Veg) (stems, pith or cambium); insects (Ins); and another category (Oth) (drinking water, honey, mushroom).

$$feed\ category(\%) = \frac{feed\ category\ selected}{all\ categories} \times 100 \quad (2)$$

The feed preferences used the Neu index to calculate the preference for additional feed at the feeding site (as shown in Table 1), if  $w \geq 1$  is preferred but if  $w \leq 1$  = not preferred. Where a = the observed amount of orangutan feed; p = the proportion of orangutan; n = the amount of each feed species to be

consumed by orangutan; u = proportion of each food species consumed by orangutan ( $n/\Sigma n$ ); w = preference index ( $ui/pi$ ); b = standardized selection index ( $wi/\Sigma w$ ).

**Table 1.** Neu index for additional feed

Name species	Availability		Utilization		Preference index	
	a	p	n	u	W	b
<i>Musa sp.</i>						
<i>C.papaya</i>						

Jacobs index [12] to calculate natural feed preferences, as shown in Equation (3), where  $D_i$  is index of preference,  $r_i$  is the proportion of feed utilization,  $p_i$  is the proportion of abundance of feed trees. The preference of orangutan's feed were grouped into 4 categories, namely highly preferred ( $D_i$ : 0.51-1.00), preferred ( $D_i$ : 0.01-0.50), less preferred ( $D_i$ : -0.51-0.00), and not preferred ( $D_i$ : -1.00 -0.50). Category 'uncategorized' given for species that can not be found on sampling plot.

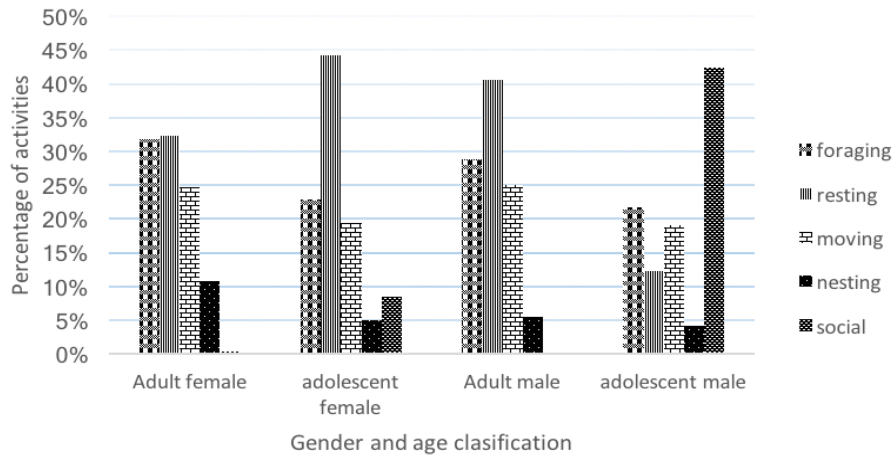
$$D_i = \frac{(r_i - p_i)}{(r_i + p_i - 2r_i p_i)} \quad (3)$$

**3. RESULT AND DISCUSSION**

**3.1. Daily Activities of Reintroduced Bornean Orangutan**

The longest duration of orangutan daily activity was owned by an adolescent male with 743 ( $\pm 29.3$ ) minutes, while the shortest duration was an adult female with 722 ( $\pm 27$ ) minutes. Meanwhile, Maya (Adult female) had the highest standard deviation is 691 ( $\pm 55.1$ ). This indicates that each individual has a high variation of daily time. it can be influenced by internal and external factors, including the different nutritional needed, the availability of feed at their location, and the bad weather. The fruit availability in some locations can cause increased moving activity of active period. In the other research like in Sebangau, social interaction can increase the activity period [13].

Based on the results (Figure 1), the highest foraging or feeding activity was by adult female orangutan (32%). However, other individuals will prefer foraging in the forest never visiting the feeding site except Maya (adult female). Maya's feeding activity is unique to her baby and only be seen while consuming additional feed at the feeding site. Maya will distribute food (food sharing) and the baby will ask for food (food begging). According to [14] food sharing (sharing food) will be preceded by food begging (asking for food), but not all food begging will end with food sharing. The highest moving activity was by an adult female and adult male



**Figure 1.** Reintroduced Bornean orangutan daily activities

(25%). The moving activity was carried out to get food, find for mating, and even raise child [15].

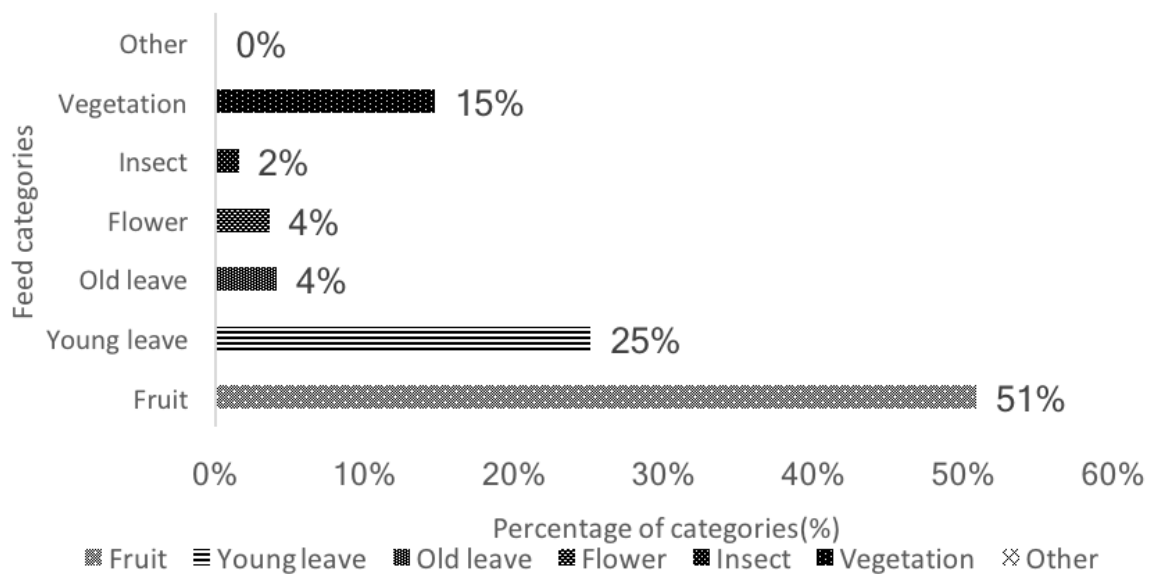
The longest resting activity was by an adolescent female (44%), either nest building (11%). Adult female tend to do rest activities and would be higher when they were adolescents. In contrast to a male orangutan, they will allocate more daily time to rest when adults than when they are adolescents. Orangutan will not choose food trees to avoid disturbance by strangers and predators while sleeping [16]. The highest social activity of orangutan was by juvenile male (42%). Orangutans aged 7-8 years will be dominant in social activities such as playing [17].

**3.2. Differences Activities in Feeding Sites and Nature Forest**

Based on the results of Fisher's test. It concluded

that by rejecting  $H_0$ , the proportion of reintroduced Bornean orangutan to the feeding site was less than those did not go to the feeding site ( $P=1 > 0,05$ ), and additional feed had no effect on the presence of orangutan at the feeding site. Orangutan preferred to look for natural food in the forest rather than in feeding sites, so they spent more time in the forest. The orangutan's ability to get natural food was based on the experience of each individual [18].

Orangutan that did not come to visit are influenced by limiting factors, including the length of time the orangutan have been reintroduced into the wild ( $X_1$ ) and the age at reintroduction ( $X_2$ ). The multiple linear regression model is  $Y = -1.956 + 0.136X_1 + 0.226X_2$ . In addition, threat factors also affect the arrival of orangutan to the feeding site. Based on the results ( $F_{test} > 9,55$ ), it was both factors had a simultaneous



**Figure 2.** Food categories for reintroduced Bornean orangutan

effect on the arrival of orangutan.

### 3.3. Types, Composition, and Feed Preferences

Identification of food tree species there were 42 species of feed consumed by 23 families, and 4 species unidentified or a species can't be identified. The food tree species was dominated by Myrtaceae with 5 species and 4 species of Moraceae. Types of Myrtaceae for

example ubar putih (*Syzygium tawaense*), nenasi (*Syzygium buxifolium*), and jejambu (*Eugeneia cuprea*). In addition, orangutan consume almost all parts of it, one of them is lamanaduk (*Dyospyros pilosanthera*). In previous research in Tanjung Puting with the same subspecies, orangutan could consume 281 feeds from 203 different species [22], Orangutan are a species of Highly Opportunistic Feeders [19, 20].

**Table 2.** Food preferences of the reintroduced Bornean orangutan

Categories	No	Local name	Species	r <sub>i</sub>	p <sub>i</sub>	D <sub>i</sub>
Highly preferred	1	Papung	<i>Sandoricum emarginatum</i>	1.14	4.27	0.73
	2	Kumpang Darah	<i>Knema conferta</i>	0.57	0.21	0.66
Preferred	1	Ketiau	<i>Ganua motleyana</i>	1.36	3.42	0.45
	2	Jejambu	<i>Eugeneia cuprea</i>	0.91	0.83	0.34
	3	Berbasung	<i>Polyalthia lateriflora</i>	1.59	2.99	0.28
	4	Kangkoban	<i>Neoscortechinia philippinensis</i>	1.59	2.56	0.24
	5	Medang	<i>Actinodaphne</i> sp.	1.59	2.56	0.24
	6	Marigalang	<i>Alstonia angustifolia</i>	1.36	1.71	0.22
	7	Bentan	<i>Parastemon urophyllus</i>	1.14	1.17	0.10
	8	Selingsing	<i>Hypolytrum nemorum</i>	5.57	86.00	0.09
	9	Rengas	<i>Gluta rengas</i>	5.45	15.38	0.07
Less Preferred	1	Bengkuang	<i>Macaranga diepenhorstii</i>	2.05	2.00	-0.01
	2	Puak	<i>Artocarpus anisophyllus</i>	10.34	5.56	-0.05
	3	Ramania	<i>Bouea oppositifolia</i>	6.59	1.72	-0.34
	4	Keraya	<i>Ficus</i> sp.	10.34	2.14	-0.26
	5	Ubar Putih	<i>Syzygium tawaense</i>	12.27	2.14	-0.27
	6	Bangaris	<i>Koompassia malaccensis</i>	1.82	1.28	-0.35
	7	Bekunyit	<i>Diospyros polita Bakh</i>	2.39	1.28	-0.45
Not Preferred	1	Habu-habu Rawa	<i>Symplocos celastrifolia</i>	0.11	0.31	-0.56
	2	Heharang	unidentified	0.11	0.31	-0.56
	3	Lamanaduk	<i>Dyospyros pilosanthera</i>	13.98	1.28	-0.62
	4	Ubar Hiang	unidentified	0.11	0.43	-0.71
	5	KerANJI	<i>Dialium indum</i>	1.82	1.05	-0.83
	6	Kekupui	<i>Sarcotheca diversifolia</i>	0.11	0.62	-0.86
	7	Pengeladian	unidentified	0.23	0.85	-0.90
	8	Galam Tikus	<i>Syzygium zeylanicum</i>	0.11	0.85	-0.96
	9	Pudu	<i>Artocarpus kemando</i>	0.11	0.86	-0.96
	10	Mola	<i>Garcinia nigrollneata</i>	0.11	0.94	-0.98
	11	Kumpang	<i>Knema cinerea</i>	0.45	1.29	-1.46
	12	Mahang	<i>Macaranga hypoleuca</i>	0.11	6.01	-1.24
	13	Mendoking	<i>Elaeocarpus griffithii</i>	0.11	2.58	-1.17
	14	Merang	<i>Tetramerista glabra</i>	3.30	0.86	-1.61
	15	Nenasi	<i>Syzygium buxifolium</i>	0.57	1.04	-1.11
	16	Ubar Merah	<i>Syzygium leucoxydon</i>	0.34	3.00	-2.05
Uncategorized	1	Belalek	unidentified	1.70	-	-
	2	Dahanen	<i>Korthalsia flagellaris</i>	0.45	-	-
	3	Medang Pipit	unidentified	1.14	-	-
	4	Pakis	<i>Stenochlaena palustris</i>	2.73	-	-
	5	Bendo	<i>Artocarpus elasticus</i>	0.11	-	-
	6	Rasau	<i>Pandanus Helicopus</i>	1.02	-	-
	7	Bejaka	<i>Spatholobus littoralis</i>	4.20	-	-
	8	Rotan	<i>Calamus</i> spp.	0.23	-	-

The part of the plant that orangutan like the most are fruit (51%) Figure 2. Orangutan like fruit because they are more readily available in the forest and have a higher nutritional content than other categories, thus good enough for their energy needs [21]. Other parts consumed young leaves (25%) and other plant parts (15%) such as pith, umbut, and bark. Some individuals consume insects to fulfill the needs of animal protein [13]. In this research, orangutan consumed insects like termites and ants (2%).

Based on Neu index analysis, additional feed have 2 ranks of preferences. The first rank additional feed preference was banana (*Musa sp.*). If given bananas to orangutan, they would be taken and eaten first. The second rank was papaya (*Carica papaya*). The interest of reintroduced orangutan in consuming additional feed was not significant, because the variety of additional feed types is not as much as their natural food.

Based on the analysis of feed preference index on Table 2, there were 5 categories of natural feed preferences. One of the highly preferred species is 'papung' (*Sandoricum ermarginatum*, Di 0.73) and 'kumpang darah' (*Knema conferta*, Di 0.66). Categories that can not be identified were uncategorized. The plant species have small relative densities in nature and have low availability in the plot sampling of research area. There are 8 types of plants, one of them are 'bejaka' (*Spatholobus littoralis*) and 'belalek' (unidentified), which does not have a preference index value.

The variations of orangutan's diet can be seen by age class and sex categories. The highest diet variation of reintroduced Bornean orangutans was adolescent females, which 21 species of plants and 2 species of insects. However adult females have less diet variation than adolescent females, which 18 species of plants, 1 species of insect, and 2 species of additional feed. Diet variations for female orangutans will decrease when they get older and body weight increases [23].

There were different behaviour of reintroduced orangutan active in feeding sites and forests, such as food sharing and food begging. The arrival of reintroduced Bornean orangutan was not affected by additional feed in feeding sites, they rathered looking for natural food in forests. The additional feed composition was given banana and papaya. The natural feed composition from 42 tree species that 23 families and 4 species unidentified. The highest food form consumed is fruit (51%), young leaves (25%), and other plant parts (15%). Natural feed preferences were papung (*Sandoricum ermarginatum*) of 0.73 and kumpang darah (*Knema conferta*) of 0.66. Other categories were 9 species of Preferred, 7 species of Less Preferred, 16 species of Not Preferred, and 8 species Uncategorized.

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## REFERENCES

- [1] I. Singleton, S.A. Wich, S. Husson, S. Stephens, U.S.S.L. Matmoko, Orang-Utan Population And Habitat Viability Assessment: Final Report, Apple Valley, IUCN/Species Survival Commission Conservation Breeding Specialist Group, 2004.
- [2] D. Holmes, Deforestation in Indonesia. A Review of the Situation in 1999, Jakarta, World Bank, 2000.
- [3] P. Jepson, J.K. Jarvie, K. Mackinnon, K.A. Monk, The end for Indonesia's lowland forests?, Science, no. 292, 2001, pp. 859–86.
- [4] H.D. Rijksen, E. Meijaard, Our Vanishing Relative: The Status of Wild Orang utans at the Close of the Twentieth Century, Kluwer Academic Publishers, 1999.
- [5] A.J. Marshall, Nardiyono, M.L.M. Engstro, B. Pamungkas, J. Palapa, E. Meijaard, S.A. Stanley, The blowgun is mightier than the chainsaw in determining population density of Bornean Orangutans (*Pongo pygmaeus morio*) in the forests of East Kalimantan, Biological Conservation, vol. 129, 2006, pp. 566–578.
- [6] M. Ancrenaz, M. Gumal, A.J. Marshall, E. Meijaard, S. Wich, *Pongo Pygmaeus wurmbii*, The IUCN Red List of Threatened Species 2016, 2016, DOI:<http://dx.doi.org/10.2305/IUCN.UK.20161.R.LTS.T39782A17990568.en>
- [7] IUCN, IUCN Guidelines for Reintroduction, Cambridge, 1998.
- [8] B. Beck, K. Walkup, M. Rodrigues, S. Unwin, D. Travis, T. Stoinski, Best practice guidelines for the re-introduction of Great Apes, Gland, SS Primate Specialist Group of the World Conservation Union, 2007. [9] E. Grundmann, D. Lestel, A.N. Boestani, M.C. Bomsel, Learning to survive in the forest: What every orangutan should know, The apes: Challenges for the 21st century, Chicago, Brookfield Zoo, 2001, pp. 300-304.

- [10] C.P. Yeager, Orangutan rehabilitation in Tanjung Puting National Park, *Conservation Biology*, no. 11, vol. 3, 1997, pp. 802-805.
- [11] A.E. Russon, Orangutan rehabilitation and reintroduction: Successes, failures, and role in conservation, in: S.A. Wich, S.S.U. Atmoko, T.M. Setia, C.P. van Schaik (Eds.), *Orangutans Geographic Variation in Behavioral Ecology and Conservation*, New York Oxford, University Press, 2009.
- [12] J. Jacobs, Quantitative measurement of food selection - a modification of the forage ratio and Ivlev's electivity index, *Oecologia*, no. 14, vol. 4, 1974, pp. 413-417.
- [13] H.C. Morrogh-Bernard, S.J. Husson, C.D. Knott, S.A. Wich, C.P. van Schaik, M.A. van Noordwijk, I. Ancrenaz, A.J. Marshall, T. Kanamori, N. Kuze, R. bin Sakong, Orangutan activity budgets and diet, in: S.A. Wich, S.S. Utami Atmoko, T.M. Setia, C.P. van Schaik (Eds.), *Orangutan: Geographic Variation in Behavioral Ecology and Conservation*, New York, Oxford University Press, 2009, pp. 119-135.
- [14] R. Zuhra, D.P. Farajallah, E. Iskandar, Aktivitas makan orangutan (*Pongo pygmaeus*) di pusat primata schumtzer, *Jurnal Primatologi Indonesia*, no. 6, 2009, pp. 21-26.
- [15] B.M.F. Galdikas, Orangutan diet, range, and activity at Tanjung Puting, Central Borneo, *International Journal of Primatology*, no. 9, 1988, pp. 1-35.
- [16] J. Sugardjito, Selecting nest-sites of Sumatran orang-utans, *Pongo pygmaeus abelii* in the Gunung Leuser National Park, Indonesia, *Primates*, no. 24, 1983, pp. 467-474.
- [17] D.S. Pusparini, Perilaku adaptasi orangutan Sumatera (*Pongo abelii* Lesson 1827) eks-rehabilitan di Cagar Alam Jantho, Aceh Besar, Bogor, 2019.
- [18] Russon, Return of the native: cognition and site-specific expertise in orangutan rehabilitation, *International Journal of Primatology*, no. 23, 2002, pp. 461-478.
- [19] E.S. Dierenfeld, *Orangutan Nutrition*, Brookfield Illinois, Orangutan SSP Husbandry, 1997, pp. 115-121.
- [20] H.D. Rijksen, *A Fieldstudy on Sumatram Orangutan (Pongo abelii) Ecology, Behavior, and Conservation*, Wageningen, H. Veenman & Zonen Publisher, 1978.
- [21] C. Knott, Energetic responses to food availability in the great apes: Implications for hominin evolution, in: D.K. Brockman, C.P. van Schaik (Eds.), *Seasonality in primates*, Cambridge, 2005, pp. 351-378.
- [22] B.M.F. Galdikas, *Orangutan adaptation at Tanjung Puting Reserve, Central Borneo*, Los Angeles, University of California, 1978.
- [23] T. Sinaga, *Studi habitat dan perilaku orangutan sumatera (Pongo pygmaeus abelii) di Bohorok, Taman Nasional Gunung Leuser, Bogor, Institut Pertanian Bogor*, 1992.