

Daily behavioral research on Sumatran orangutan (*Pongo abelii*) mothers and offsprings at Suaq Balimbing Research Station, Gunung Leuser National Park, Aceh Province, Indonesia

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Abstract. Sutekad D, Jannah M, Fitri L, Fauziah F. 2022. Daily behavioral research on Sumatran orangutan (*Pongo abelii*) mothers and offsprings at Suaq Balimbing Research Station, Gunung Leuser National Park, Aceh Province, Indonesia. *Biodiversitas* 23: 5108-5121. Discovering the daily behavior of female orangutan mothers and their offspring can provide information for use as a recent reference in orangutan conservation action plans. This research aims to determine the daily behavioral patterns of mother and offspring Sumatran orangutans (*Pongo abelii*) at the Suaq Balimbing research station. This study was conducted between June 2019 and March 2020 and used focal animal sampling as the method. The method used consists of searching and daily behavioral logging. The results of the research showed that six orangutan mothers and offsprings (three mother-offspring pairs) showed different behavioral patterns. The distinction was felt in the distribution of time spent on activities. Eating, moving, resting, nesting, and social activity are all part of an orangutan's daily behavior. The proportion of time allocation used in the daily activities of female mother and Sumatran orangutan pairs (*Pongo abelii*) that is successfully observed in the Suaq Balimbing research station are eating (68.79%), resting (11.59%), moving (11.02%), nesting (1.11%), others (5.04%) and unknown (2.45%). Orangutans' diet plants in Suaq Balimbing consist of 30 species from 25 families, including the liana diet, plants consumed with the seeds, and plants consumed by the bark. According to the findings of this study, the behavior of a mother Sumatran orangutan, while it is with its offspring can be described.

Keywords: Orangutan behavior, *Pongo abelii*, Sumatran orangutan

INTRODUCTION

The Orangutan (*Pongo*) is one of the favored and preserved indigenous species in Indonesia because they play a crucial role in preserving forest sustainability and as seed dispersers (Nijman 2017). According to Sloan et al. (2018), orangutans may be found in numerous forest locations on the island of Sumatra, including North Sumatra (Bohorok, Tangkahan, and Batang Toru) and Aceh (Singkil, Ketambe and Suaq). According to Manduell et al. (2012) the Suaq Balimbing forest is a densely populated habitat for Sumatran orangutans. The Suaq Balimbing forest orangutans have a far larger range than previous studies have revealed.

The Sumatran orangutan (*Pongo abelii*) was listed as critically endangered on the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species in 2017. Furthermore, according to the 2017 Convention on International Commerce in Endangered Species of Flora and Fauna, *Pongo abelii* is classified as Appendix I in the field of animal trade (CITES). *Pongo abelii* is also listed as a preserved species in the Minister of Environment and Forestry Regulation on Conserved Plants and Animals (Ministry of Environment and Forestry, 2018). According to Meijaard et al. (2012), orangutans have unique survival needs, particularly in terms of habitat

and home range, which are normally confined to a specific height. However, contemporary issues like hunting, illicit fishing, land use change, and habitat fragmentation might impair individual orangutans' capacity to breed, resulting in a reduction in the natural population of orangutans.

According to Bressane et al. (2021), orangutans may be classified into five categories depending on their age group (cohort) (offspring, juveniles, adolescents, adult females, and adult males). Orangutans aged 0-2.5 years are classified as offspring, and their lives are still dependent on their mothers for food and eating, nesting, resting, and moving or moving around. Juveniles are orangutans between the ages of 2.5 and 5 years old that still cling to their mothers but have performed brief outings on their own, playing alone or with peers under mother's supervision and sleeping with their mothers at first. Juveniles are orangutans aged 5-8 years that begin to exhibit social behavior but still move with their mothers and are cautious when encountering adult orangutans. Frohlich et al. (2019) stated that offspring and juvenile orangutans are heavily supported by their mothers. Mothers will care for their offspring for a period of 7 to 12 years. It will educate them on how to survive in the wild, such as how to obtain food, during their foster care phase. The mother orangutan may oversee her offspring through observing (peering), asking for food (begging), and exploring.

Orangutans are primarily frugivorous; they favor fruit as their primary food source (Russon et al. 2009). The distribution of plants has a significant impact on the size and scope of an orangutan's home range. According to Utami-Atmoko et al. (2009), the adult male orangutan's range can reach 1000-1500 ha, while the adult female's range is approximately 250-300 ha. Female orangutans are typically philopatric; they tend to settle in or near their birthplace (van Noordwijk et al. 2012). *Artocarpus integer*, *Cyathocalyx sumatranus*, *Streblus elongatus*, and *Dipterocarpus grandiflorus* are the top three diet plants for Sumatran orangutans, according to research conducted at the Soraya Research Station, Leuser Ecosystem, Aceh (Regina et al. 2020).

Understanding the daily behavior of female orangutan mothers and their offspring can submit information as a recent reference in action plans for orangutan conservation, such as establishing a learning process comparable to the original mother of reintroduced orangutans that lost their mothers. The ability of orangutan offspring to survive in nature is a product of the learning process that occurs when they are with their mothers. According to Armas Fitra (Suaq Balimbing Research Station staff members), four pairs of orangutans (mother-offspring) were discovered at the Suaq Balimbing Research Station between February and April 2019. However, there are no studies on the daily behavior of female mothers and offspring also their diet plants in the area.

Based on these explanations, it is critical to perform the study on orangutan offspring's learning through their mothers. As a result, we are interested in conducting this research at the Suaq Balimbing Research Station. The focus of this research was to report the daily behavior patterns of Sumatran orangutans' female mothers and offspring at the Suaq Balimbing Research Station and also to understand the types of orangutan diet plants in the area.

MATERIALS AND METHODS

Searching

During the initial stage of data gathering, searching was carried out. The search for target animals was guided by the available trail system map (Figure 1). Individual orangutan targets (mother and offspring) were sought by moving along the research site's pathways or visiting multiple fruit-bearing foraging trees. Several indications, included as movement noises, scent (urine or excrement), and vocalizations, can be used to identify mother female and offspring orangutans (kiss squaek or longcall).

Individual orangutans are identified after being discovered by studying their morphology, which includes hair color, hair arrangement form, hair thickness, face shape, vocal cord size, scars, and daily behaviors. The findings of orangutan identification included a name, age group (cohort), and sex. When an orangutan is recognized, it is classified as an individual orangutan (mother and offspring).

Daily behavioral logging

This study employs focal animal sampling by following individual orangutans (mother and offspring) from their nest in the morning until they construct a new nest for the night. Data on orangutan behavior was gathered every two minutes. This technique was utilized by Morrogh-Bernard et al. (2002) to standardize orangutan data collection. The following behaviors were observed and recorded: eating, moving, resting, socializing, playing, nesting, and vocalization-with the support of Suaq Balimbing, research station guide assistant (Table 1). If the focused orangutan is feeding at the time of observation, the types and sources of food have been recorded.

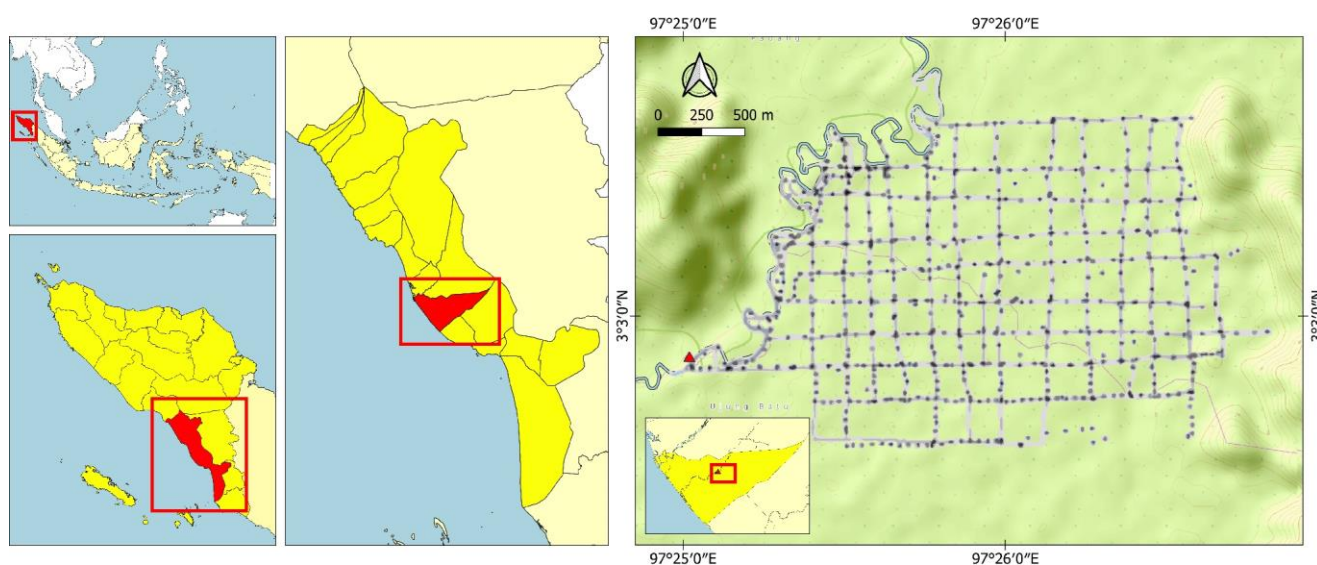


Figure 1. Trail system map at Suaq Balimbing Research Station, Leuser Ecosystem, Indonesia

Table 1. Description of orangutan's behavior

Behavior	Description
Eating	Eating, drinking and removing metabolic waste (urination and defecation)
Moving	Quadrupedal, bipedal, brachial, self-playing, and autogrooming behaviors
Resting	Sleep and not doing activities
Socializing	Allogrooming, sexual, vocal, playing together, affiliative and aggressive
Playing	Not having a clear purpose, like hanging while shaking a branch, which orangutan offspring typically perform
Nesting	Break branches, collecting leaves, and build nests
Vocalization	Sounding voice

Table 1. Identification and length of observation of a Sumatran orangutan (*Pongo abelii*) mother and its offspring at Suaq Balimbing Station, Leuser Ecosystem, Indonesia

Orangutans name	Age group (cohort)	Age (year)	Observed (minute)	Time proportion (%)
Friska	Adult female	23	3690	12.27
Frankie	Juvenile male	7	3658	12.16
Ellie	Adult female	20	5952	19.78
Eden	Juvenile female	5	5958	19.80
Bebita	Adult female	Unknown	396	1.32
Benito	Juvenile male	Unknown	396	1.32
Lisa	Adult female	31	1808	6.01
Lois	Juvenile male	9	1750	5.82
Tiara	Adult female	25	1694	5.63
Tornado	Juvenile male	7	1684	5.60
Pinniata	Adult female	20	1548	5.15
Pepito	Juvenile male	7	1550	5.15
Total			30.084	100

It took a minimum of three hours to observe the everyday routines of female orangutan mothers and their offspring for one day. In this study, female orangutans and their offspring were monitored for 3 to 13 hours every day. The observations came in the form of daily behavior and food plant kinds for Sumatran orangutans at the Suaq Balimbing research station. Identification of forage vegetation types was performed immediately in the field with the support of Suaq Balimbing research station personnel and assistants. The study lasted for three months and was terminated if certain events, such as inclement weather and the movement of female orangutans with their offspring, exceeded the parameters of the study.

RESULTS AND DISCUSSION

Female orangutan mothers and their offsprings' daily behavior

In this study, six pairs of Sumatran orangutan (*Pongo abelii*) female mothers and offspring were successfully tracked and observed. Based on the data provided at the research site, each of the orangutans discovered was identified by name, age (primarily), and sex. The physical traits of each orangutan allow it to be identified. Individual orangutans are identified with the assistance of research station personnel on the site. During this investigation, all orangutans were seen for a total of 30,084 minutes, with various time periods of observation (Table 1).

According to the data in Table 1, Ellie and Eden are the mothers and offspring pairs of Sumatran orangutans with the longest duration of observation time (reaching more than 19% of total observation time). The duration of time observed for this couple is impacted by their mobility, which tends to be leisurely in moving from one tree to another so that it may be easily followed. Furthermore, this orangutan couple is simple to locate thanks to phenological data on the fruiting season provided at the research site. Ellie and Eden are frequently shown on transects A, D, E, and C, which lead to the northern portion of the forest, where there are abundant fruiting Malacca (*Tetramerista glabra*) trees. Sumatran orangutans exhibited a strong affinity for fruit as a dietary source.

The female mother pairs and the Sumatran orangutan offsprings Bebita and Benito had the shortest period of observation (just 1.32% of the total observation time), according to the research results. The limitation of time available to observe this pair is due to their wild and unaccustomed nature to the presence of humans. This pair of orangutans was discovered by coincidence and was not the intended object of observation due to the fact that it had never been tracked previously. This couple was discovered at 10:42 a.m and was tracked throughout the day until it was in the midst of preparing a night nest to rest.

The nest of this Sumatran orangutan's mother and kids turned out to be exceedingly far beyond the perimeter of the Suaq Balimbing site study, hence it could not be followed the next day. During the observation, the orangutan pair displayed various behaviors that indicated they were unfamiliar with human presence. The female mother is portrayed doing the kiss queuek (KSQ) vocalization. When the pair recognized the presence of the researcher, they made a quick move to the top of the tree. They selected a tree branch height of more than 10 meters as a position for the activity. They appear to be intimidated, strived to flee and avoid humans. The site of the orangutan couple's night nest, which is far distant and not included in the research area, is not a destination that people frequently visit, according to authorities on the site.

The results presented in Table 1 also revealed that there is a temporal discrepancy between the mother and the orangutans. This was discovered in the orangutan pair Lisa and Lois when Lisa (the female mother) was studied for a longer period of time than its offspring (there was a difference of 58 minutes in observation time). The difference in observation time is due to a difference in activity time, where the subject, Lois (a juvenile male), woke up later in the morning and fell back asleep faster

than its mother. When the mother was still creating nests at night, the newborn orangutans of this couple were seen to wake up earlier in the morning and promptly join the night nest. In general, Sumatran orangutans begin their activities when they awaken from their nest in the morning and continue until they return to preparing a nest at night to sleep. According to Carter et al. (2021), orangutan activity starts at daybreak and finishes roughly an hour before nightfall. Adult orangutans normally wake up at 06.00 a.m and go back to sleep around 06.00 p.m, according to Roth et al. (2020).

The Sumatran orangutans observed at the Suaq Balimbing research station began to be active on average around 06:39 a.m. (with an interval between 06:20 and 06:58 a.m.) and completed their activities about 6 p.m., according to the study data (with an interval between 03:54 and 06:58 p.m). Female orangutans appeared to be active for an average of 9 hours and 6 minutes every day. Meanwhile, orangutan offspring were active for an average of 9 hours and 4 minutes every day. This data is comparable to the research by Bani et al. (2018), who conducted a study on the average length of daily activity of Bornean orangutans with the purpose of monitoring wild Bornean orangutans.

This observation had succeeded in characterizing a variety of daily behaviors, including feeding, resting, moving, nesting, and others (in the form of drinking, playing, making noise, stalking, copulation, trying to eat, and asking for food). Other actions, such as asking for food and attempting to eat, are typically performed by orangutan offspring and not by their mothers. On either side, there are some behaviors that are performed by the mother but not by the offspring, such as nursing. However, data that is neither identified nor known (unknown/unkw) is classified individually.

The difficulty of collecting data during observations due to interruption of the observer's sight due to extensive vegetation or tree canopies, inaccessible elevations, fog and lighting conditions, and severe rain conditions causes this unknown behavioral data. Krutzen et al. (2011) highlighted that while orangutans' daily behavior generally involves three primary activities, specifically feeding, resting, and moving, there are data that are unknown related to obstruction or loss of the observer's perspective of the existence of orangutans in the wild and being monitored. This can occur as a result of environmental conditions, including tree height, dense tree canopy, and wetness, which all have an impact on the visibility of the orangutans observed.

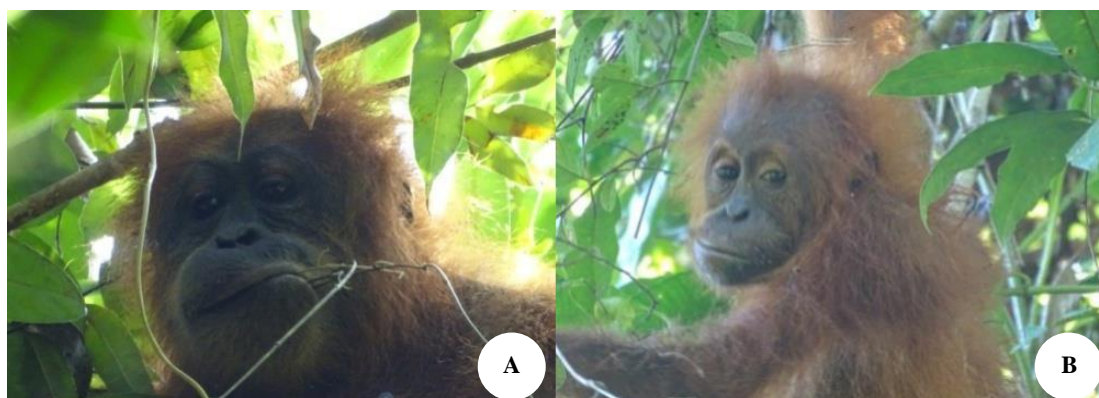


Figure 2. A Sumatran orangutan (*Pongo abelii*) mother and its offspring were spotted at the Suaq Balimbing research station in the Leuser Ecosystem, Indonesia: A. Ellie (the female mother) and B. Eden (the juvenile female)

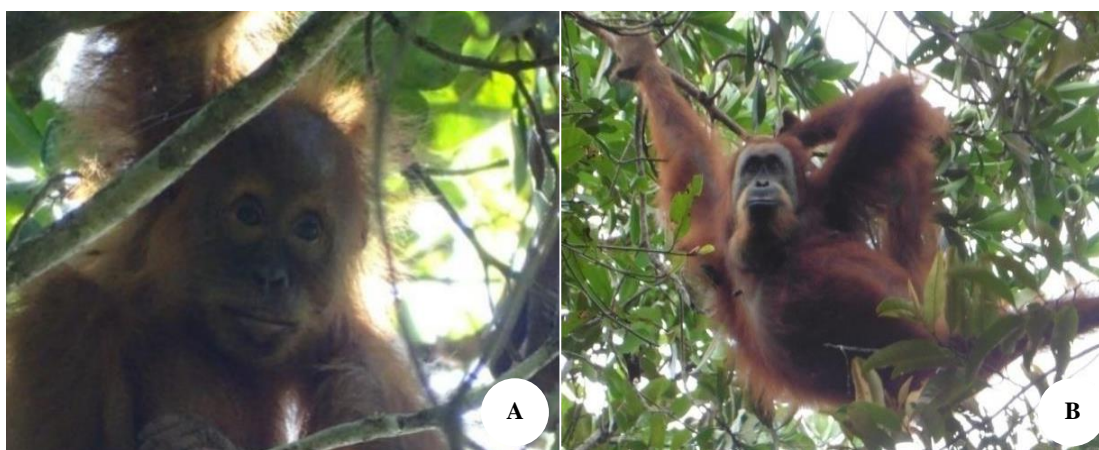


Figure 3. Sumatran orangutan (*Pongo abelii*) mother and offspring pairs were discovered in the Suaq Balimbing research station, Leuser Ecosystem, Indonesia: A. Bebita (female mother) and B. Benito (offspring) (male juvenile)

As shown in the research results, all female mother pairs and Sumatran orangutan offspring that were observed at the Suaq Balimbing research station spent the majority of their daily activity feeding (64.89% of total observation time). Moving (11.02%) and resting (11.59%) were the next most frequent activities. Nesting behavior is the least significant activity performed by orangutans during observations, accounting for only 1.11% of total observation time. The total duration for nesting was even smaller than the period allotted for uncertain data in this observation, which was 738 minutes, or 2.45% of the overall observation time (Table 2 and Figure 4). The data on the proportion of time allocated to daily activities of this female mother pair and their Sumatran orangutan offspring (Figures 2 and 3) is similar to data from previous research conducted by Fox et al. (2004), where adult orangutans in

Suaq Balimbing spend the majority of their daily activities eating (55%), resting (25%), moving (7%), nesting (2%) and other activities.

Eating behavior

From the observations of the female mother pairs and the Sumatran orangutan offspring, we found that each individual's time allocation for eating is substantially distinct. Among all the orangutans' mothers and offspring, Ellie and Eden, followed by Lois, spent the most time feeding (reaching 72% of their total daily activity). Meanwhile, the orangutan pair Bebita and Benito had the lowest feeding time allocation, allocating 58.08% and 54.04% of their daily activity time to eating, respectively.

Table 2. The allocation of time used in daily activities of Sumatran orangutan (*Pongo abelii*) female mother pairs and its offspring was successfully observed at Suaq Balimbing Research Station, Leuser Ecosystem, Indonesia

No.	Individuals	Observed time (minutes)						Total
		Eating	Resting	Moving	Nesting	Others	Unknown	
1	Friska	2498	378	386	70	218	140	3690
	Frankie	2448	364	378	0	224	244	3658
2	Ellie	4332	524	666	114	288	28	5952
	Eden	4330	548	660	0	374	46	5958
3	Bebita	230	28	82	8	36	12	396
	Benito	214	22	72	0	42	46	396
4	Lisa	1268	342	128	48	12	10	1808
	Lois	1272	302	114	32	6	24	1750
5	Tiara	1012	278	270	34	54	46	1694
	Tornado	1008	254	284	0	72	66	1684
6	Pinniata	1042	228	140	28	88	22	1548
	Pepito	1040	218	136	0	102	54	1550

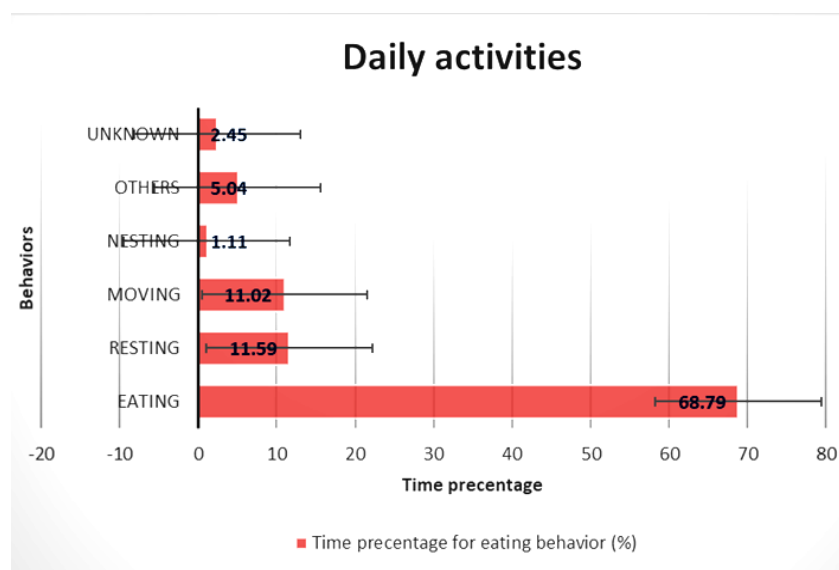


Figure 4. The quantity of time spent on daily activities of the Sumatran orangutan (*Pongo abelii*) female mother pairs and their offspring, which was successfully monitored in the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

There is a variation in the allocation of feeding time between mother orangutans and their young based on the data of each individual. Individual orangutans, Lois and Tornado, are the offspring of each orangutan mother that prioritize feeding beyond their mothers. Lois is a juvenile male orangutan with the highest score for eating time (72.69%). Lois surpassed her mother's (Lisa's) feeding time allocation record of 70.13% of her daily activity time. Female orangutan mothers (Friska, Ellie Bebita, and Pinniata) have more eating time than their offspring (Figure 5).

Figure 5 shows that, while the time allocated for eating between mothers and offspring varies, there are general similarities between each pair. Five mother orangutans (Ellie, Friska, Tiara, Bebita, and Pinniata) spent almost the same amount of time for eating as their children, but just one mother orangutan (Lisa) spent less time than its offspring. Due to the fact that moms and offspring always engage in activities together, their mealtimes are frequently coordinated to coincide. If the mother consumes food, the child will consume food as well. Our observations have revealed that young orangutans spend the majority of their time with their mothers.

Perhaps the individual orangutan child is in the learning period, so it will always follow its mother's activities. Only Lois individuals were observed to become self-sufficient during the observation. Orangutan offspring, according to Sauciuc et al. (2021), tend to do the same activities as their mothers while they are tiny and often with their mothers. The same is true for the use of feeding time between

mother and offspring. Orangutan offspring gain independence gradually, according to John (2020). Teenagers (5-8 years) bring an improvement in skills, autonomy to choose food, the ability to build nests, and social skills.

The observed orangutans' high allocation of feeding time was not necessarily associated with the fruiting season. The Suaq Balimbing rainforest area was not in fruiting season at the time of this research. Fruit trees are only found in a few Malacca species (*Tetramerista glabra*) in a small forest area. Perhaps this is why orangutans have to lengthen the duration of their feeding period during the fruiting season due to the caloric value of the food they consume. This is consistent with Laurance et al. (2020) observation that frugivorous primates prolong the duration of their feeding activity during the poor fruit season.

Because the Suaq Balimbing rain forest is not in fruiting season, orangutans must consume different sorts of food instead of fruit. Insects, cambium/bark, roots (Figure 6), young leaves, and other plants are used as substitute meals. According to Mikeliban et al. (2021), orangutans are opportunistic foragers or gatherers, which means they eat anything they can get because, in addition to fruit, orangutans eat leaves (including young shoots and stalks), insects (ants, termites, grasshoppers, crickets, fleas, etc.), the layers under the bark of certain trees (especially *Ficus* and other Moraceae tribe trees such as *Payena* spp.), flowers, bird eggs, small vertebrates (geckos, squirrels, and slow lorises) and honey.

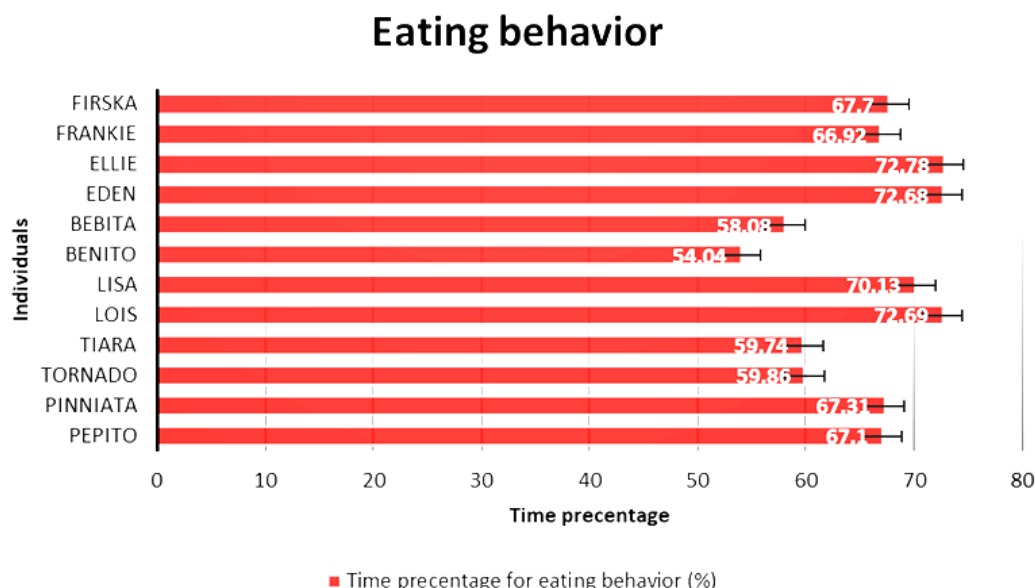


Figure 5. The quantity of time spent on eating of the Sumatran orangutan (*Pongo abelii*) female mother pairs and their offspring, which was successfully monitored in the Suaq Balimbing research station, Leuser Ecosystem, Indonesia



Figure 6. An individual Edén orangutan (a juvenile female) was observed consuming the root of the tombang (*Rhaphidophora maingayi*) in the rainforest area of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

Moving behavior

During observations, the female mother couple and the Sumatran orangutan offspring can be seen moving or exploring. It involves moving from one tree to another. Orangutans migrate to discover and satisfy their food demands in order to survive. According to Louys et al. (2021) the most essential element in determining the extent of an orangutan's home range is food availability. Meijaard et al. (2012) also said that food availability has a big impact on orangutans' diets as frugivores. As a result, the distribution of food quantity and quality according to time and place is the primary determinant of its migratory behavior.

Observational data suggests that each orangutan couple moves in various ways, including going up and down, climbing, moving with two hands in a bipedal stance, and

moving like a four-legged animal. The movement is performed while traveling between trees or from one limb to another to feed. According to Kane et al. (2019), orangutans usually go up trees, hanging, climbing, and laying down tree trunks (treesway), whereas orangutans walk bipedally and quadrupedally on land (Figure 8). According to Hardus et al. (2012), orangutans move or explore by walking with all four hands (quadrupeds) and feet in tree canopy branches or swinging, utilizing strong tree branches to support their body (tree way). Furthermore, Bressane et al. (2021) indicated that all orangutan motions were sluggish and uneven.

According to observational data, the orangutan couple Bebita (mother) and Benito (offspring) move the most. The Bebita individual is an adult female mother who moves for 20.71% of his daily activity time. Benito, on the other hand, spends 18.18% of his time moving (Figure 7). The Bebita and Benito pair's high mobility is supposed to be related to their wild nature, which is particularly protective of human presence. During the observation, the adult female orangutan always makes evasive motions, such as ascending a tree swiftly in a higher position with its offspring, to hide its fear. When it settles down, it descends again but then rises when it notices the presence of an observer.

Lisa and Lois are the two orangutan pairs that move the least. Lisa's lack of time allocation for activity is assumed to be attributable to age. Hence, Lisa is the oldest adult female mother among the other mothers, so they do not relocate very much. If it moves, it moves more slowly. Furthermore, the individual named Lisa had a baby named Leon and had died at the time of the observation, according to the field officer's statement. Furthermore, the field officer indicated that Lisa's behavior during the observation was consistent with her regular behavior when it had a baby.

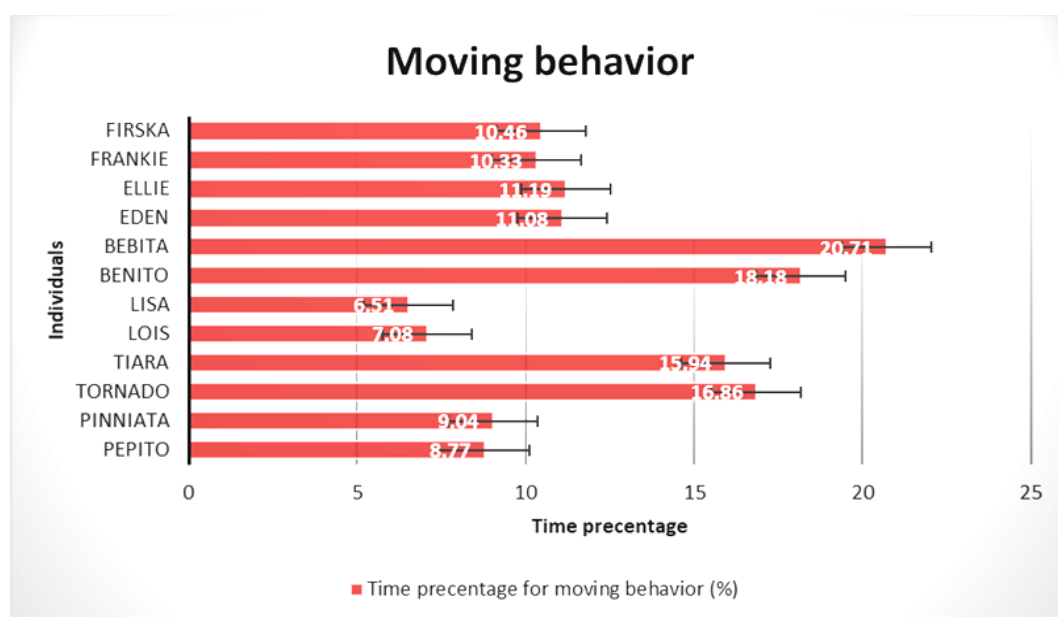


Figure 7. Percentage of time spent moving in the daily activities of mother and offspring Sumatran orangutans (*Pongo abelii*) observed in the forest area of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

Observations also suggested that orangutans spent almost all of their time in trees and only occasionally descended to the forest floor. This is said to be done to foresee the presence of predators on the forest floor, which can be perilous to orangutans. According to Russon et al. (2015) one of the functions of orangutan arboreal existence is to shield them from predators or attacks by other species. Several orangutans were killed in the Ketambe area by tigers (*Panthera tigris*) and clouded leopards (*Neofelis nebulosa*).

This investigation, however, discovered orangutans descending to the forest floor. Lisa and its offspring Lois were the orangutans that were observed. During the observation, Lisa's individual, who was Lois's female mother, was spotted once coming down to the ground to pick young leaves from ferns. According to field officers who have worked at the Suaq Balimbing research station for more than 12 years, and based on information obtained from past researchers in the Suaq Balimbing forest, Lisa's individual behavior of traveling down to the forest floor is novel. This orangutan mother does it frequently. According to them, Lisa is quite familiar with the forest environment because she has owned it for a long time; Lisa had even been there long before the officers arrived and worked at the research station. Therefore, it is only natural that Lisa is already accustomed to the presence of humans.

The outcomes of this research also revealed that the presence of offspring has an effect on the movement of orangutans who still have offspring. The female mother tends to consider and pay attention to its distance from the presence of offspring. Observational studies indicate that the distances between the mother and the orangutans were significant. Following the data in Table 3, the most common distance between mother and offspring throughout the observation was 0x2 meters, with a total observed time of 4545 minutes. While the distance of zero meters is rarely recorded, with a total observation time of only 467 minutes. The distance is assumed to be related to the mother's efforts to impart independence to its child. Because the offspring is no longer under the control of the mother and can escape moving away, the greater the distance between the mother and the orangutan offspring,

the more independent the child will be in carrying out its activities.

All of the orangutans observed in this investigation were relatively inexperienced orangutans. As a result, the most frequent distance between mother and child is two meters. A distance of 0 meters is extremely rare and occurs only when a female mother is breastfeeding her offspring. According to Kunz et al. (2021) mothering by offspring is a process of independent learning and preserving and supporting life in stages. The child's age will be followed by an increase in his or her distance from the mother. Feeding competition with the mother is one sign of the independence process.

Resting behavior

Rest is one type of activity displayed by orangutans. Orangutans can be seen resting in various situations, including sitting, standing, and hanging from tree branches. As mentioned by Kamaluddin et al. (2022), the process of exploring the forest causes orangutans to rest by remaining still, sitting, standing, and laying on tree branches, hanging, and sleeping in nests (Figure 10). Observations on six pairs of female mothers and orangutan offspring indicated that the allocation of rest time for the female mother was primarily suggested by the individual Lisa. While Bebita individuals demonstrate the allocation of motheral rest time. Lois provided the most resting time for individual offspring, whereas the orangutan Benito showed the least resting time (Figure 8).

Lisa's orangutan resting habit is assumed to be linked to psychological elements from the presence of its offspring (Baby Leon), who just died, such that her everyday conduct is still like having a baby hauled away till the time of observation. The female mother pair and orangutan offspring Bebita and Benito, who have the least rest time allotment among all orangutans, highlighted different things. This is believed to be due to the orangutan pair's strong aversion to the presence of observers. Because they were not acclimated to the presence of humans, the orangutan couple Bebita and Benito moved more to avoid observers. As a result, they presented significantly inadequate rest.

Table 3. The distance between mother and offspring of a Sumatran orangutan (*Pongo abelii*) successfully observed at the Suaq Balimbing research station in the Leuser Ecosystem, Indonesia

No	Individual	The distance between mother and offspring (minutes)					Unkw
		0 m	0>x≥2 m	2> x≥5 m	5>x≥10 m	10> x≥50 m	
1	Friska	25	588	546	516	59	89
	Frankie	43	459	589	570	76	86
2	Ellie	149	1363	907	395	95	35
	Eden	151	1285	913	494	89	45
3	Bebita	4	46	35	48	24	33
	Benito	8	38	20	36	42	54
4	Lisa	0	27	53	252	549	7
	Lois	0	19	55	236	544	5
5	Tiara	16	101	117	68	457	23
	Tornado	20	108	114	72	470	30
6	Pinniata	20	254	175	114	67	127
	Pepito	31	257	185	107	62	120
Total		467	4545	3709	2908	2534	654



Figure 8 In the forest region of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia, the mother and offspring of Sumatran orangutans (*Pongo abelii*): Ellie and Eden in their daily activities were observed



Figure 10. Individual juvenile Sumatran orangutan (*Pongo abelii*) Tornado shown resting behavior (sitting) in the rainforest region of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

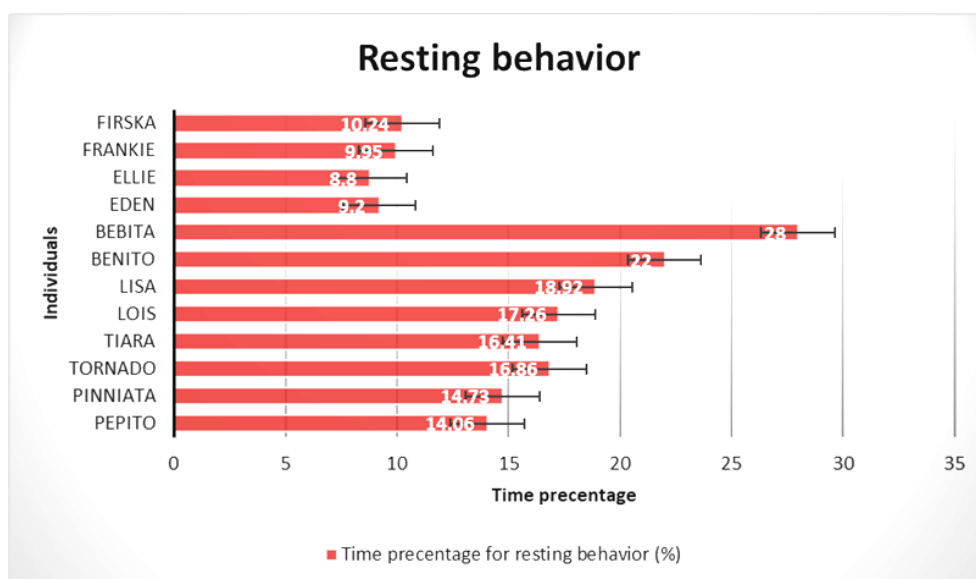


Figure 9. Percentage of time spent resting in the daily activities of mother and offspring Sumatran orangutans (*Pongo abelii*) observed in the rainforest area of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

Nesting behavior

Orangutan activities, including nesting, are primarily carried out in trees. Orangutans will create nests to sleep in at least once a day. The nesting behavior seen in all individual orangutans during this investigation accounted for only 1.11% of their total daily activity time (Figure 10). During the day, the nest that serves as a resting spot is also used. The nest is a location for orangutans to relax temporarily after searching for food and shelter when it rains, in addition to having a long rest. Following Davies et al. (2019), the nest itself serves as a resting spot for orangutans once they have completed their daily activity. Similar to Nasution et al. (2018), the time to build a nest may be impacted by multiple factors like as weather, the distance of the nest from the foraging tree, and each individual's hunger to satisfy their demands.

Based on the data in Figure 11, the individual orangutan Lisa spent the most time nesting, whereas Pinniata spent the least time nesting. Except for Lois, who spent 1.83% of its total activity time building nests, orangutan offspring do not create nests in general. Lois is an orangutan offspring that is supposed to be gaining independence and is the eldest of the orangutan offspring. According from Amalia et al. (2022), juvenile orangutans aged 4-7 years will migrate with the mother from one tree to another but have begun to detach and will be totally free from the mother at the age of 7-12 years, although they may occasionally move with the mother. The time required for the mothers to build their nests differs significantly. The longer an individual orangutan spent nest-building, the longer the documented nesting time. Despite having the same number of nests, the distribution of time spent creating nests differs (Table 4).

The Friska orangutan takes the longest average time to make a nest, in accordance with the data in Table 4. Meanwhile, Lisa built a nest in the shortest period of time. The difference in time spent creating the nest is assumed to be due to the increased size of Friska's nest compared to Lisa's nest. Friska needed a larger nest because to the presence of Frankie (its offspring), who slept with Friska. Furthermore, the architectural process influences the rate of nest construction. If the orangutans construct a roof to shelter themselves from rain, the nest-building process will take longer.

The number of nests observed varies according to the amount of time the observations are conducted. The more individual orangutans that are observed, the more nests are discovered. Friska and Ellie, the orangutans, had the most nests, six in total, as determined by six days of observations. Lisa builds the same number of nests as Friska and Ellie, but its overall number of observations is smaller. This occurs because Lisa built two nests (a day nest and a night nest) in one day, which equals the number of Friska and Ellie's nests.

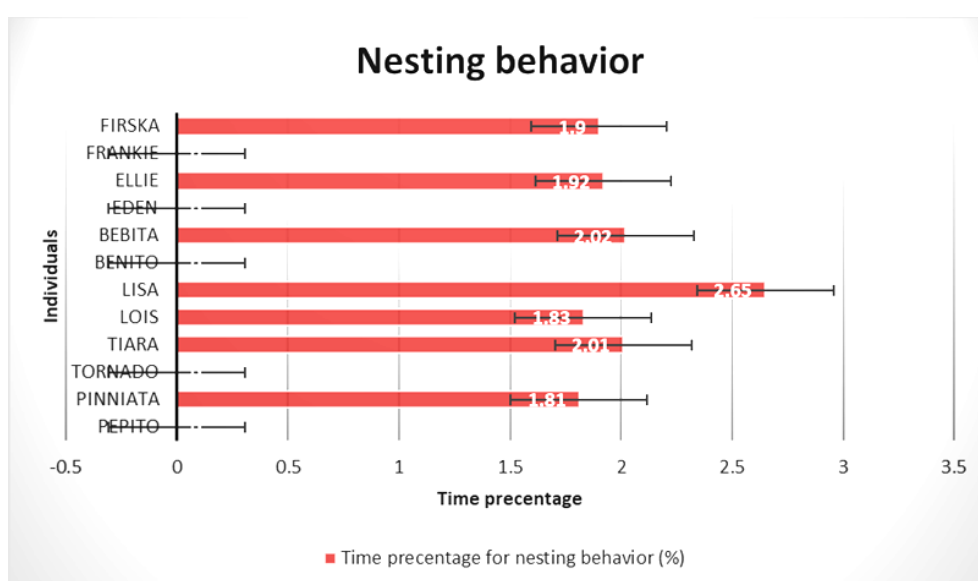


Figure 11. Percentage of time spent nesting in the daily activities of mother and offspring Sumatran orangutans (*Pongo abelii*) observed in the forest area of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

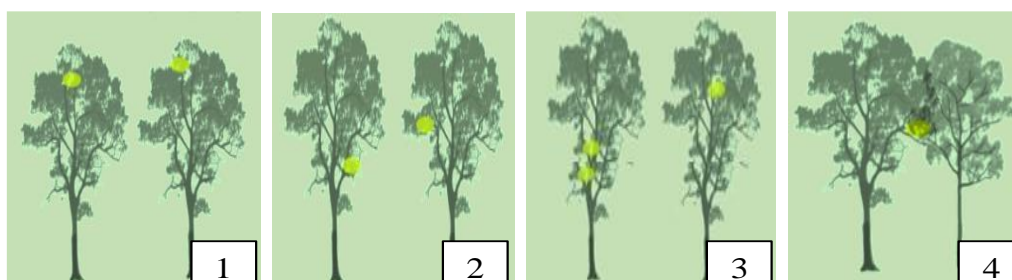


Figure 12. Illustration of orangutan nest position

Table 4. The Sumatran orangutan (*Pongo abelii*) mother and offspring nesting time, number of nests, and nest position were all observed at the Suaq Balimbing research station in the Leuser Ecosystem, Indonesia

No	Individuals	Status	Nest total	Average nesting time (minutes)	Nest position			
					1	2	3	4
1	Friska	Mother	6	12		3	2	1
2	Ellie	Mother	6	8	1		5	
3	Bebita	Mother	1	8			1	
4	Lisa	Mother	6	4	1	1	4	
5	Lois	Child	3	7		1	2	
6	Tiara	Mother	2	9			2	
7	Pinniata	Mother	2	11		1	1	
Total					2	6	17	1



Figure 13. Individual Sumatran orangutan (*Pongo abelii*) nests were discovered in the forest area of the Suaq Balimbing research station in the Leuser Ecosystem, Indonesia

The position of the nest is made to allow the orangutan to get a good and clear direction of view around the forest (Figure 12). The results in Table 4 also suggest that position 3 is the most frequently used by orangutans as a nest. This posture is near the top of a tree, which is great for orangutans. This position not only provides the best and widest view of the surroundings, but it is also the safest from predators. According to Pujiyani (2009), the advantage of a nest at the top of a tree is that the perspective from there is more flexible, making it easier for orangutans to pay attention to their surroundings.

With a total of six nests built, the nest in position 2 is the second largest chosen by orangutans. This position is supposed to have been chosen due to the need for a larger nest and a body weight that is not too substantial to be sustained between tree branches. According to Niningsih et al. (2021), orangutans who build nests in position 2 have a body weight that allows them to survive in tree branches that are not on the main trunk of the tree.

The sound of the main branch of the tree breaking horizontally with the foot signifies the beginning of the process of building a nest, which is subsequently built in the shape of a circle as its fundamental foundation. Only after gathering small tree bits for use as a basis, roof, and blanket. Following Kuswanda et al. (2020), the process of building a nest begins with the selection of a nest tree, followed by the breaking of branches for the nest's foundation, the arrangement of branches and leaves for the mattress layer and supports, and the last step of branch knotting.

Other behaviors included social interactions between orangutans, such as playing, conversing, aggression, copulation, feeding tolerance, and begging. Spillmann et al. (2015) mentioned that the semi-solitary nature of orangutans limits social contact to specific times of the day. Observational data suggest that the orangutan pair Tiara and Tornado exhibit the largest percentage of other behaviors, whereas the pair Lisa and Lois showed the lowest percentage (Figure 13). Lisa and Lois, the orangutan couple, have little social interaction because Lois is an

individual child who is about to be liberated and will be able to live independently.

Andini et al. (2021) also mentioned that nest building could occur in various stages, including rimming, which involves bending a branch horizontally to make a nest circle and holding it in place with another branch. Then comes hanging, in which the branches are bent into the nest to form a bowl. Piling is the next step, in which the branches are bent downwards to support the nest loop and add strength. Loose, where the branch is broken from the tree and finally positioned as a base or roof at the base of the nest.

Others behavior

Other behaviors included social interactions between orangutans, such as playing, conversing, aggression, copulation, feeding tolerance, and begging. According to Spillmann et al. (2015), the semi-solitary nature of orangutans limits social contact to specific times of the day. Observational data suggest that the orangutan pair Tiara and Tornado exhibit the largest percentage of other behaviors, whereas the pair Lisa and Lois showed the lowest percentage (Figure 13). Lisa and Lois, the orangutan couple, have little social interaction because Lois is an individual child who is about to be liberated and will be able to live independently.

Observations suggest that orangutans use other activities to engage in social activities. These social activities include a sequence of lessons taught to offspring by their mothers in order for them to gain independence. Try feeding, begging, peering, bridge, drink, agonistic, and vocalization are the lessons (Table 5). According to Mendonça et al. (2017), one of the common social interactions is the link between mothers and offspring in the form of care and learning until the child becomes autonomous. According to Preuschoft et al. (2021), orangutans are generally individual or solitary and can coexist with other individuals at particular times, such as during reproduction and female mothers with offspring that are not yet independent.

According to the data in Table 5, social watch behavior is another behavior that orangutans frequently engage in, while try feeding is another behavior that they rarely engage in (trying to eat). The offspring attempted to feed the mother in order to learn how to obtain and remember the feed to be consumed. The low percentage of try eating behavior seen is likely to be attributable to the orangutans' individual age, as they are already able to discern between edible and non-consumable food.

Social activities are more common in foraging trees, where more than one orangutan is present. According from Manduell et al. (2012), in a forest location with enough food available, such as Sumatra, mothers will gather and their offspring will play together. Abdullah et al. (2021) further stated that during exploration, orangutans could be seen engaging in social activities when they meet other orangutans.

Orangutan diet plants

Fruit, flowers, leaves, young leaves, bark, insects, grass, lianas, and soil are all part of an orangutan's diet. According to Louys et al. (2021), orangutans, being frugivorous animals, will consume more fruit than other types of food. When fruit is scarce, orangutans eat a variety of other plants and insects, including leaves, shoots, flowers, epiphytes, lianas, and bark, as well as termites and ants.

The findings of observations on the variety of orangutan food plant species (*Pongo abelii*) in the Suaq Balimbing rainforest revealed 25 families and 30 plant species (Table 6.). *Fibraurea tinctoria*, *Indorouchera griffithiana*, *Rhaphidophora maingayi*, *Drynaria sparsisora*, *Cayratia trifolia*, *Freycinetia angustifolia*, *Alyxia oliviformis*, *Tetracera gkaidica*, *Dapania racemosa*, and *Ficus microcarpa* are examples of liana diet. Other plants consumed with the seeds include *Dialium patens*,

Garcinia celebica, *Polyalthia glauca*, *Artocarpus heterophyllus*, *Litsea gracilipes*, and *Camptosperma auriculatum*. Several additional plant species that are consumed by the bark include *Alstonia pneumatophora* and *Gluta renghas*.

The results shown in Table 6 reveal that orangutans' diets differ significantly. According to Onrizal et al. (2019), fruit is the primary source of food, accounting for up to 60% of the total, with the remainder consisting of flowers, young leaves, bark, and various sorts of insects. According to field observations in the Suaq Balimbing studied area of orangutans at the time, they mostly ate grass, roots, leaves, seeds, and tree bark. This is because the species that orangutans consume had not yet begun the fruiting season at the time of the study, therefore orangutans were rarely seen consuming fruit.

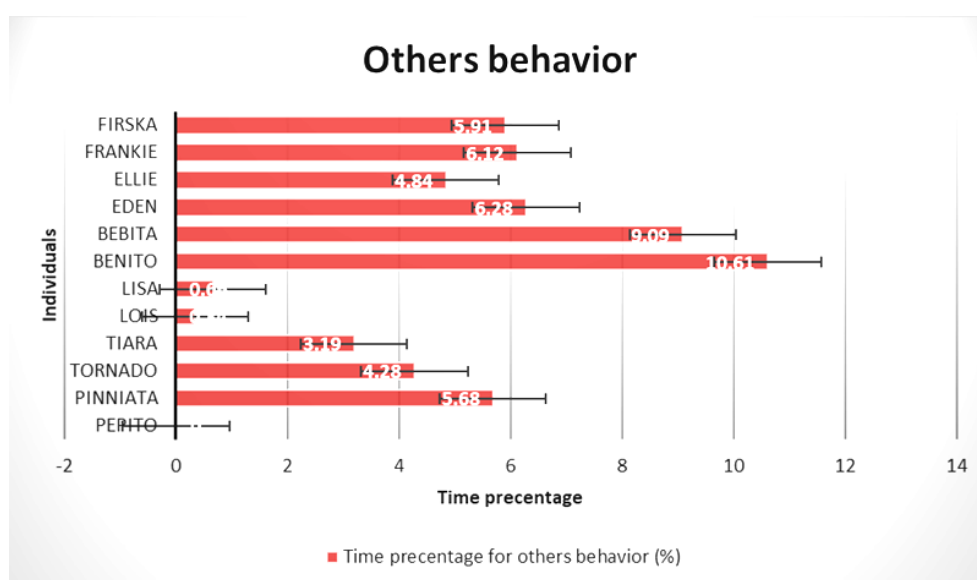


Figure 14. Percentage of time spent others behavior in the daily activities of mother and offspring Sumatran orangutans (*Pongo abelii*) observed in the forest area of the Suaq Balimbing research station, Leuser Ecosystem, Indonesia

Table 5. The distance between mother and offspring of a Sumatran orangutan (*Pongo abelii*) successfully observed at the Suaq Balimbing research station in the Leuser Ecosystem, Indonesia

Individual	Observation times (minutes)										Total (minutes)
	Drink	TF	Beg	Peer	Expl	Voc	Bridge	Ago	S.P	S.Watch	
Friska	22	0	0	0	58	12	54	26	0	46	218
Frankie	56	12	14	28	48	18	0	0	20	28	224
Ellie	0	0	0	0	46	22	88	72	0	60	288
Eden	78	16	26	38	44	64	0	0	32	76	374
Bebita	0	0	0	0	0	18	6	0	0	12	36
Benito	14	0	0	4	2	2	0	0	0	20	42
Lisa	0	0	0	0	0	0	0	0	0	12	12
Lois	0	0	0	0	0	0	0	0	0	6	6
Tiara	0	0	0	0	30	0	0	0	0	24	54
Tornado	4	2	8	8	12	4	0	0	8	26	72
Pinniata	0	0	0	0	22	4	10	0	0	52	88
Pepito	10	0	8	12	28	4	0	0	14	26	102
Total	184	30	56	90	290	148	158	98	74	388	1516

Note: Drink: drink; TF: try feeding; Beg: begging; Peer: peering; Expl: explore; Voc: vocalization; Bridge: body bridge; Ago: agonistik; S.P: social playing; S.Watch: social watching

Table 6. Food plants for orangutans at Suaq Balimbing station, Leuser Ecosystem, Indonesia

Species	Family	The portion consumed
<i>Campnosperma auriculatum</i>	Anacardiaceae	Dg; Sd
<i>Gluta renghas</i>	Anacardiaceae	Bk
<i>Polyalthia glauca</i>	Annonaceae	Dg
<i>Xylopiya malayana</i>	Annonaceae	Sd
<i>Alyxia oliviformis</i>	Apocynaceae	Veg
<i>Alstonia pneumatophora</i>	Apocynaceae	Bk
<i>Pothos inaequilatera</i>	Araceae	Veg; Lv
<i>Rhaphidophora maingayi</i>	Araceae	Veg; Lv
<i>Parastemon urophyllus</i>	Chrysobalanaceae	Yl
<i>Garcinia celebica</i>	Clusiaceae	Dg; Sd
<i>Garcinia havilandii</i>	Clusiaceae	Yl
<i>Tetracera indica</i>	Dilleniaceae	Bk
<i>Shorea teysmanniana</i>	Dipterocarpaceae	Yl
<i>Dialium patens</i>	Fabaceae	Dg; Sd
<i>Flagellaria indica</i>	Flagellariaceae	Veg
<i>Aeschynanthus horsfieldii</i>	Gesneriaceae	Lv
<i>Litsea gracilipes</i>	Lauraceae	Dg; Sd
<i>Nothaphoebe umbelliflora</i>	Lauraceae	Sd
<i>Indorouchera griffithiana</i>	Linaceae	Veg; Yl; Lv
<i>Fibraurea tinctoria</i>	Minispermaceae	Yl
<i>Artocarpus heterophyllus</i>	Moraceae	Dg; Sd
<i>Ficus microcarpa</i>	Moraceae	Dg; Sd
<i>Dapania racemosa</i>	Oxalidaceae	Fl
<i>Freycinetia angustifolia</i>	Pandanaceae	Veg; Lv; Yl
<i>Xanthophyllum incertum</i>	Polygalaceae	Yl; Lv
<i>Drynaria sparsisora</i>	Polypodiaceae	Veg; Yl; Lv
<i>Uncaria glabrata</i>	Rubiaceaceae	Veg
<i>Sterculia oblongata</i>	Sterculiaceae	Yl
<i>Tetramerista glabra</i>	Tetrameristicaceae	Dg; Sd
<i>Cayratia trifolia</i>	Vitaceae	Sem

Note: Sd: seed; YL: young leaf; Lv: leaf; Bk: bark; Fl: flower; Veg: vegetation; Sem: all; Dg: fruit

This study concludes that the observed behaviors of parent and offspring orangutans at the Suaq Balimbing Research Station, Leuser Ecosystem, Aceh, Indonesia include eating, resting, moving, nesting, others, and unknown. In addition, there are thirty plant species that are consumed by orangutans. Our research is anticipated to serve as the foundation for understanding the behavior of orangutan mothers and offspring.

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