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**Daily Activity of Proboscis Monkey (*Nasalis larvatus*
Wurmb. 1878) in Disturbed and Degraded Habitat of Peat
Swamp-Riparian Ecosystem of Rawa Gelam, at Tapin
Regency, South Kalimantan-Indonesia**

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Abstract

The daily activity of proboscis monkeys was studied on the degraded habitat of peat swamp ecosystem of Rawa Gelam, Tapin Regency, South Kalimantan Province. Data of daily activities were collected by followed the groups from early morning until late afternoon when the monkey went to the sleeping tree using the Scan sampling and Ad liebetum methods.

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The all of the groups observed has recorded almost have the same daily activities pattern, i.e. group 1 feeding 28.79%; moving 14.56%; resting 53.37% and social activity 3,28%. group 2 feeding 30.92%; moving 15.41%; resting 50.75% and social activity 2.91%. group 3 feeding 32.61%; moving 13.16%; resting 52.75% and social activity 1.47%, and group 4: feeding 32.08%; moving 13.97%, resting 51.64% and social activities 2.31%. Proboscis monkey eating leaves (89.4%), flowers (6.82%) and fruits (3.78%). The monkeys have different food preference when dry season and rainy season. Several times recorded proboscis monkey eating lotus flower. The monkeys used different height level when eating and resting. In dry season, the monkey mostly used 0-5 meters and used 5-10 meters in the rainy season. The length of daily range of proboscis monkey varies between 432 meters - 860 meters with an average length of 600.5 meters. Home range size of target groups of proboscis monkey were varied, which is group one 26 hectares, group two 32 hectares, groups three 21.25 hectares and group four 22.5 hectares.

Keywords: Proboscis monkey; *Nasalis larvatus*; daily activity; peat swamp habitat.

1. Introduction

Proboscis monkey (*Nasalis larvatus* Wurm. 1878) are generally found living in various types of habitats, such as mangroves, peat swamp forest, riparian forest, from the seaside to the highlands. Proboscis monkey also found in many types of habitat that have changed its function as cultivation land, such as rubber forests, karst, rice fields and ponds. In these habitats, groups of proboscis monkeys living in the stands of remnant vegetation and isolated, and perform their daily activities.

Some studies related to aspects of the daily activity of the proboscis monkey groups have done, including by [1,2,3] in the group of proboscis monkeys in the mangrove forest; Reference [4] in the peat swamp forests, References [5,6] in riparian forests estuaries. Meanwhile, research activities in disturbed habitats of proboscis monkeys, conducted by [7] in the rubber forests.

The quality decreased of primate habitat are expected to affect the daily activity patterns and habitat spatial utilization. Proboscis as arboreal animals require the presence of tree stands in her life, as a source of food, shelter, and sleeping tree. Depth research related to the daily activity patterns in groups of proboscis monkey in a disturbed and degraded habitat of Rawa Gelam, needs to be done, to determine the adaptation level of proboscis to the habitat condition.

Daily activity in this research including eating, movement, resting and social activity. Proboscis monkey daily activity patterns seen in the proportion of time eating, movement, rest and social activities that are used in the one-day activity. The pattern of use of the space means the use of vertical space from the ground to the top of trees, as well as horizontal space, which includes comprehensive daily and wide of home range areas of proboscis monkey. This study was aimed to analyze the patterns of daily activity of the proboscis monkeys, which live in disturbed and degraded habitat of swamp ecosystem of Rawa Gelam, Tapin Regency, South Kalimantan.

The study area was dominated with cultivated areas, such as fields and gardens with 100 m – 200 m width of

natural vegetation on the both sides of river bank, while the river/canal used by coal mining company to transport coal from the stock pile to the port.

2. Methodology

Observation of the daily activities of proboscis monkey groups in the Rawa Gelam swamp habitat, at Sungai Puting, conducted on four different groups. Group 1 consist of 15 individual, group 2 consist of 16 individual, group 3 consist of 23 individual and group 4 consist of 36 individuals. Group 1 and group 2 occupied the same habitat, at the left edge of Puting River, while group 3 and group 4 is located on right side of the river banks of the Puting River (Figure 1).

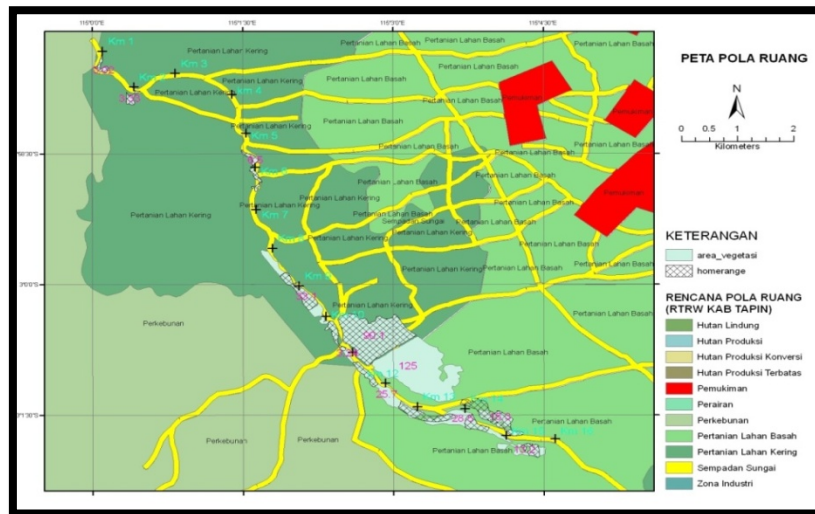


Figure 1: Map of the study site at Rawa Gelam swamp land of Puting River

Data were collected from the morning at 06.00 am, when the proboscis woke until the evening when the proboscis inside to the sleeping tree, at 06.00 pm. The observer following the path of movement of the groups were observed, and record every activity performed by the target group. The method used were Scan Sampling Method and Ad liebetum [8] with record interval every 10 minutes. Daily activity category refers to the category of daily activities [3], namely:

- a. Feeding : grabbing, carry and eat the food put into the mouth, chew and (presumably) throw or release the feed held with limbs (hands or feet).
- b. Moving : an movement activity from one place to another by quadropedal, bipedal, jumping or swinging.
- c. Rest: Sitting, standing, lying down or walking in place (shift) as needed around the site without doing any activity.
- d. Play: move with the purpose of undirected, whether taken alone or together with other individuals
- e. Grooming: scratching or take anything from the parts of their own body or other individu's body with her mouth, hands or feet.
- f. Call : voice communications are carried out by individual of adult male and/or adult female. This call

can be as information to inform their territory, alarm call when they meet the group competitor or predator.

The use of vertical space above the tree when the proboscis perform daily activities are recorded based on the interval strata altitude A: 0-5 meters; B: 5-10 meters and C: 10 -> 15 meters.

The data obtained were compiled and analyzed descriptively and presented in tables or graphs. To analyze the data of significance between groups were tested using chi square analysis (X^2) [9]. The results of this study compared with results of other studies that have been published.

3. Result

3.1. Time Budget of Daily Activities

Group of proboscis monkeys in Rawa Gelam swamp of Putting river observed, perform daily activities for 11-12 hours and begin its daily activities early in the morning at 07.30 and ends at 18.00 after entering sleeping tree. All of the groups observed have the same daily activities pattern, i.e. group 1 feeding 28.79%; moving 14.56%; resting 53.37% and social activity 3.28%. group 2 feeding 30.92%; moving 15.41%; resting 50.75% and social activity 2.91%. group 3 feeding 32.61%; moving 13.16%; resting 52.75% and social activity 1.47%, and group 4: feeding 32.08%; moving 13.97%, resting 51.64% and social activities 2.31% (Figure 1). Statistically, all groups of proboscis monkeys were observed to have the same pattern of daily activities, i.e. feeding activity ($X^2 = 0.28$; $p < 0.05$; $df = 3$); Moving ($X^2 = 0.19$; $p < 0.05$ $df = 3$); resting ($X^2 = 0.08$; $p < 0.05$ $df = 3$); social ($X^2 = 0.75$; $p < 0.05$ $df = 3$).

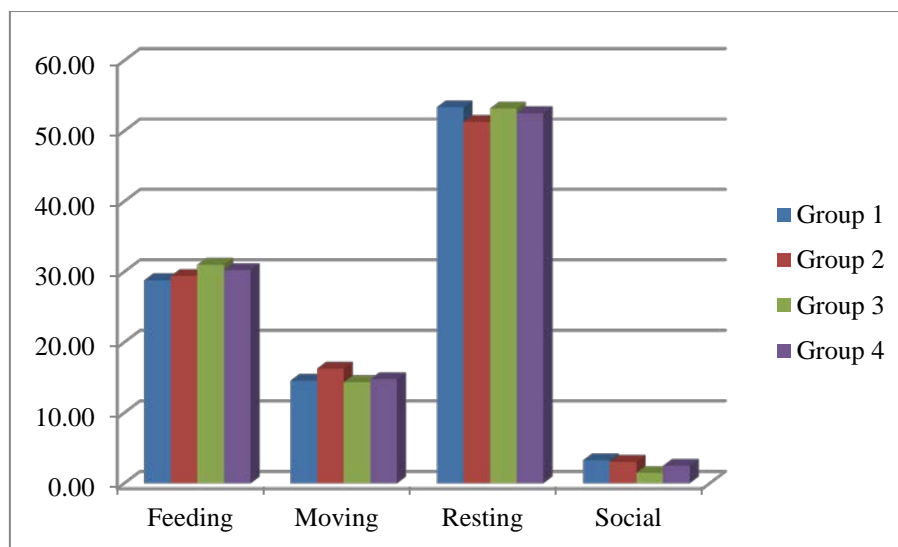


Figure 2: Time budget of daily activities of the target groups of proboscis monkey in Rawa Gelam

3.2. Feeding Activity

Feeding activity is an activity carried out by the proboscis monkey is continuously and interrupted with other activities. The proportion of feeding time of proboscis monkey group was 31.1% of total time daily activities.

However, there are two main times of feeding, in the morning between the hours of 07:30 to 10:00 and in the afternoon between 15:00 to 18:00. Feeding activity is rarely done in the period between the hours of 11:00 to 15:00 (Figure 3).

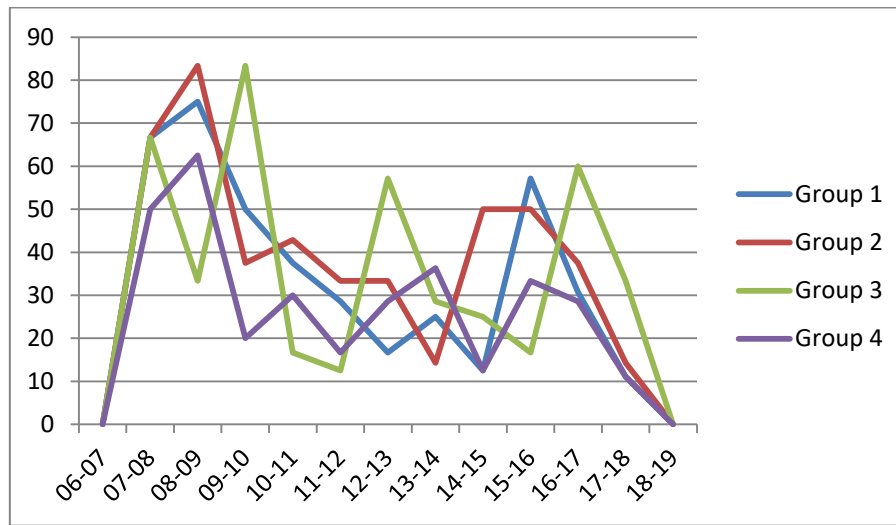


Figure 3: Time budget of proboscis monkey at peat swamp of Rawa Gelam

During the study, we noted that the proboscis monkey ate five species of food, but I believe that they ate more, such as some species of grasses. Proboscis monkey consumed different food preference during rainy season and dry season. During the rainy season, the proboscis monkey eating more leaves and fruit of pulantan, whereas in the dry season proboscis monkey consume more kelakai leaves and other grass species rather than pulantan. In rainy season, the proboscis monkey's food were consists of pulantan 66.71%, kelakai 26.38, Tamparah 12.32%, perupuk 9.57% and other species 10.4%. Whereas in the dry season proboscis monkey food composition consists of pulantan 28.98%, 65.95% kelakai, tamparah 20.97, perupuk 25.17% and other types 28.32%. Proboscis monkey eating leaves (89.4%), flowers (6.82%) and fruits (3.78%). Several times recorded proboscis monkey eating lotus flower (Figure 4).

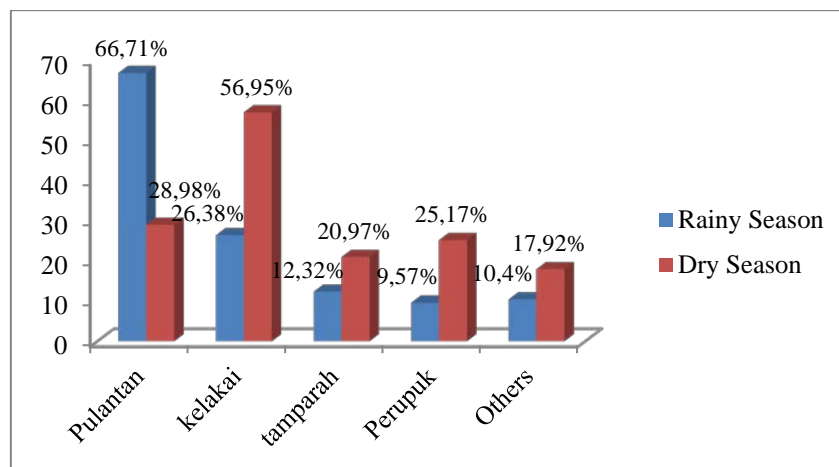


Figure 4: Presentage of food species that consumed by proboscis monkey

3.3. Moving Activity and Spatial Use

Moving activity carried out by proboscis monkey to look for food resources and a place for resting. The results showed that that the average of time budget of moving activity was 14.27% with a range of time budget between 13.16% - 15.41% The movement began at 7:00 h moving out from the sleeping tree to find the nearest food source around the sleeping tree. Statistically, there was no difference in the pattern of movement activity in the rainy season and the dry season ($X^2 = 0.19$; $df = 3$, $p < 0.05$). In other words, the weather did not affect the movement pattern of proboscis monkey in the peat swamp of Rawa Gelam.

The length of daily range of proboscis monkey varies between 432 meters - 860 meters with an average length of 600.5 meters. Group one took an average of 503 meters per day with the length of daily range was between 160 meters - 900 meters, while group two took an average of 432 meters per day with the length between 250 meters - 800 meters.

A group three took an average of 607 meters per day with a length range between 300 meters - 950 meters, while a group four took an average of 860 meters per day with daily length between 600 meters - 1250 meters. Home range size of target groups of proboscis monkey were varied, which is group one 26 hectares, group two 32 hectares, groups three 21.25 hectares and group four 22.5 hectares (Figure 5). Sometime home range between adjacent groups were overlap.

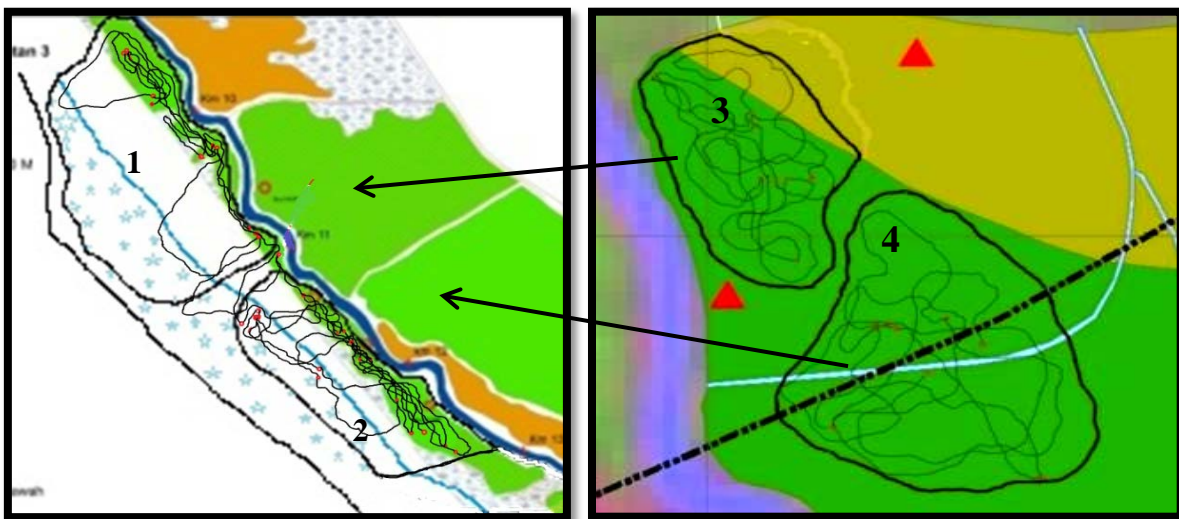


Figure 5: Home range of the groups of proboscis monkey during conducted the research

During feeding activity, the proboscis monkey using different strata vertical space when rainy season and dry season. During the rainy season proboscis monkey often use strata height of 5-10 meters and when the dry season is more often using strata height of 0-5 meters (figure 6).

The utilization of vertical space during feeding activity was related to the distribution of food species, which consumed by proboscis monkey.

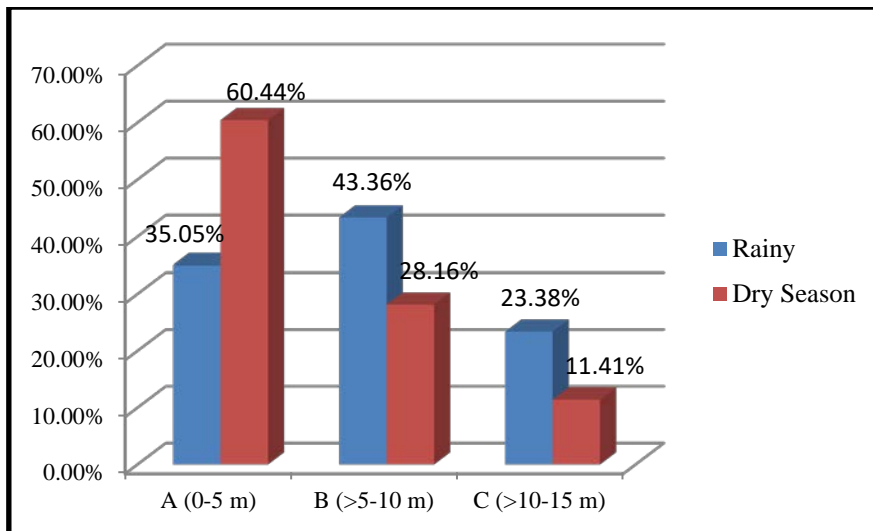


Figure 6: The usage of vertical space during feeding activity of the proboscis monkey

When conduct the traveling, the groups of proboscis monkey in Rawa Gelam more frequent use height strata of 5-10 meters above the ground, with an average frequency of 53.39% . Sometimes they also walked in the ground (30.53%), but very rarely used the height strata of 10-15 meters (Figure 7). Basically, the movement was done to find the source of food and a comfortable resting place.

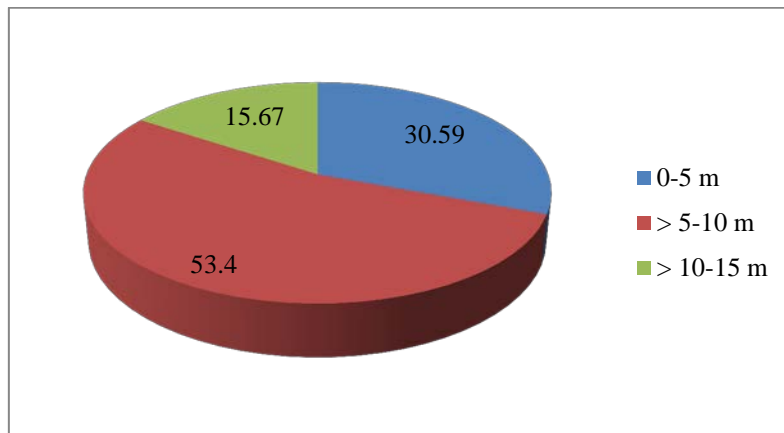


Figure 7: The use of vertical space by the proboscis monkey during their movements activity

When resting, proboscis monkey using the different strata of height during the rainy season and dry season. Proboscis monkey used strata height of 5-10 meters in trees during the rainy season and strata height of 0-5 meters above the trees during the dry season ($X^2 = 13.98$; $df = 3$; $p > 0.05$) (Figure 8). In the rainy season pulantan trees, which was a dominant tree species on the proboscis monkey habitat have a dense of leaf growth that make comfortable for rest. Meanwhile, during the dry season, most of the pulantan leaves was falled down, due to forest fire. As a result, the proboscis monkey was more comfortable took a rest on the forest floor, under a fallen tree branches or the dried vines (Figure 9).

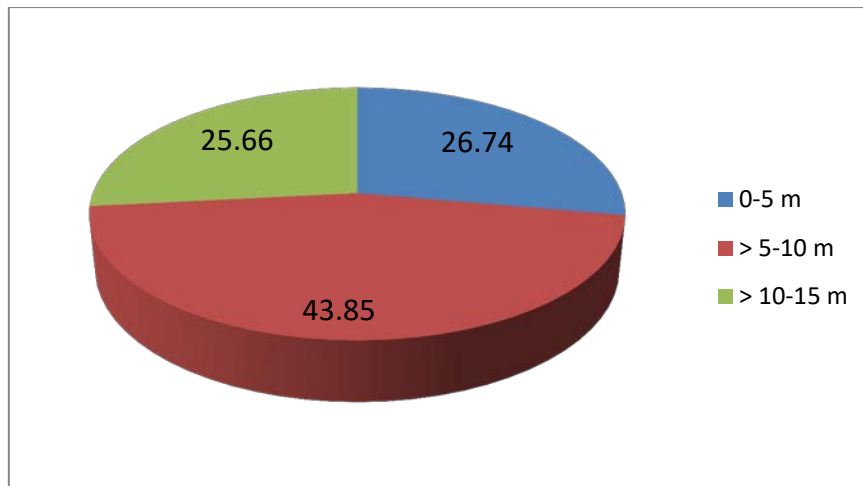


Figure 8: The use of heights by the proboscis monkey during resting time

3.4. Resting and Social Activity

Group of proboscis monkey in the swamp habitat of Rawa Gelam have an average budget of resting time is 52.13% of total daily activities, with a range between 51.64% - 53.37%. The resting time budget is the highest proportion compare with other activities. i.e. the time of feeding activity (31.1%), moving (14.28%) and social activities (2.49%). In the morning (6:00 a.m. to 9:00 pm) temperature at the proboscis monkey habitat range between 32°-33°C, and at the daytime temperatures rise between 35°-36°C and decreases to 33°-34°C in the afternoon,



Figure 9: Resting position of proboscis monkey when rainy season (A) and dry season (B).

Social activity is an activity that is generally conducted during their resting time, in the form of interaction between individuals in a group. Such activity were grooming, playing, mating, call and agonistic behavior (Figure 10). In the proboscis monkey groups was studied, the average proportion of social activity times was 2.49% of the total time budget of daily activities, with a proportion range between 1.47% - 3.28%. In this study, social activity recorded was grooming 31.56%, play 10.53%. and long call 57.89% (Figure 11).

Grooming is a social activity that is most often done by proboscis compared with other social activities. The

aimed of grooming is to clean a parasite in the body. But besides that grooming also signify social closeness between individual who do it. Grooming activities recorded during research conducted among adult female with a child or baby, and among young individual. Playing mostly did by juvenile and infant. Playing for juvenile serves as a learning tool (learning behavior). Play activities performed by individuals proboscis monkeys were chasing and fighting. Another social activity recorded were call and agonistic behavior. Activities conducted as an alarm to the group members when there was interference.



Figure 10: Group of proboscis monkey resting and playing in the ground

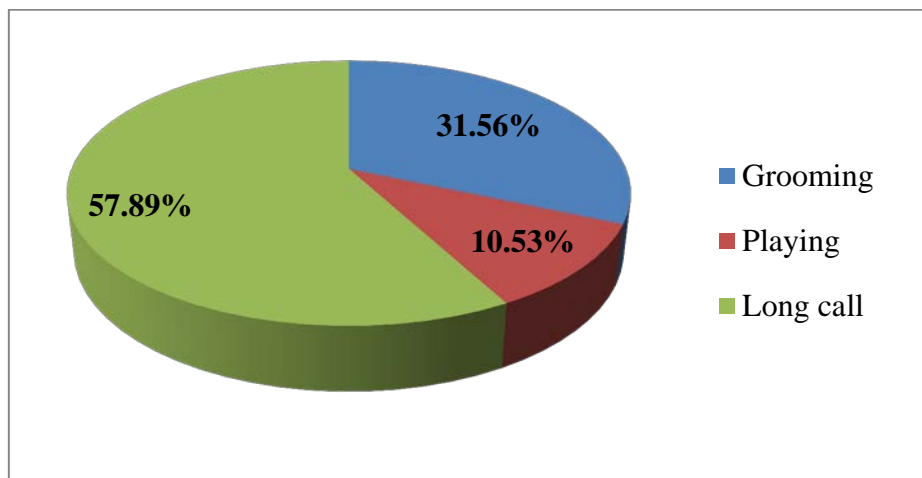


Figure 11: The proportion of social activities of proboscis that recorded during this research

Social interaction was occurred between sympatric groups of long-tailed macaque (*Macaca fascicularis*) and javan leaf-eating monkey (*Trachypithecus auratus*). When the group of proboscis monkey adjacent to the long-tailed monkey group, the proboscis monkey always make an alarm call and will stay away, but if it was adjacent with a group of leaf monkey, the proboscis group did not give any respond. The distance between proboscis monkey and sympatric groups when met each other was between 25-50 meters. Sometime the distance between sympatric groups less than 25 meters. During the study noted that the proboscis monkeys and leaf monkey consumed the same food source, i.e. pulantan, kelakai, tamparah, perupuk and other types of grass. While the long-tailed macaque, the competition occurred more towards to the use of space, especially resting places and sleeping tree. During the study recorded the proboscis monkey seven times adjacent to leaf monkey, three times

with long-tailed monkeys and twice recorded three species perform daily activities within the same habitat. Twice recorded that the proboscis was changed their sleeping trees because of long-tailed macaque invasion.

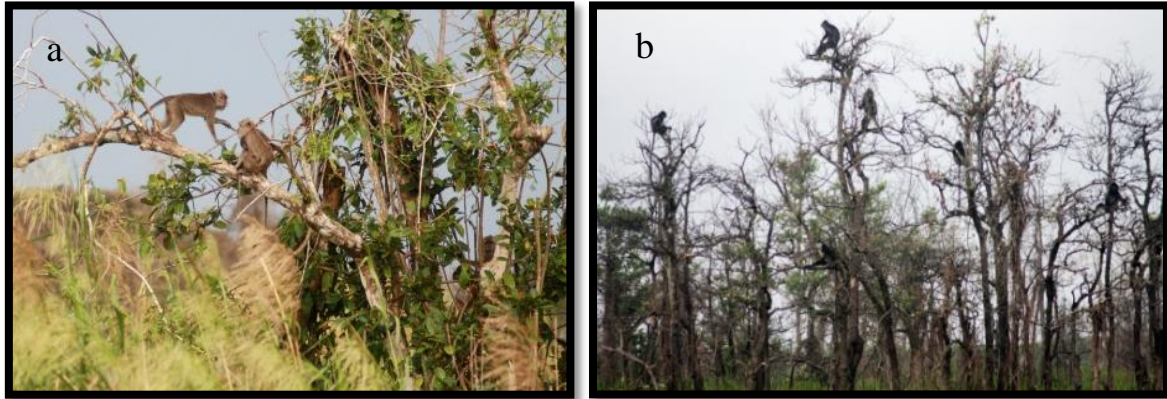


Figure 12: Two sympatric species to proboscis monkey; a. Long-tailed macaque (*Macaca fascicularis*) and b. Leaf-eating monkey (*Trachypithecus auratus*)

4. Discussion

The time budget of daily activity on this study also occurred in the group of proboscis monkeys in some different habitats. Reference [2] noted that the proportion of daily activities in Kuala Samboja is feeding activity 39.25%, resting 33.33%, moving 23.18%, playing 4.76%, 1.28% and browse for agonistic behavior 2.35%. Reference [10] in his observations on other groups also noted the proportion of daily activity time proboscis monkey, eating 23.39%, 45.03% and moving break 21.64%. Reference [13] noted that the proportion of daily activities on the river group proboscis monkey Sangkimah, Kutai National Park, eating 27.9%, moving 52.2% and resting 19.9%. Reference [12] noted that the proportion of daily activity time proboscis monkey in embank River, Sabah, eating 20.4%, 75.9% and the rest 3.6% move. The proportion time budget of proboscis daily activity in mix-rubber plantation was, feeding activity 41.30%, moving 40.66% and resting 14% [7,5] in the group of proboscis monkeys at Bako National Park, Sarawak, namely the feeding activity of 50.5%, 25.7% and moving rest 22.7% (Table 1).

Table 1: Time budget of daily activities of proboscis monkey in several habitat types

Time budget of Activities (%)				Habitat	Resource
Feeding	Moving	Resting	Social		
23,39	21,64	45,03	--	Riparian mangrove	[10]
27,9	19,9	52,2	--	Riparian mangrove	[1]
20,4	3,6	75,9	--	Riparian forest	[12]
41,30	14	40,66	--	Rubber plantation	[7]
50,5	22,7	25,7	--	Mangrove forest	[5]
31,1	14,27	52,13	2,49	Peat swamp forest	This research

The proportion of feeding time proboscis monkey was varied in several different habitat. Reference [5] reported that the proboscis monkey in Bako National Park, Sarawak has the proportion of feeding time was 51% of total daily activity, while [10] noted that the proportion of feeding activity was 23.39%, Reference [13] noted that proboscis monkey in Kutai National Park has proportion of feeding time was 27.9% and Soendjoto (2005) noted tha the proboscis monkey in rubber plantation has proportion of feeding time was 41.30%.

To get a food source, primates not only consider the content of nutrients that exist in every type of potential food and nutritional needs, but also consider the time and energy required to get the source of the feed to the nutritional value contained therein. Leaf-eating primates are very selective in choosing the leaves that will be consumed. In general, prefer the leaves with the lowest tannin content, but high in protein and at least secondary element content. Reference [1] states that if the leaf has contain higher of protein in the diet, will has a lower tanin contain, while if it has a higher levels of minerals it will be increasingly high levels of tanin. Based on the research results of [14], pulantan and kelakai contains high levels of protein, which is 13.59% and 15.91%, while tamparah only contain protein at 6.09% (Table 2).

Table 2: The chemical contain of some food species that consumed by proboscis [14]

Chemical Contain	Pulantan (%)	Kelakai (%)	Tamparah (%)
Protein	13.59	15.91	6.09
Fiber	10.97	11.93	14.05
Fat	1.76	1.31	0.4
K	0.41	0.26	0.11
Ca	0.23	0.05	0.06
Na	0.18	0.53	0.38
Mg	0.09	0.066	0.11

During their feeding time, the proboscis monkey using different height positions on the trees, where in the rainy season often used height level of 5-10 meters above the ground and in the dry season is more commonly used height of 0-5 meters above ground level. This was related to the availability of food. In the rainy season, the young leaves of pulantan trees, which is one of his favorite food was growth abundantly. So proboscis monkey prefers to consume the leaves and fruit of pulantan rather than other species. Meanwhile, during the dry season, a lot of pulantan's leaves was falled down, due to fires. Reference [1] mentions that the proboscis monkey in the river Sangkimah, Kutai National Park using 10-15 meter height position in the tree when conducted feeding activity. Proboscis monkey in the rubber plantation more often use a height of less than 15 meters while doing feedng, moving and resting [7].

The length of daily cruising proboscis monkeys in Rawa Gelam is shorter than the length of daily cruising proboscis monkey groups in several other habitats. Reference [15], reported that the average length of day range group of proboscis monkeys in the Kinabatangan River is was 910 m (370-1810 m). Proboscis Kutai National

Park, East Kalimantan took an average of 1007.5 m daily cruising (range 450-1750 m) [1]. In the rubber forest, proboscis monkey groups take the average length of 541.24 meters with a range of daily roaming between 250 meters - 950 meters [7]. Reference [15] in his study group proboscis monkey in the Kinabatangan also mentioned that rainfall did not affect the pattern of daily cruising, but in his research, Reference [12] suggest that rainfall patterns affect the daily movement of the proboscis monkey. Reference [12] also said that the influence of rainfall on the pattern of movement of the proboscis monkey is low, however, the weather may affect the movement pattern proboscis monkey. The food sources of proboscis was distributed widely, mostly young leaves, while the fruits were served seasonally. Some researchers said that the movement patterns of primates affected by the spatial and temporal distribution of food resource availability ([16,15,17]). In the Rawa gelam primary food source is the young leaves and fruit pulantan and several types of grasses and ferns. This condition was also as a strategy for proboscis monkey to minimize their energy lost due to long distance traveling. Some studies showed that home range size decreases as food sources become more abundant ([18,28]).

When comparing the pattern of movement activity of proboscis monkey in various types of habitats, it showed the home range size of proboscis have wide variations. Such differences may be caused by different types of habitat. Different types of habitat can affect patterns of distribution, abundance and availability of food sources (Boonratana, 2000). Food resources in Rawa Gelam relatively dispersed evenly, with high abundance, but a little diversity. So proboscis monkey not have to walk too far to get their food. Primate species are expected to decrease their day range lengths as high-quality foods become scarce. Conforming to optimal foraging theories, they then exploit low-quality food sources that are common [19]. In the mangrove forest of Nipah Panjang, home range size of proboscis monkey groups varied from 13.4 hectares to 38 hectares [20], while home range size of proboscis monkey in Kuala Samboja was ranged from 15.47 hectares to 30.71 hectares [10]. In Samunsam Wildlife Sanctuary, proboscis monkey group has an extensive home range size up to 900 hectares [15]. [20] states that the difference in the size of the area roaming proboscis can be caused by various factors, among others: a) differences in the availability, distribution, and abundance of food resources, b) the quality of food available, c) the structure of habitat, d) barrier displacement, e) social organization and breeding systems, f) population density, and g) the presence of predators.

Resting period is a phase in which individuals of proboscis monkey not conduct any activity, including the activity of eating and movement. During the resting time, proboscis monkeys use more time to sit quietly in the branches and twigs of trees or sitting on the ground. The only activities that undertaken by the proboscis is grooming, whether self grooming or groomed other individuals.

Group of proboscis monkeys in the swamp habitat of Rawa Gelam have an average proportion of resting time is 52.13% of total daily activities, with a range between 51.64% - 53.37%. The proportion of time was higher than proportion time of feeding activity (31.1%), moving (14.28%) and social activities (2.49%). The peak of the resting time was occurred between 11.00 – 15.00 in the afternoon. At that time, the range of temperature was between °35-°36 Celsius.

On the leaf eater primates of Colobines sub family, it took longer to digest the food than frugivorous and

insectivore primates. Because the cellulose content and high fiber on the leaves are hard to digest, so it requires energy and a long time to change components in the leaves into energy that can be utilized for activities and growth. In addition, resting is a strategy of proboscis monkeys as a reaction to the increasingly hot temperatures [10]; do not waste energy for the excessive activity [7]. According [15], by resting, proboscis monkeys can relax his muscles. The difference of the distribution, size, and abundance of food resources among habitats can cause different of range size and patterns in primates ([18,21,22]).

When resting, proboscis monkeys used different heights strata during the rainy season and dry season. Proboscis more use strata height of between 5-10 meters in trees during the rainy season and strata height of 0-5 meters above the trees during the dry season. In the rainy season, pulantan, a dominant tree species on the proboscis monkey habitat, has a lot of leaves, so it is quite comfortable to rest. Meanwhile, during the dry season, caused by fires, many pulantan trees whose leaves falled and die, so bekantan more comfortably resting on the forest floor or under a fallen tree branches or vines dried up (Figure 13).

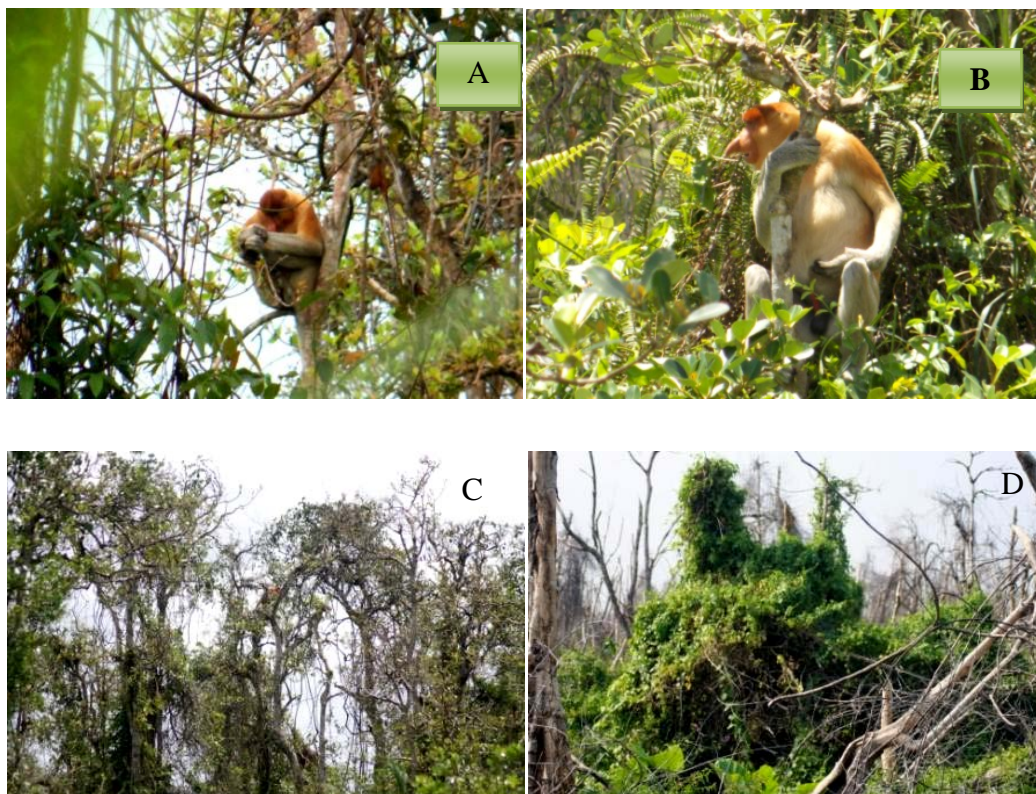


Figure 13: The Position of proboscis monkey during resting time. A. When the rainy season and B. Dry season; C. Tree's canopy condition when rainy season; D. When the dry season

Social activity in groups of proboscis monkeys were rarely, as in general primate group of sub-family Colobines. Reference [1] in his research on proboscis monkeys at Kutai National Park, only recorded 5 times grooming activity. Grooming activities conducted between individuals also serves to maintain social bonds between individuals in a group of primates [23]. Leaf-eating primates required a longer time to digest their feed and a lot of energy to digest. So while resting proboscis monkey rare to conduct social activities as a strategy to save energy.

Sympatric populations often occur naturally in species of primates. A sympatric population in general is the presence of two or more species in an ecosystem habitat, in the same time. The presence of sympatric species usually caused similarities in habitat use, such as the preference for the same food resources or use of space in the same habitat. According [24], resource competition the same feed was common among primate species.

The presence of two sympatric species of primates, the long-tailed macaque and leaf monkey at the proboscis monkey's habitat have different objectives. Langurs and proboscis monkeys are foliosvore primates (leaf eaters). Both types of these primates consume the same type of food. However, during the study did not look any conflict between the proboscis monkeys and teh langur in getting food resources. The food resources spread evenly and abundantly. Group of proboscis monkeys in the rubber plantation were compete in food sources with the langurs. Proboscis consumed 18 species of plants and langur consumes 15 species of plants. Of these, there were 11 species of plants consumed by both species [7]. References [25,26] reported that dietary overlap between cercopithecine species is higher for fruits than for less popular items such as leaves. Dietary overlap between proboscis monkeys and long-tailed macaques was greatest when fruit was highly available and a major part of the diet. In [27] review of interspecific competition, he states that dietary overlap is generally least during periods of food scarcity. On the other hand, the presence of long-tailed macaques in the proboscis monkey habitat was related to get a sleeping tree and a place to rest in the afternoon. Reference [24] says that the competition between sympatric species can be reduced if there are differences in the use of space A vertical, different food preferences and activity patterns of different times (diurnal versus nocturnal).

5. Conclusion

The daily activity patterns of proboscis monkey in Rawa Gelam relatively the same as the daily activity patterns of proboscis monkeys found in several other habitat types. Their ability on dietary strategies on the habitat that low of food abundance and/or availability is probably the result of specialized physiological adaptations of proboscis monkey lived in the degraded habitat. The adaptation to the habitat condition also showed through the proportion of time budget of their daily activities, i.e. moving, resting and social activity.

6. Recommendation

To maintain the sustainability of the population of proboscis monkeys in the habitat of "rawa gelam", it is necessary to restore the habitat in order to ensure the availability of food resources, the diversity of food resources and the availability of sleeping trees. Considering these habitats are cultivated land, the habitat restoration should be done with agroforestry system. Thus, the area swamp forest proboscis habitat can provide economic value to the community

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