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Cohabitation Study of Tricolour Langur (*Presbytis chrysomelas ssp. cruciger*) and Proboscis Monkey (*Nasalis larvatus*) in Bukit Semujan Danau Sentarum National Park

Studi Kohabitasi antara Langur Borneo (Presbytis chrysomelas ssp. cruciger) dan Bekantan (Nasalis larvatus) di Taman Nasional Danau Sentarum

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ABSTRACT

The tricolour langur and proboscis monkey in Bukit Semujan cohabited and utilized the same resources. Cohabitation, mainly due to resource constraints, needed substantial attention to ensure the survival of these primates. This research aimed to map the utilization of canopy strata vertical forest structure and vegetation as food sources and identify the size and overlap of ecological niches for both primates. This research occurred in Danau Sentarurn National Park (DSNP) from July to December 2021. The data collection employed the ad libitum method. The results indicated that cohabitation occurred in the canopy strata vertical forest structure utilization, particularly stratum B and C, and was related to food availability for both primates. The Jaccard Index of the stratum utilization association was 0.6 for swamp forests and 0.8 for hillside forests, while the food plant association was 0.2. In addition, the ecological niche of the tricolour langur overlapped 48% against the proboscis monkey and 34% on the contrary. The tricolour langur's niche size (FT) was 0.32278 ≤ 0.5960 ≥ 0.81253, while the proboscis monkey was 0.20866 ≤ 0.52837 ≥ 0.78529 at 95% confidence interval.

INTISARI

Penggunaan habitat yang sama oleh langur borneo dan bekantan di Bukit Semujan membuat keduanya berasosiasi dalam menggunakan sumberdaya. Keterbatasan sumberdaya membuat kohabitasi menjadi hal yang penting untuk diperhatikan guna mendukung kelestarian kedua jenis primata. Penelitian ini bertujuan memetakan pembagian ruang vertikal dan tingkat kesamaan pemanfaatan tumbuhan pakan kedua primata; mengidentifikasi nilai tumpang tindih serta luas relung ekologi kedua primata. Penelitian dilaksanakan pada bulan Juli hingga Desember 2021 di Bukit Semujan Taman Nasional Danau Sentarum. Pengumpulan data dilakukan dengan metode ad libitum. Kohabitasi teridentifikasi pada pemanfaatan ruang vertikal yang erat kaitannya dengan ketersediaan pakan kedua primata. Kedua primata teramati dominan menggunakan strata B dan C dalam beraktivitas. Indeks Jaccard pada asosiasi penggunaan ruang vertikal yaitu 0,6 (hutan rawa) dan 0,8 (hutan bukit), sedangkan terhadap asosiasi tumbuhan pakan sebesar 0,2. Relung ekologi langur borneo tumpang tindih sebesar 48% bekantan dan relung ekologi bekantan tumpang tindih 34% terhadap langur borneo. Perhitungan luas relung ekologi langur borneo adalah 0,32278 ≤ 0,59605 ≥ 0,81253, sementara pada bekantan 0,20866 ≤ 0,52837 ≥ 0,78529 pada tingkat kepercayaan 95%.

Introduction

Bukit Semujan is one of the areas in the Lupak Mawang Resort, Danau Sentarum National Park (DSNP), known to be the habitat for the Sentarum or tricolour langur (*Presbytis chrysomelas ssp. cruciger*) and the proboscis monkey (*Nasalis larvatus*). In the IUCN Red List, the tricolour langur was listed in the critically endangered (CR) category, while the proboscis monkey was in the endangered (EN) category (Nijman et al. 2020; Boonratana et al. 2021). According to the Ministry of Environment and Forestry (MoEF) decree No. P.106/MENLHK/SETJEN/KUM.1/12/2018, the proboscis monkey became one of the protected species, while tricolour langur was not on the list. The presence and cohabitation of both primates in Bukit Semujan have led to the sharing of spaces and resource utilization.

Sharing space and food plants in the same habitat could lead to competition and conflicts, particularly for the limited resources. Cohabiting species often share resources through differences in habitat space utilization (Vrcibradic & Rocha 1996), foraging methods (Slater 1994), food selection (Luiselli et al. 1998), and activity patterns (Wright 1989). Interspecific interactions within and between different taxonomic groups significantly affected species distribution and community structure (Beaudrot et al. 2012). However, recent studies on primate community structure focused more on species diversity and richness than on the ecological niche separation of the species (Ganzhorn 1997).

Understanding community dynamics, particularly interspecific interactions, became crucial in wildlife management decision-making. For example, to determine the priority areas for conservation and wildlife species release and avoid disrupting the existing communities. Research and analysis of species cohabitation are essential to develop better management strategies and support species conservation. This research aimed to map the utilization of canopy strata vertical forest structure and vegetation as food sources and identify the size and overlap of ecological niches for tricolour langur and proboscis monkeys. In DSNP, information on the cohabitation of tricolour langur and proboscis monkeys became valuable for the management unit to enrich the habitat with food source vegetation for both species and determine zoning within the national park.

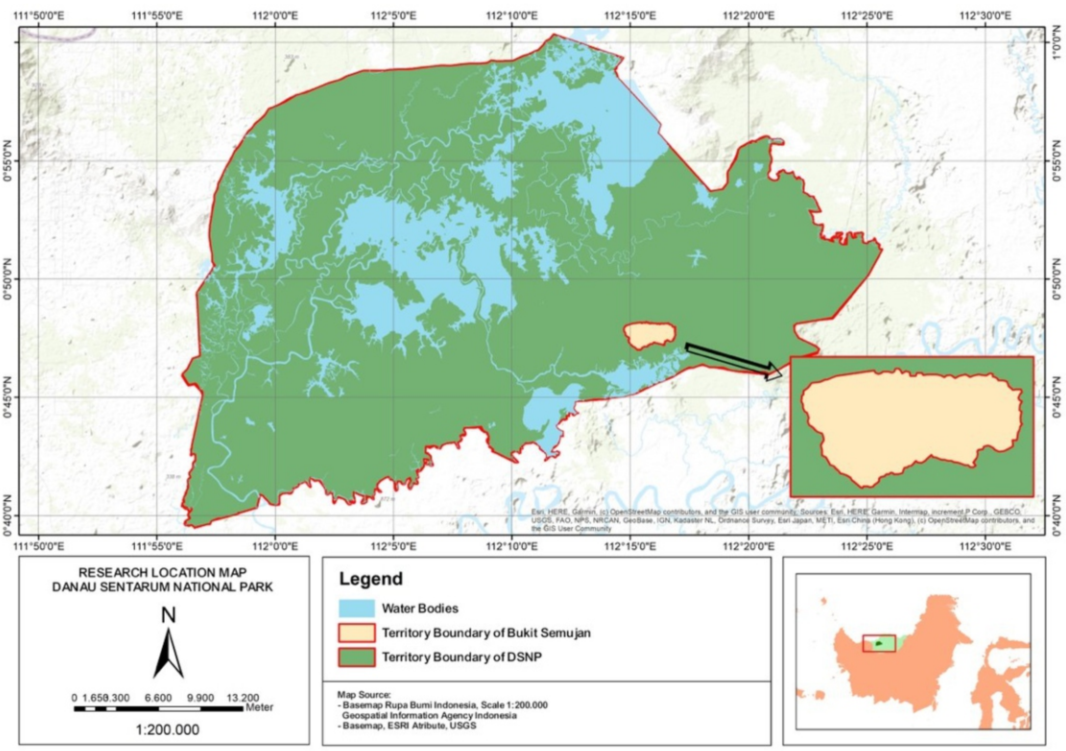


Figure 1. Research location map

Materials and Methods

Location and Time

This research occurred at Bukit Semujan, Lupak Mawang Resort, Danau Sentarum National Park, West Kalimantan, from July to August 2021 and December 2021 to January 2022, corresponding with the rainy season and fruiting seasons of the hill and swamp. The area also comprised tropical rainforests, peat, and freshwater swamp forest ecosystems (Nijman and Nekaris 2012).

Materials

This research used a Global Positioning System (GPS), binoculars, a digital camera, a compass, writing tools, a rangefinder, and tally sheets to observe three groups (21 individuals) of tricolour langurs (*Presbytis chrysomelas cruciger*), two groups (22 individuals) of proboscis monkeys (*Nasalis larvatus*), and vegetation in the southern part of Bukit Semujan. Data processing and analysis used Microsoft Word 2016, Microsoft Excel 2016, and ArcGIS 10.8 software.

Data Collection and Analysis

Habitat use, food selection, and daily activity patterns became the parameters to define ecological niches (Holt 1987). Therefore, this research investigated the niche overlap by factoring in vertical forest structure utilization, daily activity patterns, and food plant selection. Primary data collection of the daily activities employed the ad libitum method by recording all visible activities without time limitation and describing them in detail (Altman 1973). The daily activities observation included feeding, resting, moving, and socializing, and the associated stratum for those activities. Soerianegara and Indrawan (1998) categorized forest canopy strata into A (>30 m), B (20–30 m), C (4–20 m), D (1–4 m), and E (0–1 m). The observation data consisted of the strata utilization frequencies for daily activities. The calculation of activity and strata utilization percentages used the following formula (Kuswanda and Sugiarti 2005).

$$\text{Activity percentage x} = \frac{\textit{number of activity}}{\textit{total activity}} \times 100\%$$

$$\text{Stratum Utilization x} = \frac{\textit{number of activity at stratum x}}{\textit{total activity}} \times 100\%$$

The food plant species identification and their abundance used vegetation inventory in swamp and hillside forest habitats where both primates commonly engaged in their activities. The sample plot locations determination used judgment sampling based on the frequency of activity occurrences in the locations. There were five and six sample plots in the swamp and hillside forests. The vegetation inventory used a 20 x 60 m nested line plot design, combined transects, and plots (Andewi et al. 2015). The plots consisted of 2 × 2 m, 5 × 5 m, 10 × 10 m, and 20 × 20 m (Figure 2) for seedlings, saplings, poles, and trees, respectively (Soerianegara and Indrawan 1998). The measurements in the sample plots included species and their quantity, tree height, and crown size. Local communities also contributed to the information about the food plants for both primates.

The niche overlap analysis compared the overlap value of the tricolour langur against the proboscis monkey (Mpm) and the overlap value of the proboscis monkey against the tricolour langur (Mmp) using MacArthur and Levin (1967) calculation method. The calculation involved the proportion of food resources used by the tricolour langur (Pip) and proboscis

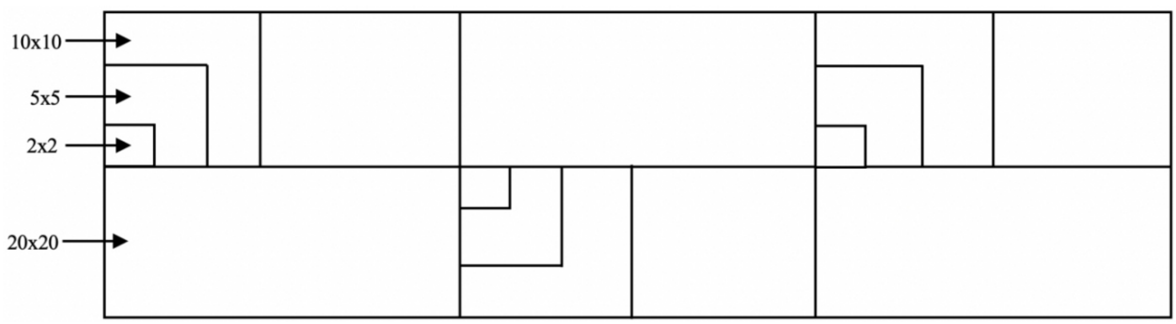


Figure 2. Plot Design

monkey (Pim) to the total food resources. Niche breadth (FT) analysis used Smith's (1978) formula that considered the presence of food resources used by the species. The niche breadth values ranged from 0 (minimum) to 1 (perfect/maximum). The Jaccard Index (JI) determined the degree of association between tricolour langurs and proboscis monkeys regarding vertical forest structure and food plant utilization (Magurran, 1988). The Jaccard Index values ranged from 0 (no association) to 1 (maximum association). This index produces minimal bias, even with a small sample size (Goodall 1973).

- Niche overlap of tricolour langur against proboscis monkey (Mpm):

$$Mpm = \frac{\Sigma P_{ip} \cdot P_{im}}{\Sigma P^2_{ip}}$$

- Niche overlap of proboscis monkey against tricolour langur (Mmp):

$$Mmp = \frac{\Sigma P_{ip} \cdot P_{im}}{\Sigma P^2_{im}}$$

Description:

Mpm : Overlap value of the tricolour langur against proboscis monkey

Mmp : Overlap value of the proboscis monkey against Tricolour langur

P_{ip} : Food resources used by the tricolour langur

P_{im} : Food resources used by the proboscis monkey

$$FT = \Sigma(\sqrt{Pj.aj})$$

Description:

FT : Niche breadth

Pj : Proportion of resources used by the observed individual

aj : Proportion of resource-j to the total resources

For large samples with a 95% confidence interval for FT, appropriate outcomes were obtained through the following arcsine transformation,

Below 95% confidence interval = sin [x –(1.96/2 √)]

Above 95% confidence interval = sin [x +(1.96/2 √)]

Description:

X = Arcsin (FT)

Y = Total number of individuals studied = Σ Nj

$$JI = \frac{a}{a{=}b{=}c}$$

Description:

a = number of sample units used by tricolour langurs with proboscis monkeys

b = number of sample units used only by tricolour langurs

c = number of sample units used only by proboscis monkeys

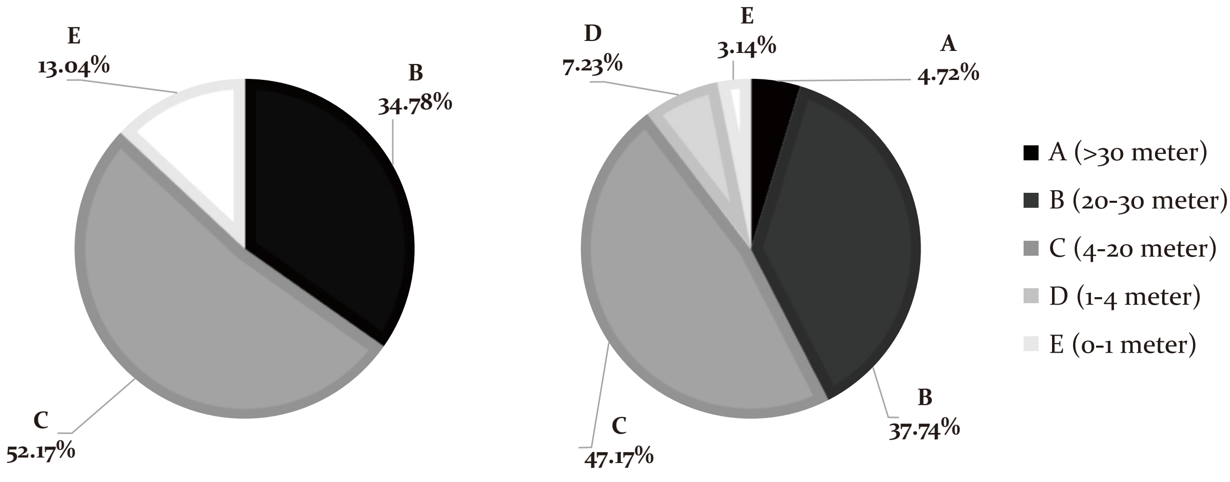
Results and Discussion

Stratum Utilization

Stratum Utilization by tricolour langurs

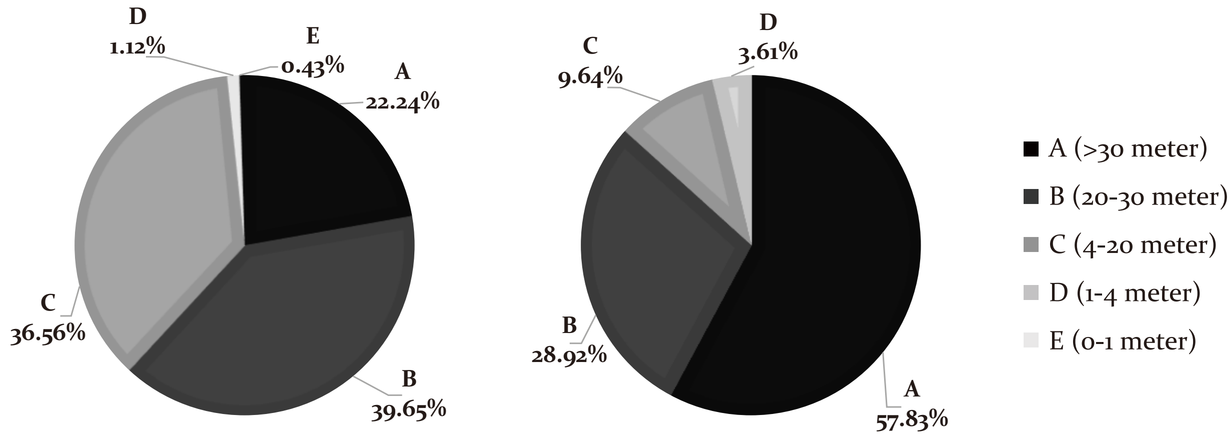
The vertical forest structure utilization resulted from the interaction between wildlife and their habitats based on height and canopy strata (Santosa 1990). Food sources, shelter, and resting places influenced the observed tricolour langurs and proboscis monkey movements. Our direct observation from July to August 2021 revealed that the tricolour langurs moved uphill in the late afternoon to sleep on the trees. The uphill trees had an average height of >30 m with a good canopy continuity, ensuring the safety of the primates from predators while resting. Moreover, July and August became the fruit season in Bukit Semujan and attracted tricolour langurs to roam the areas with higher elevations.

Tree canopies correlated with the tricolour langur's daily activities because tricolour langurs were arboreal wildlife with dominant activities on tree canopies. The tricolour langurs were more frequently found in stratum C of swamp forests (52.17%) than in hillside forests (47.17%) (Figure 3). The C stratum of swamp forests became the strategic meeting point for individuals or groups due to their excellent accessibility to various canopy corners, making food gathering easy. Furthermore, the position of the C stratum was not very low, minimizing the risk of crocodile predation in the swamp. The authorities identified saltwater (*Crocodylus porosus*) and false gharials (*Tomistoma schlegelii*) species in the park. Moreover, the C stratum had larger branches than other strata, facilitating easy movement by grabbing



(a) (b)

Figure 3. Stratum utilization percentage of tricolour langur at (a) swamp forests; and (b) hillside forests



(a) (b)

Figure 3. Stratum utilization percentage of tricolour langur at (a) swamp forests; and (b) hillside forests

the branches with their limbs. Canopy density could protect langurs from predators and other disturbances (Kusumanegara et al. 2017).

Tricolour langurs rested (sleeping) during the daytime in the hillside forests, specifically on dipterocarp trees (*Dryobalanops lanceolata*) with an average height of 45 m and a wide/dense canopy. Langurs tended to select tall trees with dense crowns to protect them from sunlight and other dangers. Stratum C became the prominent place for feeding activities, as langurs consumed fruits and young leaves at 4–20 m heights. However, langurs sometimes descended to the ground (stratum E at 0-1 m height) to eat fallen rubber seeds in both habitats. Alpha male primates frequently produced vocalizations at higher and open canopies, allowing clearer sounds for other group members.

Stratum Utilization by proboscis monkeys

Proboscis monkeys used strata B (39.65%) and C (36.56%) of swamp forests and strata A (57.83%) and B (28.92%) of hillside forests (Figure 4). Trees in the hillside forests were taller than in the swamp forests. Stratum A of the hillside forests could reach more than 30 m in height. This height could become a safe place for proboscis monkeys and avoid the risk of predation. However, adult males frequently used stratum C for feeding activities. Stratum C had a relatively larger branch size than other strata, facilitating the movement of adult males. Adult males tended to have bigger body sizes and engaged more frequently in feeding activities than in movements. Proboscis monkeys seldom used strata D and E due to their thin crowns, making strenuous movements during a sudden threat from predators. Several observed activities in stratum D included moving, feeding, and vocalizations, while several monkeys descended to the water (stratum E) and vocalized. During the observation in the swamp forest, a juvenile Proboscis Monkey fell into the water while attempting to move, and it vocalized to seek help from its parents or other individuals.

Daily Activities

Daily Activities of Tricolour Langurs

Tricolour langurs started their activities around 06:00 and ended around 17:00. They started with vocalizations or morning calls to indicate their presence to other groups and territories (Rahman, 2011). The langurs moved together in groups from morning to midday to search for food. They moved to search for resting sites and remained silent during midday. Between 13:00 and 16:00, they resumed roaming and searching for food. At 17:00, they started moving to search for trees as their sleeping sites. This research observed five groups, each led by an adult alpha male.

In swamp forests, the observed activities were moving (32.58%) and feeding (34.39%), while in the hillside forests were socializing (61.81%) and moving (23.30%) (Figure 5). The relatively low encounters with Tricolour langurs were due to their high sensitivity to observers' disturbances (noise and movements). They could move quickly in threatening and alert conditions, leading to high percentages of movement activities in both habitat types. Adult alpha males led the movement of the langur group, followed by all group members. Although langurs were folivores, they consumed certain fruits to fulfill their nutritional needs, as observed from July to August 2021. However, this research observed that no langurs consumed insects or water, leading to the assumption that they met these needs by consuming fruits and leaves.

Langurs slept between 11:00 and 13:00 in trees with dense crowns to protect them from the heat and other dangers. They tended to reduce activities during midday to maintain their body temperature. During rainy days, they tended to rest, hide, and be silent. The most frequently observed social activities were agonistic and vocalizations. This agonistic behavior included aggression and intimidation at observers and other primates through loud and prolonged vocalizations. Vocalization became one of the means of communication and information exchange. Vocalizations in Langurs often co-occurred with moving activities.

Daily Activities of Proboscis monkeys

Like tricolour langurs, proboscis monkeys were primarily arboreal and performed most of their activities in tree canopies. In the swamp forests, the observed activities were feeding (40.02%) and resting (38.35%), while in the hillside forests were moving

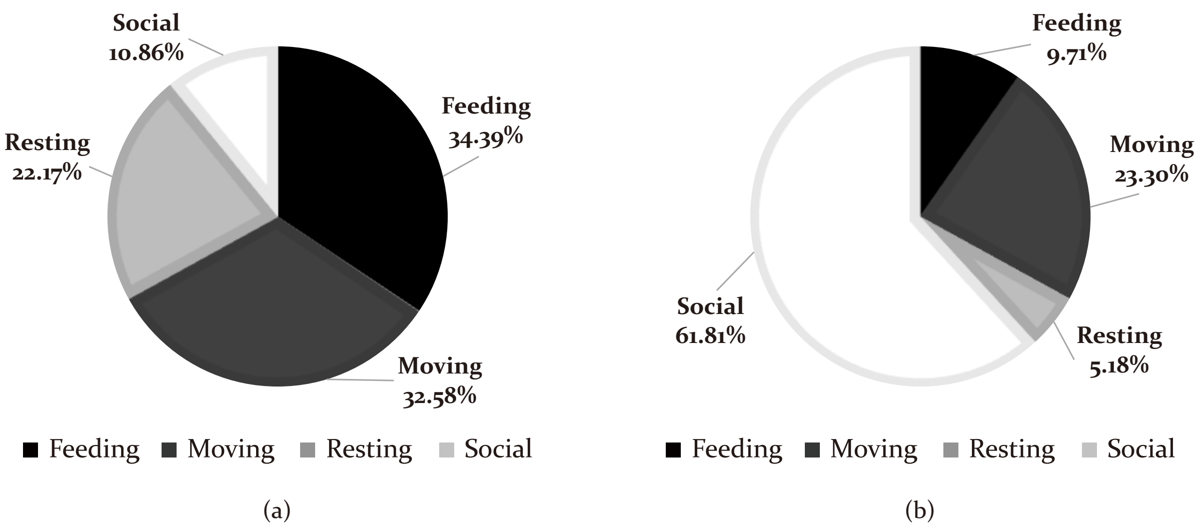


Figure 3. Stratum utilization percentage of tricolour langur at (a) swamp forests; and (b) hillside forests

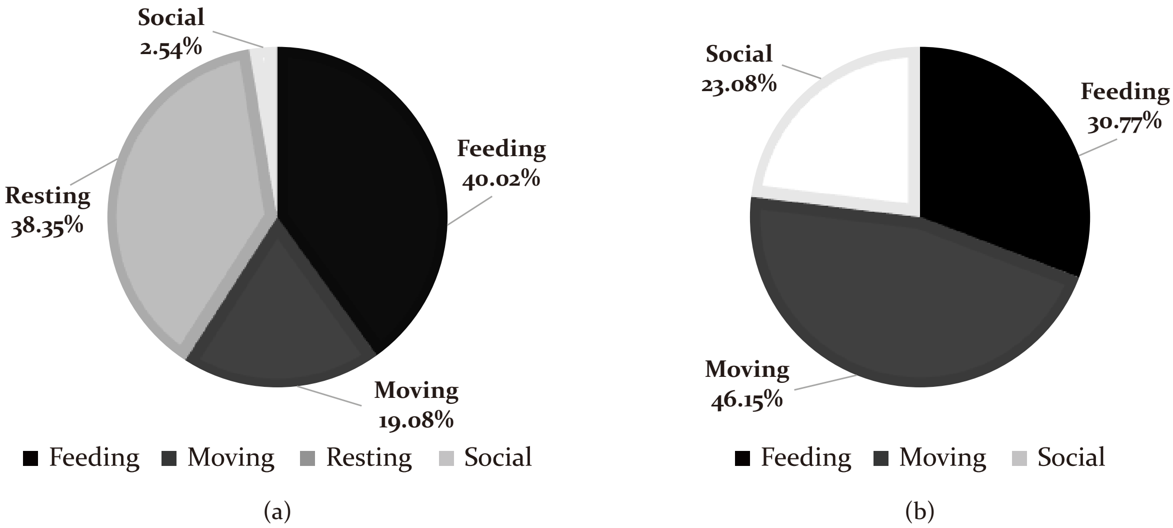


Figure 3. Stratum utilization percentage of tricolour langur at (a) swamp forests; and (b) hillside forests

(46.15%) and feeding (30.77%) (Figure 6). This research encountered more proboscis monkeys than tricolour langurs as the proboscis monkeys had bigger group sizes than langurs. In addition, langurs were more sensitive to human presence than proboscis monkeys.

July to August 2021 was the fruiting season in the hillside forests, and proboscis monkeys more frequently searched for food in hillside forests than in swamp forests. In contrast, December 2021 to January 2022 was the fruiting season in the swamp forest, and proboscis monkeys more frequently searched for food in swamp forests than in hillside forests. They ate young leaves and fruits. Hulbert et al. (1996) suggested that the home range of several mammal species decreased when food availability increased in their areas. Body size influences resting activities. A group led by a relatively large adult alpha male tended to move slower and had more frequent resting activities. Another group with infants could slow down the movement of adult females. Proboscis monkeys tended to select trees for sleeping close to the food sources. During the fruiting season on the hillside, they rested (slept) near the hillside. However, the primates preferred to rest near swamp forests in the late afternoon during the non-fruiting season on the hillside.

There were two groups of proboscis monkeys in the research location. The first group was one male group of 18 individuals, led by one adult alpha male and consisting of several adult females. The second group was an all-male group of eight individuals comprising only one female and several males. The groups involved in intraspecific competition. The second group exhibited physical aggression toward the first group and attempted to mate with the female from the first group. Murai (2004) revealed that adult females often temporarily joined all-male groups for mating. Another observed social activity was play, such as chasing games, which juvenile individuals commonly performed. Adult females also carried and watched the infants.

Niche Overlap

Niche was considered the entire range of biotic and abiotic conditions enabling a species to maintain a stable population size (Wiens & Graham 2005). Niche overlap could indicate interspecific competition. Ecological niche overlap emphasizes the utilization of several similar resources by two or more species (Abrams 1980). In other words, two or more species share the existing spatial niche (Hutchinson 1958). Competition occurs when the resource availability needed by one species decreases due to the activities of other species. Arboreal animals, such as tricolour langurs and proboscis monkeys, were highly likely to compete for resources.

This research used Mac Arthur and Levin's (1967) formula to estimate the niche overlap of tricolour langurs with proboscis monkeys (Mpm) and vice versa (Mmp). The calculation involved the proportion of food resources used by tricolour langurs (Pip) and proboscis monkeys (Pim) to the total food resources. The analysis resulted in 0.48 of Mpm and 0.34 of Mmp, indicating a 48% niche overlap of tricolour langurs with proboscis monkeys and a 34% niche overlap of Proboscis monkeys with tricolour langurs. The results also revealed that tricolour langurs and proboscis monkeys shared the same resources. Limited food resources, space, and age structure within the group (Hidayat 2022) could lead to niche overlap. The presence of infants could limit the movement range of the group and increase the chances of accidental encounters between species.

The cohabitation between tricolour langurs and proboscis monkeys indicated they had relatively specific niches, allowing them to survive. Sushma & Singh (2006) suggested that the cohabitation probability between two species with high niches overlap in narrow niches was less likely. However, the chance could increase with broader niches because both species could reduce the competition by using untapped resources by their competitors. So far, tricolour langurs and proboscis monkeys could cohabitate by niche and food source partitioning. However, niche overlap could trigger future conflicts. The observed competition and conflicts in Bukit Semujan were also commonly manifested through agonistic behaviors (Diva 2022).

Niche Breadth

Niche breadth (FT) indicates the diversity of resources used by a population and the population's dependency on the resources they use. The FT calculation of tricolour langurs and proboscis monkeys employed the Smith (1978) formula and emphasized their food resource utilization. The identification of food resources used direct and indirect observation, including bite marks. The FT of tricolour langurs was 0.32278 ≤ 0.59605 ≥ 0.81253 at a 95% confidence interval. Meanwhile, the FT of the proboscis monkey was 0.20866 ≤ 0.52837 ≥ 0.78529 at a 95% confidence interval. The niche of tricolour langurs was broader than the proboscis monkeys, indicating that the langurs had more diverse food resources and were less vulnerable to environmental changes than proboscis monkeys. The diversity of food sources affected the niche breadth, lineages, species invasions, climate change responses, extinction vulnerabilities, and surrounding ecosystems (Carscadden et al. 2020).

Degree of Association

Vertical Forest Structure

This research observed tricolour langurs and proboscis monkey activities on the vertical forest structure of swamp and hillside forests to analyze the vertical space degree of association used by both primates (Table 1 and 2). The calculation resulted in 0.6 and 0.8 Jackard Index for swamp and hillside forests, respectively. The values indicated that

Table 1. Vertical forest structure utilization at swamp forests

Stratum	Tricolour Langur (%)	Proboscis Monkey (%)	Combination (%)
A	0	12.33	0
B	8.24	21.99	8.24
C	12.37	20.27	12.37
D	0	0.2	0
E	3.09	0.24	0.24
Total	23.70	55.44	20.85

Table 2. Vertical forest structure utilization at hillside forests

Stratum	Tricolour Langur (%)	Proboscis Monkey (%)	Combination (%)
A	1.07	34.38	1.07
B	8.6	17.19	8.60
C	10.74	5.73	5.73
D	1.65	2.15	1.65
E	0.72	0	0.72
Total	22.78	59.46	17.77

tricolour langurs and proboscis monkeys used similar canopy strata in swamp and hillside forests. Both primates used strata B, C, and E of the swamp forests, and they used all strata of the hillside forests, leading to a higher Jaccard Index of hillside forests. The use of strata B and C in both habitats indicated that both primates preferred dense canopy for their activities.

This research also observed a simultaneous use of resources by both primates. A group of proboscis monkeys unintentionally entered an area where tricolour langurs were using it. When the monkeys arrived, the langurs engaged in agonistic behaviors through incessant vocalizations. However, this happened in a very short time, and the langurs moved to another location. Langurs tended to avoid conflicts and confrontations in resource utilization with cohabited species (Singh et al. 1998; Porter 2001), although both primates had an unimale-multifemale social system led by an adult alpha male, influencing their tendency to defend their territory (Santosa et al. 2012). The cohabited species generally used resources at different times.

Food Resource

Food resources indirectly affected the interactions between species in Bukit Semujan. Daily foraging (movement) was affected by the evenness of food distribution (Rezeki and Zainudin 2016). The randomly distributed food resources in Bukit Semujan challenged the observation and identification of moving patterns, leading to unintentional encounters and conflicts between the two primate species (Diva 2022). Types of food affected its quality, such as the digestible cellulose content and specific compounds (Harrison 1986). The tricolour langurs and proboscis monkeys used 15 plant species in Bukit Semujan as their food sources (Table 3). Proboscis monkeys preferred the leafy parts of plants, while tricolour langurs ate leaves, fruits, and seeds. Both primates were members of the Colobinae subfamily and had a digestive system with fermentation techniques (Bismark 2009), similar to ruminants. The fermentation techniques allowed them to digest leaf cellulose content (Chivers and Hladik 1980).

Langurs used ten plant species as their food sources, while proboscis monkeys used eight plant species. Engkurung (*Grewia paniculata*), kenarin (*Diospyros sp.*), and kebesi (*Pternandra galeata*) were three out of 15 plant species that became food sources for both primates. The calculation of the Jaccard Index resulted in 0.2, indicating that both primates had an overlap food source. Still, they only sometimes used them simultaneously because each primate had other preferred plant species.

The diet of the primates at Bukit Semujan was seasonal and became very similar during the fruiting season. Using non-overlap other food sources became crucial for both species to survive and cohabit when the resources were limited. Increased competition led to niche separation until they reached no overlap (Schreier et al. 2009). Furthermore, July and August represented the transition from the rainy to dry

Table 3. Food plant species of tricolour langur and proboscis monkey at Bukit Semujan

No	Local Name	Scientific Name	Tricolour Langurs	Proboscis Monkey
1	Tekam padi	*Polyalthia insignis* (Hook.f.) Airy Shaw	✓	
2	Resak	*Garcinia lateriflora* Blume	✓	
3	Keranji bukit	*Garcinia rostrata* (Hassk.) Miq.	✓	
4	Kenarin	*Diospyros* sp.	✓	✓
5	Karet	*Hevea brasiliensis* (Willd. ex A.Juss.) Müll.Arg.	✓	
6	Engkurung	*Grewia paniculata* Roxb. ex DC.	✓	✓
7	Kebesi	*Pternandra galeata* Ridl.	✓	✓
8	Sibau	*Nephelium uncinatum* Radlk. ex Leenh.	✓	
9	Kemerawan lempung	*Dipterocarpus* sp.	✓	
10	Terap	*Artocarpus odoratissimus* Blanco	✓	
11	Kawi	*Shorea balangeran* Burck		✓
12	Putat	*Barringtonia acutangula* Gaertn.		✓
13	Rengas	*Gluta renghas* L.		✓
14	Kayu tahun	*Carallia* sp.		✓
15	Sikup	*Garcinia celebica* Desr.		✓

seasons, with fruit-bearing food plants commonly found in the hillside forests. Therefore, langurs and monkeys moved to the hillside forests. December was a rainy season and the end of fruit seasons. Available food resources in Bukit Semujan were mainly leaves. Therefore, primates tended to roam around their original habitats in swamp forests and ecotones. The environmental conditions, such as seasons, affected the abundance of available food and could stimulate competition and conflicts (Rusterholz 1981).

Implications for Primate Conservation

The DSNP, particularly Bukit Semujan, became the home for primate species, such as tricolour langurs (*Presbytis chrysomelas* ssp. *cruciger*) and proboscis monkeys (*Nasalis larvatus*), silvered leaf monkey (*Trachyphytecus cristatus*), gibbons (*Hylobates abbotti*), red langurs (*Presbytis rubicunda*), and long-tailed macaques (*Macaca fascicularis*). The initial investigation of the cohabitation of tricolour langurs and proboscis monkeys was crucial as they were endemic to the region. Data on primates' cohabitation in DSNP became essential for the park management unit to provide information on interspecific interaction among arboreal primates and engage in habitat conservation activities. The activities could include enrichment planting with food plant species. In addition, the data could become the input for revisiting the DSNP's zoning, as the primates' existing habitats were in the national park's utilization zone.

Conclusion

The cohabitation between tricolour langurs and proboscis monkeys in Bukit Semujan of DSNP occurred within the utilization of vertical tree structures, which could lead to competition and conflicts. The Jaccard Index calculation for the association of both primates yielded 0.6 and 0.8 for swamp and hillside forests, respectively. Both primates used B and C strata for most activities due to the availability of abundant food resources and adequate protection from predation. The Jaccard Index for the number of food plant species was 0.2. Moreover, the ecological niche overlap of tricolour langurs and proboscis monkeys was 48%, while that of proboscis monkeys and tricolour langurs was 34%. The ecological breadth (FT) of tricolour langurs was $0.32278 \leq 0.59605 \geq 0.81253$, and that of proboscis monkeys was $0.32278 \leq 0.52837 \geq 0.81253$. The utilization of the vertical tree structure was also closely related to the availability of food plant species in Bukit Semujan. Enrichment planting with food plant species could support the existence and cohabitation of both primates in the DSNP. Promoting primate diversity and campaigning to raise community awareness became crucial efforts to support the survival of both primates in the DSNP.

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