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Vegetation characteristics of Asian Tapir (*Tapirus incidus*) habitat in Way Kambas National Park

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ABSTRACT

The Asian tapir (Tapirus indicus) is a protected, endemic species whose survival depends heavily on habitat conditions and quality. Way Kambas National Park is one of the important conservation areas in Sumatra. This study aims to quantify vegetation structure, species composition, potential food plant availability within Asian tapir habitats, and spatial distribution patterns of Asian tapir, conducted from January to February 2026. Data were collected through field observations and vegetation analysis. Vegetation analysis was conducted using 20 × 20 m line plots, totaling 50 plots. Asian tapir distribution data were obtained through line transect surveys and direct observations of signs such as footprints, feeding traces, feces, and wallows. The results indicate that Asian tapirs select habitats with high vegetation cover, abundant food availability, water sources, temperatures ranging from 27°C to 36°C, flat slopes (0–8%), and elevations of 25–50 masl. The spatial distribution of Asian tapirs forms a clustered pattern, as evidenced by 56 recorded signs of their activity. The findings also show a relationship between habitat characteristics and Asian tapir distribution, particularly the distance from water sources. Protecting secondary forests, maintaining food resources and water availability, and strengthening regular forest patrols are essential to support long-term Asian tapir conservation.

Keywords: Conservation Biology, Distribution Pattern, Food Plants, Habitat Quality, Tropical Rainforest

1. Introduction

Asian tapir (*Tapirus indicus*) is one of Sumatra's protected endemic species. This underscores the importance of conservation efforts focused on the Asian tapir population, distribution, and range, which are inextricably linked to the condition and quality of its habitat. The habitat must provide essential components, such as food, water, shelter, and suitable environmental conditions, to support the species' survival. Asian tapirs prefer dense vegetation cover, are located near water and food sources, and are minimally disturbed [1]. The presence of Asian tapirs plays a crucial ecological role in maintaining the balance of the forest ecosystem as seed dispersers and regulators of understory vegetation structure [2]. This highlights the role of conservation areas in safeguarding Asian tapir populations and their natural habitats. Way Kambas National Park (WKNP) is one of Indonesia's key conservation areas, serving as the primary habitat for various key Sumatran wildlife species. Its ecosystem consists of lowland rainforests, freshwater swamps, mangroves, and coastal areas at elevations of 0–50 masl. The Asian tapir's habitat potential is below 1000 masl and tends to be near water sources [3]. These conditions make WKNP a relatively suitable habitat for the Asian tapir because the area is surrounded by water.

Research on the habitat characteristics and distribution patterns of Asian tapirs is essential to understanding the habitats they use and their distribution, as well as to inform habitat management strategies that can provide supporting data for government conservation efforts. Several studies on Asian tapir in WKNP have been conducted, including on foraging distribution [4], habitat suitability [5], and abundance and activity patterns [6]. Research on Asian tapir habitat characteristics has been conducted in other areas, namely Bukit Tiga Puluh National Park by [7] and Tesso Nilo National Park by [8]. Differences in geographical conditions and environmental characteristics between areas allow for variations in Asian tapir habitat selection. Furthermore,

neither of these studies has addressed Asian tapir distribution patterns or the relationship between habitat and distribution. This study aims to quantify vegetation structure, species composition, and potential food plant availability within Asian tapir habitats, examine spatial distribution patterns, and determine the relationship between habitat and Asian tapir distribution in WKNP.

2. Method

2.1. Study Area

The study was conducted in January and February 2026 during the rainy season. The research site was at Rawa Bunder Resort, Way Kanan, Way Kambas National Park (Figure 1). The resort covers 9,824.47 hectares. The land cover consists of secondary forest and shrubland.

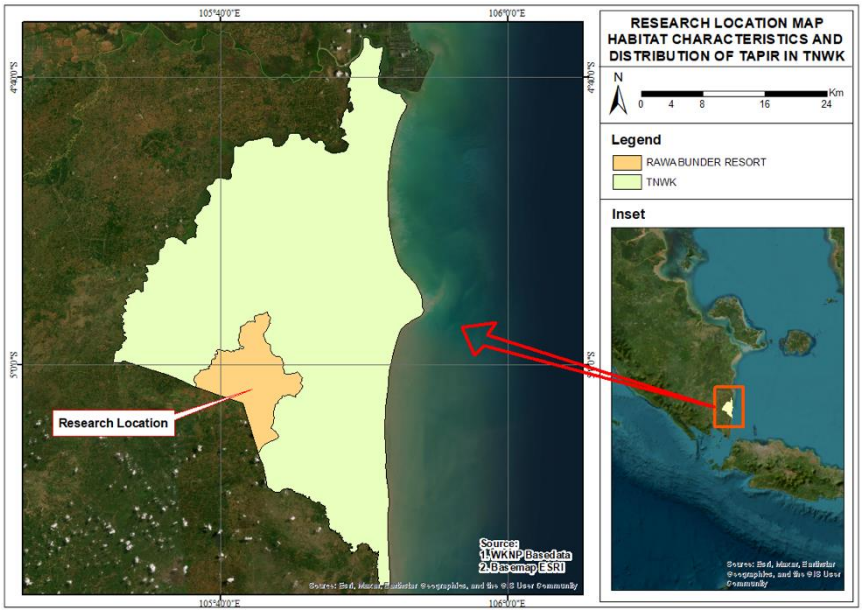

Figure 1. Research location

2.2. Data Collection

The research subjects included Asian tapir activity traces and habitat conditions used by the Asian tapir. Data on habitat characteristics were collected through field observations and vegetation analysis. Asian tapir habitats were identified through purposive sampling based on signs of their presence. The vegetation analysis method used was the line-plot method. Data collection utilized 5 transect lines, each 1 km in length. Each transect line contained 10 observation plots, spaced 100 m apart. The sample plot size for seedlings is 2 m × 2 m, for saplings 5 m × 5 m, for poles 10 m × 10 m, and for trees 20 m × 20 m [9] (Figure 2).

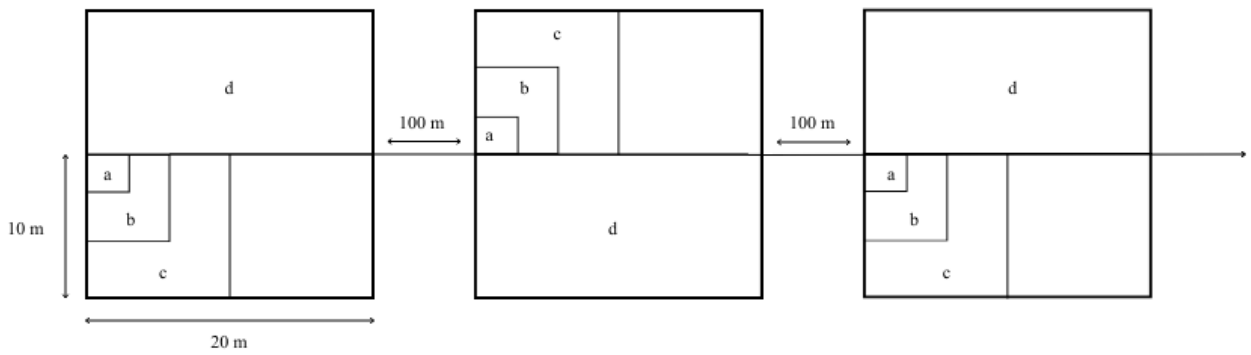

Figure 2. Vegetation analysis plot designs: (a) 2 m × 2 m for seedlings; (b) 5 m × 5 m for saplings; (c) 10 m × 10 m for pole; (d) 20 m × 20 m for tree

The habitat conditions observed include temperature, elevation, slope, food availability, canopy cover, distance from water sources, and distance from roads. Elevation and slope were determined from a DEM (Digital Elevation Model). Distance from water sources and roads was determined using the Indonesian

Topographic map. Canopy cover will be measured using 50 m x 10 m plots to represent Asian tapir habitat. The distribution of the Asian tapir was determined through both direct and indirect observations using a 1 km line transect method. Interviews were conducted to identify signs of activity found. Coordinates were recorded for each encounter using Avenza Maps.

2.3. Data Analysis

Vegetation analysis data were calculated to determine the Importance Value Index (IVI) for each plant species recorded. The calculation steps are as follows, including density, frequency, and dominance [9].

$$\text{Density}=\frac{\text{Number of a species}}{\text{Total area sampled}} \tag{1}$$

$$\text{Relative Density}=\frac{\text{Density of a species}}{\text{Total density of all species}}\times 100 \tag{2}$$

$$\text{Frequency}=\frac{\text{Number of plots in which a species occurs}}{\text{Total area sampled}} \tag{3}$$

$$\text{Relative Frequency}=\frac{\text{Frequency of a species}}{\text{Total frequency of all species}}\times 100 \tag{4}$$

$$\text{Dominance}=\frac{\text{Total basal area of a species}}{\text{Total area sampled}} \tag{5}$$

$$\text{Relative Dominance}=\frac{\text{Dominance of a species}}{\text{Total dominance of all species}}\times 100 \tag{6}$$

For pole and tree:

$$\text{IVI}=\text{RD}+\text{RF}+\text{RDom} \tag{7}$$

For seedling and sapling:

$$\text{IVI}=\text{RD}+\text{RF} \tag{8}$$

To determine species diversity in the observation plot, the Shannon-Wiener Diversity Index is used as follows [10].

$$H'=-\sum_{i=1}^{n} Pi \ln Pi \tag{9}$$

Canopy cover visualization of Asian tapir habitat will be performed using the Spatially Explicit Individual-based Forest Simulator (SExI-Fs) software. The canopy cover data is obtained from the following formula [11].

$$ba=\left(\frac{1}{2}d\right)^2\pi \tag{10}$$

$$\text{Canopy Cover}=\frac{\text{Total of basal area}}{\text{Total area sampled}}\times 100 \tag{11}$$

To determine the availability of tapir food in each habitat, the following formula is used

$$\text{Food Availability}=\frac{\text{Total of food plants}}{\text{Total of all species}}\times 100 \tag{12}$$

For Asian tapir distribution, encounter results in the form of coordinate points will be processed using ArcGIS software by ESRI to generate an Asian tapir distribution map. This map illustrates Asian tapir distribution patterns based on both direct and indirect encounters. The relationship between habitat characteristics and Asian tapir distribution was analyzed using nonparametric statistical tests, specifically the chi-square test [12]. If the data obtained did not meet the requirements for the chi-square test, a descriptive analysis was performed. The variables used were activity tracks and habitat characteristics, including slope, elevation, canopy cover, distance from water sources, and distance from roads.

$$\text{Calculated } X^2 \text{ value} = \frac{(\sum f_0 - f_e)^2}{f_e} \quad (13)$$

3. Result and Discussion

3.1. Habitat Characteristics of Asian Tapir

Vegetation structure is a key factor reflecting Asian tapir habitat quality [13]. Overall, the vegetation analysis identified 42 families. The secondary forest exhibited greater species diversity than the shrubland, with 59 species. Shrubland contained only 31 species, with 28 species at the seedling stage. The vegetation diversity index values for the two ecosystems are presented in Table 1.

Table 1. Species diversity index (H') for two land cover types

Growth Stage	Secondary Forest	Shrubland
Seedling	2.84	1.71
Sapling	2.70	1.24
Pole	2.54	0.75
Tree	2.30	0

Table 1 shows that species diversity in secondary forests is higher than in shrublands, with values of 1.5 > H' < 3. Higher species diversity generally indicates a more complex ecosystem with greater ecological resilience and stability. Shrublands exhibit greater diversity, the tree growth stage has a value of 0. This is because there is only one tree species present, Sonokeling (*Dalbergia latifolia*). Research by [14] indicates that low species diversity is due to the area's vulnerability to disturbances. These conditions indicate that the environment can influence plant species diversity. The high species diversity at the seedling level in both ecosystems indicates that natural regeneration, ensuring sustainable food availability for Asian tapirs. Furthermore, seedlings are newly growing saplings with a height of less than 1.5 m, which tapirs can easily reach. This aligns with the study by [2], which found that Asian tapirs generally consume young, newly growing plants that are soft and easy to chew.

Secondary forests feature dense vegetation and rich biodiversity. Their vegetation structure provides a suitable habitat for Asian tapirs to survive. Vegetation analysis of the secondary forest identified 49 species in the seedling and understory layers, 26 species in the sapling layer, 25 species in the pole layer, and 23 species in the tree layer. The results of the IVI calculation show the dominant species at each growth stage as presented in Table 2.

Table 2. The importance value index of vegetation in the secondary forest in Rawa Bunder Resort

Growth Stage	Local Name	Scientific Name	IVI (%)
Seedling	Senduduk Bulu	*Clidemia hirta*	24.65
	Paku Rane	*Selaginella plana* (Desv.) Hieron	23.85
	Soka*	*Ixora* sp.	17.96
Sapling	Berasan*	*Symplocos stenosepala*	26.75
	Jambon*	*Syzygium sp.*	23.63
	Soka*	*Ixora* sp.	23.63
Pole	Berasan*	*Symplocos stenosepala*	76.17
	Puspa	*Schima wallichii*	52.66
	Teluntum	*Lumnitzera racemose*	23.61
Tree	Puspa	*Schima wallichii*	93.74
	Berasan*	*Symplocos stenosepala*	34.10
	Parutan	*Cleistanthus sumatranus*	21.44

Note: *) food plants

The seedling layer was dominated by *Clidemia hirta*, *Selaginella plana* (Desv.) Hieron, and Ixora sp., with Clidemia hirta having the highest IVI value of 24.65%. *Clidemia hirta* is an invasive alien plant species with high competitive ability for light and growing space [15]. This indicates that *Clidemia hirta* can compete by taking up light and growing space away from other species, thereby dominating ecosystems that limit the growth of tapir food plants. The dominant species at the sapling stage are *Symplocos stenosepala*, *Syzygium sp.*, and Ixora sp.. These three species are Asian tapir food sources, and their dominance at the sapling stage indicates adequate food availability for Asian tapir in secondary forests. The pole layer is dominated by

Symplocos stenosepala with an IVI of 76.17%. The dominant species at the tree level are *Schima wallichii*, *Symplocos stenosepala*, and *Cleistanthus sumatranus*. *Symplocos stenosepala's* presence at the sapling, pole, and tree levels suggests that this Asian tapir food source possesses strong adaptive capabilities, enabling it to grow up to the tree level. The presence of trees at the tree level can support the availability of seedlings and saplings as food plants for Asian tapirs.

Shrubland has open, uniform vegetation with little species diversity and provides only minimal shade in some areas, resulting in relatively high temperatures. Vegetation cover is essential for Asian tapirs to protect them from direct sunlight. Vegetation analysis of the shrubland identified 28 species in the seedling and understory layers, 4 species in the shrub layer, 3 species in the tree layer, and 1 species in the canopy layer. The results of the IVI calculation show the dominant species at each growth stage as presented in Table 3.

Table 3. The importance value index of vegetation in the shrubland in Rawa Bunder Resort

Growth Stage	Local Name	Scientific Name	IVI (%)
Seedling	Alang-Alang	*Imperata cylindrica*	72.37
	Senggani*	*Melastoma malabathricum*	18.34
	Kirinyuh*	*Chromolaena odorata*	18.10
Sapling	Puspa	*Schima wallichii*	73.33
	Sungkai	*Penorema cenescens*	61.67
	Salam*	*Syzygium polyanthum*	36.67
Pole	Puspa	*Schima wallichii*	197.98
	Sonokeling	*Dalbergia latifolia*	81.20
	Deluak	*Grewia paniculate*	20.81
Tree	Sonokeling	*Dalbergia latifolia*	300

Note: *) food plants

The dominant species at the seedling stage include *Imperata cylindrica, Melastoma malabathricum*, and *Chromolaena odorata*. *Imperata cylindrica* is classified as an invasive species on post-fire land [16]. Additionally, *Imperata cylindrica* cannot grow in shaded areas [17]. The dominance indicates degraded scrubland conditions with open areas and minimal shade. Nevertheless, Imperata cylindrica is a potential food source for tapirs and is abundantly available. *Melastoma malabathricum* is also a food plant of the Asian tapir, but traces of it have been found only in secondary forests, even though it is quite abundant in shrubland. Schima wallichii, Peronema cenescens, and Syzygium polyanthum dominate the sapling stage. *Syzygium polyanthum* is the only Asian tapir food species found to dominate the sapling stage. *Syzygium polyanthum* is known to have high ecological tolerance, including its ability to survive under marginal soil conditions [18]. Schima wallichii dominates the pole layer with an IVI of 197.98%. At the tree stage, only one plant species, Dalbergia latifolia, is present. Schima wallichii and Dalbergia latifolia are among the plant species selected for planting activities as part of ecosystem restoration efforts. *Schima wallichii* has thick bark, making it fire-resistant. When a tree falls, new shoots will quickly grow back when the rains come [19]. *Dalbergia latifolia* is a plant that adapts well to its environment, whether in dry or moist soil conditions [20].

Food plants of the Asian tapir were determined based on observations of feeding traces and information from Forest Police and FEM personnel who served as field assistants in the vegetation analysis. The research identified 33 food plants from 25 families. Research conducted at the Way Kanan Resort by [4] identified 15 types of food sources belonging to 9 families: Phyllanthaceae, Vitaceae, Lecythidaceae, Malvaceae, Dilleniaceae, Verbenaceae, Rubiaceae, Melastomataceae, and Lauraceae. The Asian tapir food species in the Rawa Bunder Resort are presented in Table 4.

The observations show that 7 plant species are used as feed, including *Symplocos stenosepala, Aquilaria malaccensis, Helicia* sp., *Melastoma malabathricum*, *Ixora* sp., *Syzygium* sp., and *Neolitsea zeylanica*. Based on [4] research, only the Verbenaceae and Lecythidaceae were not found in Rawa Bunder Resort. Research by [2] reported that the Moraceae family dominates Asian tapir feed. However, Moraceae species were not recorded in the present study. Moraceae is considered ecologically significant due to its dominance as a plant family and its role in supporting frugivorous animals through food provision [21]. Based on information from FEM, Asian tapirs prefer sap-producing plants that do not emit a strong odor. One sap-producing plant found as foraging evidence is *Aquilaria malaccensis*. Other sap-producing plants include *Alstonia scholaris*. Asian tapir preference for plants that do not emit a strong odor is also reflected in the discovery of *Syzygium* sp., and *Neolitsea zeylanica*.

Furthermore, the Asian tapir also prefers *Symplocos stenosepala*, with 12 feeding traces found. *Symplocos stenosepala* is an endemic species in WKNP. Fruit-bearing plants follow the patterns of the rainy and dry seasons. For example, *Nephelium lappaceum* generally bears fruit during the rainy season, so its availability increases during that period. According to [2], Asian tapirs consume grasses, young leaves, shoots, young twigs, and fruits. This aligns with the dominant foraging traces found, which consist of young leaves. Asian tapirs are selective in their food choices. They tend to select high-quality plants as food, as young plants in secondary forests have high levels of nutrients and protein in their shoots and leaves [2]. This supports the study's findings because these plants can meet Asian tapirs' energy needs for daily activities.

Table 4. Potential food plants of Asian tapir

No	Local Name	Scientific Name	Family	Edible Parts	Habitat	
					SF	SL
1	Alang-alang	*Imperata cylindrica*	Poaceae			✓
2	Bayur	*Pterospermum diversifolium*	Malvaceae		✓	
3	Berasan*	*Symplocos stenosepala*	Symplocaceae	Leaves	✓	✓
4	Blimbingan	*Rourea minor*	Connaraceae	Leaves, stems, fruit	✓	
5	Cincauan	*Cyclea barbata*	Menispermaceae		✓	
6	Gaharu*	*Aquilaria malaccensis*	Thymelaeaceae		✓	
7	Jambon*	*Syzygium sp.*	Myrtaceae	Leaves, seeds	✓	✓
8	Kalopo	*Calopogonium mucunoides*	Fabaceae			✓
9	Karetan	*Hevea brasiliensis*	Euphorbiaceae	Leaves, bark	✓	
10	Keladi	*Caladium sp.*	Araceae	Leaves	✓	
11	Kelandri	*Eurya nitida* Korth.	Mimosaceae			✓
12	Ki teja	*Cinnamomun iners*	Lauraceae	Leaves	✓	
13	Kopian	*Ixora glume*	Rubiaceae		✓	
14	Krakas*	*Helicia sp.*	Proteaceae	Leaves	✓	
15	Laban	*Vitex sp.*	Lamiaceae	Leaves	✓	
16	Medang	*Aporosa confusa*	Euphorbiaceae	Leaves, stems	✓	
17	Meniran	*Xanthophyllum flavescens*	Polygalaceae		✓	
18	Mundu	*Garcinia nervosa*	Clusiaceae		✓	
19	Paku hata	*Lygodium circinatum*	Schizaeaceae			✓
20	Paku rambat	*Lygodium sp.*	Schizaeaceae			✓
21	Pelangas	*Aporosa octandra*	Phyllanthaceae	Leaves	✓	
22	Pulai	*Alstonia scholaris*	Apocynaceae	Leaves, bark, fruit	✓	
23	Rambutan	*Nephelium lappaceum*	Sapindaceae	Fruit	✓	
24	Rumput gajah	*Pennisetum purpureum*	Poaceae			✓
25	Rumput paitan	*Paspalum conjugatum*	Poaceae	Leaves, stems		✓
26	Rumput teki	*Cyperus rotundus*	Cyperaceae		✓	
27	Salam	*Syzygium polyanthum*	Myrtaceae		✓	✓
28	Sempu air	*Dillenia*	Dilleniaceae		✓	
29	Senggani*	*Melastoma malabathricum*	Melastomataceae	Leaves	✓	✓
30	Soka*	*Ixora sp.*	Rubiaceae	Leaves	✓	
31	Sulangkar	*Leeea indica* Merr.	Vitaceae		✓	
32	Tiga urat*	*Neolitsea zeylanica*	Lauraceae	Leaves	✓	
33	Waru	*Hibiscus tiliaceus*	Malvaceae		✓	

Note: *) signs of food plants

Suitable environmental conditions support vegetation that meets the Asian tapir's dietary needs. The results of observations on Asian tapir habitat characteristics across two land cover types are presented in Table 5.

Table 5. Habitat characteristics of Asian tapir in Rawa Bunder Resort

No	Habitat Factor Conditions	Habitat Characteristics	
		Secondary Forest	Shrubland
1	Temperature (°C)	27 – 36	29 – 42
2	Canopy Cover (%)	Dense (>70)	Moderate (70-40) – Sparse (<40)
3	Feed Availability (%)	Abundant (>75)	Low (0-25)
4	Slope (%)	Flat (0-8)	Flat (0-8)
5	Elevation (masl)	25.30 – 40.61	34.30 – 40.53
6	Distance from water (m)	213.87 – 1219.6	15.28 – 396.28
7	Distance from road (m)	0.52 – 573.5	3.04 – 171.26

Temperatures in secondary forests tend to be cooler than in shrubland, ranging from 27°C to 36°C. Temperatures in the shrubland reach over 40°C. According to [2], temperature is a major factor influencing Asian tapir habitat selection. These results contradict the study by [22], which found that Asian tapir presence tends to be low at temperatures above 25–26°C. Research by [2] also shows differing results, noting that Asian tapirs are found at temperatures of 32–37°C and are less common when temperatures are below 32°C or above 37°C. These differences may be attributed to variations in geographical and environmental conditions. However, it can be said that Asian tapirs prefer habitats with cool temperatures, as they can tolerate up to 38°C. Under high-temperature conditions, Asian tapirs tend to be active at night to maintain their body temperature and choose humid habitats [2]. A study by [6] found that Asian tapirs in WKNP are more active at night. This may indicate that Asian tapir habitats in WKNP tend to be hot and dry. However, Asian tapirs are generally more active at night to avoid predation and human disturbance.

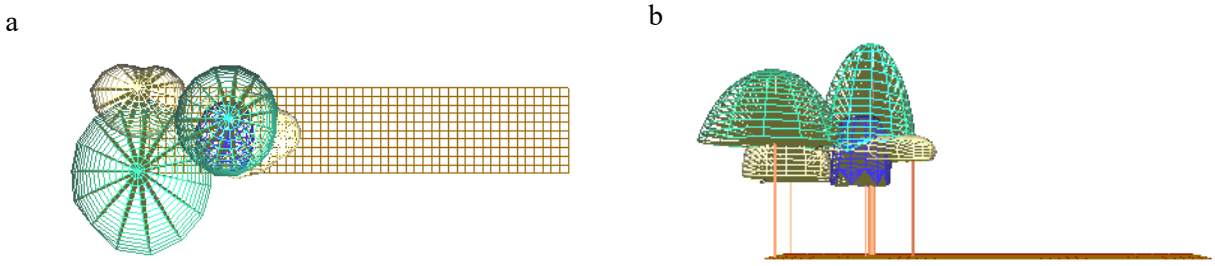

Figure 3. Canopy cover in secondary forest (a) top view; (b) front view

Canopy cover in secondary forests is dense (>70%), whereas shrubland cover varies, ranging from moderate (70%–40%) to sparse (<40%). According to [13], Asian tapirs tend to prefer habitats with dense canopy cover because these environments offer cool, humid conditions. Additionally, dense canopy cover serves as shelter from disturbances and provides shade for activities and rest [23]. These conditions also maintain environmental humidity, particularly in the soil, which supports the growth of vegetation serving as Asian tapir forage. [13] state that the Asian tapir species selects habitats based on two factors: food availability and water sources. As shown in Table 5, food availability in secondary forests is abundant (>75%) compared to shrublands (0–25%). This finding is consistent with the fact that all 26 species of Asian tapir foraging traces were found in secondary forests, whereas only 11 species were found in shrubland. This is supported by the research of [2], which noted that Asian tapirs are commonly found in secondary forests due to abundant food availability. Meanwhile, research by [7,8] found that shrubland has higher food availability than secondary forest. This food source is unstable and does not persist over time. In contrast, secondary forests are able to sustain a consistent supply of tapir food resources, which explains the higher and more stable foraging activity observed in these habitats.

According to [24], Asian tapirs prefer flat areas over those with steep topography and slopes. Observation and measurement results indicate that both locations have flat slopes (0%–8%). These findings align with the research by [3], which states that Asian tapir presence tends to increase in habitats with slopes of 0%–20%. Flat topography facilitates Asian tapirs in performing daily activities such as foraging, moving between locations, and accessing water sources. Research by [7] found evidence of Asian tapirs with a slope of 1%–17%. In several field observations, Asian tapir tracks were found heading along ridges and descending hills with relatively steep gradients of 25–40. Elevations at both locations are relatively similar. Both are below 50 masl, which falls within the elevation range of WKNP. During the observation period, the highest number of

Asian tapir activity traces was found on trail 2 at an elevation of 31.60 masl. [24] found Asian tapir at elevations below 300 masl, with the highest number of sightings at 183 masl. [7] identified 6 Asian tapir resting sites in the primary forest at an elevation of 222.50 masl. Areas with gentle slopes and low elevations generally have high humidity, which supports the growth of young vegetation that serves as a food source for Asian tapir.

Water sources in secondary forests are located farther away than those in shrubland. During the study, only two water sources that could be used by Asian tapirs were found: one on Trail 2 in the secondary forest and one on Trail 4 in the shrubland. In the secondary forest, Asian tapir tracks were found in a descending area leading to a water source, located 213.87 m from the plot. This aligns with the research by [7], which categorizes the Asian tapir as a water-dependent species, meaning it relies on water for its daily needs. The presence of Asian tapir near the road indicates that the distance is not too far. The closest distance from Asian tapir activity traces, specifically feeding traces, was found at 1.74 m from the road. Feces and tracks were found 101.45 m from the road. These results contradict previous studies that found that Asian tapir presence increases with increasing distance from the road [1,13]. Meanwhile, this aligns with the study by [24], which found a higher presence of Asian tapir at closer distances from the forest edge. This may be influenced by the abundance of food, which increases Asian tapir activity in the area despite its proximity to the road, potentially leading to interactions with humans.

3.2. Distribution of Asian tapir

Asian tapirs exhibit a clustered spatial distribution based on activity tracks. This pattern is related to the availability of resources concentrated in specific areas. This situation indicates that their activities are concentrated in areas that can meet their basic needs. All traces of Asian tapir activity are present in Figure 4.

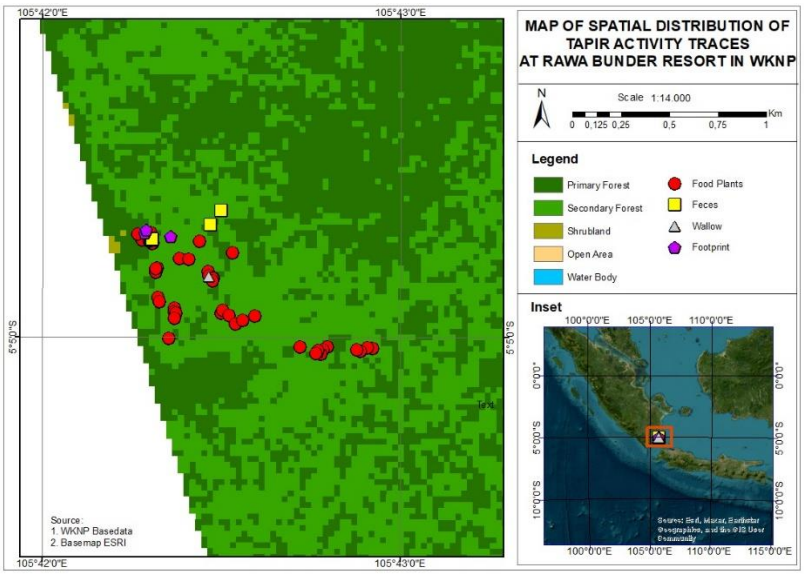

Figure 4. Asian tapir distribution based on activity traces

The results of the study indicate that Asian tapirs in WKNP use secondary forests more frequently than shrubland for their activities. The number of Asian tapir activity tracks found is presented in Table 6.

Table 6. Number of Asian tapir activity tracks

Tracks of Asian tapir Activity	Habitat Type
	Secondary Forest
Feces	9
Footprint	10
Food plant	36
Wallowing site	1
Total	56

The observations indicate that no direct encounters occurred and that no new signs of activity were found at the site during the study period. The signs of activity found consisted primarily of feeding traces, totaling

36. The high number of feeding traces in the secondary forest suggests that abundant food availability supports Asian tapir activity.

Feces were found not far from a water source, in close proximity to other feces. This aligns with [25], which states that defecation tends to occur at the same location. The size of the Asian tapir feces ranged from 16 to 18 cm. This suggests that the feces came from an adult individual. The decomposed Asian tapir feces resembled a pile of twig litter. This proves that Asian tapirs eat young shoots. Furthermore, seeds were found in Asian tapir feces, indicating that Asian tapirs also consume fruits. These findings support the conclusion that Asian tapir act as seed dispersers. [25] explain that all tapir species consume fruit and function as both seed dispersers and seed predators through the excretion of feces.

Figure 5. Feces of Asian tapir

Footprints were found only on Trail 2, Plot 1, at 10 locations, 9 of which were clustered together and accompanied by feeding traces. Meanwhile, one location was on the path leading to a water source. According to [23], Asian tapirs are constantly on the move in search of food and do not remain stationary. Based on the measurement results, the footprint sizes ranged from 12 to 16 cm. [23] The study identified footprints measuring 12 cm and 16 cm, believed to belong to an adult and a juvenile, respectively. This suggests that footprints measuring 12–13 cm belong to juveniles, while those measuring 16 cm belong to adults, given their larger size.

Figure 6. Footprint of Asian tapir

Foraging traces were found along all trails in the secondary forest. Asian tapir foraging traces were identified based on the presence of bite marks and twisted branches. The types of forage plants where feeding traces were found include Symplocos stenosepala, Melastoma malabathricum, Aquilaria malaccensis, Helicia sp., Ixora sp., Syzygium sp., and Neolitsea zeylanica. According to [2], Asian tapirs forage within their home range and return to the same location every 90–100 days. The large number of feeding traces found indicates that Asian tapir activity is dominated by foraging. This aligns with [2], which states that Asian tapirs are leaf-eating animals that spend up to 90% of their active time foraging.

Figure 7. Food plants of Asian tapir

Only one wallow was found on Trail 2. This wallow was inactive. This conclusion was based on the absence of footprints and feces around the wallow. Wallowing is one of the activities Asian tapirs typically engage in in muddy areas. Wallowing helps Asian tapirs maintain skin moisture to prevent dryness and protects their skin from insects by rubbing their bodies in the mud, which helps prevent irritation. Wallowing is usually followed by defecation and urination in the wallow [26].

Figure 8. Wallowing site of Asian tapir

3.3. The Relationship Between Habitat Characteristics and the Distribution of Asian tapir

Asian tapirs consider various habitat characteristics when selecting their habitats. The habitat characteristics analyzed as they are suspected to influence Asian tapir habitat selection include slope, elevation, canopy cover, distance from water sources, and distance from roads. Since Asian tapirs are found exclusively in secondary forests, only two parameters, distance from water sources and distance from roads, could be analyzed because data for them were available for chi-square testing.

All traces of Asian tapir activity were found on flat slopes (0–8%), suggesting that Asian tapir prefer flat slopes for their activities (Figure 9). Furthermore, the absence of activity traces on slopes classified as moderate (8–15%), moderate steep (15–25%), steep (25–40%), and very steep (>40%) may be attributed to the Asian tapir's relatively large body size, which tends to lead it to choose flat terrain to facilitate movement during its activities.

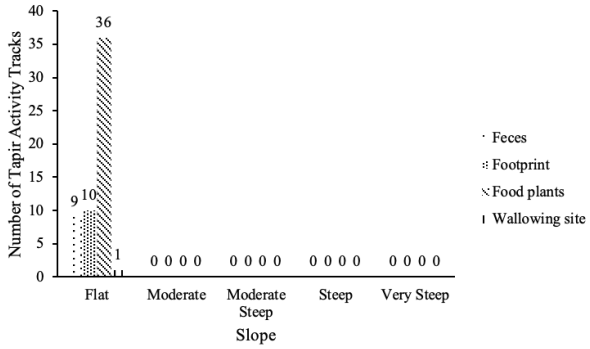

Figure 9. Number of activity tracks based on slope

All signs of Asian tapir activity were found at moderate elevations (25–50 masl) (Figure 10). According to [5], Asian tapirs can be found at elevations below 600 masl, indicating that Asian tapirs possess a high degree of adaptability to the topographic conditions of their habitats. Additionally, relatively low elevations generally have higher humidity and denser vegetation, which support the forage plants that Asian tapirs require.

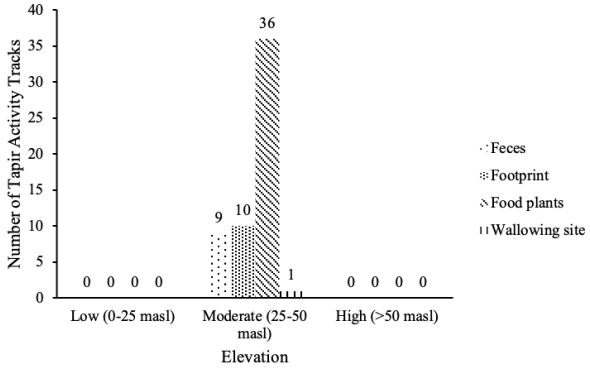

Figure 10. Number of activity tracks based on elevation

Canopy cover influences the presence of Asian tapir activity traces. All activity traces were concentrated in secondary forests, where canopy cover was dense (>70%) (Figure 11). The absence of Asian tapirs in shrublands is attributed to the lack of shade, which leads to higher temperatures. According to [1], Asian tapirs tend to prefer habitats with dense canopy cover. Furthermore, canopy cover is generally associated with the presence of water bodies, which tapirs utilize as resting and defecation sites, as well as for ectoparasite avoidance by wallowing [27].

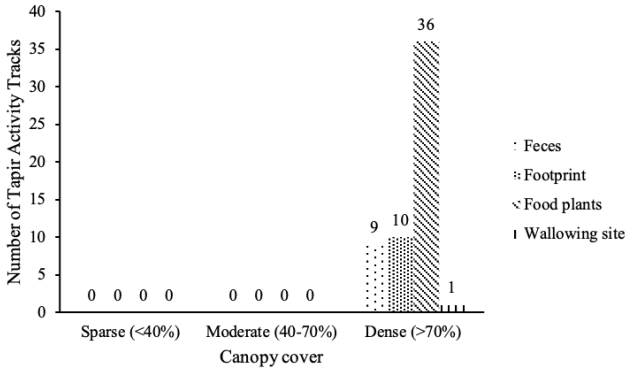

Figure 11. Number of activity tracks based on canopy cover

The chi-square calculation yielded a calculated χ^2 value (13.704) > table χ^2 value (12.592). These results indicate a relationship between distance from water sources and Asian tapir activity traces. Asian tapir activity

traces were most frequently found in habitats located within a range of 0–500 m from water sources. Only at distances >1000 m from water sources were no traces of Asian tapir activity found (Figure 12). Research by [28] found Asian tapir footprints 50 m from the edge of a lake, suggesting an Asian tapir trail leading to the lake for drinking. This is supported by [29], which reported that Asian tapir occurrence increases in habitats located near water sources. In addition to drinking, Asian tapirs rely on water for other activities such as wallowing and defecating [26]. Water sources are also used to avoid or escape from predators [27].

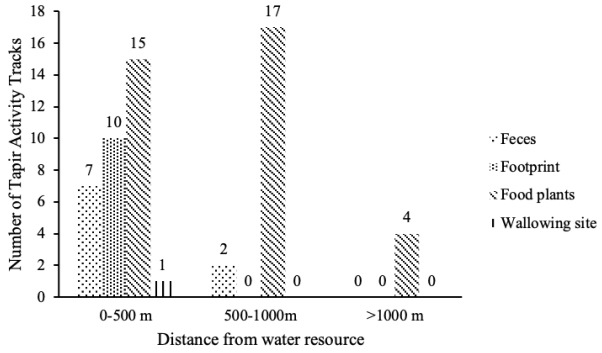

Figure 12. Number of activity tracks based on distance from the water resource

The chi-square calculation yielded a calculated χ^2 value (10.831) < table χ^2 value (12.592). These results indicate no association between distance from the road and Asian tapir activity traces. The majority of activity traces were found within a distance range of 0–500 m, totaling 54. The other two activity traces located 500–1000 m from the road were feces (Figure 13). [30] state that the Asian tapir presence increases with distance from the road, as Asian tapirs tend to avoid disturbances. This may be influenced by the abundance of food available in the area.

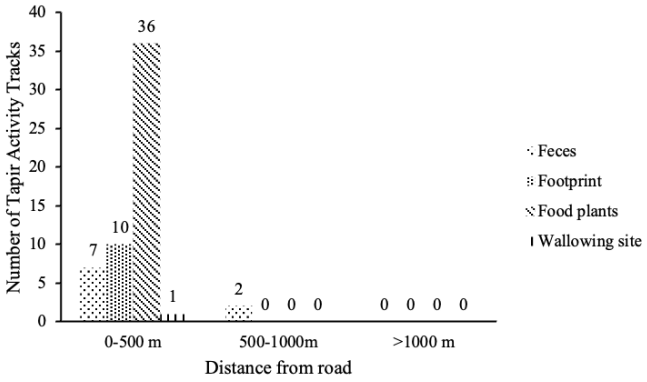

Figure 13. Number of activity tracks based on distance from the road

3.4. Implications for Asian tapir Conservation

Tapirs were primarily concentrated in secondary forests with high vegetation diversity and dense canopy cover, underscoring the importance of maintaining these habitats. Conservation efforts should prioritize protecting secondary forests from encroachment, illegal hunting, and other human disturbances. Habitat management should also include enrichment planting of key food plant species in shrubland areas and the protection of water sources to improve habitat quality. These measures, supported by regular forest patrol and community awareness programs, are essential for ensuring the long-term conservation of Asian tapir populations. Regular forest patrols can be supported by implementing the SMART Patrol system to improve monitoring effectiveness [31].

4. Conclusion

Habitat characteristics of Asian tapir in the Rawa Bunder Resort of WKNP indicate that Asian tapir are found in secondary forests with high vegetation diversity, cool temperatures (27–36°C), dense canopy cover, abundant food availability (>75%), flat slopes (0–8%), elevation (25–50 masl), and proximity to water sources

(0–500 m) and roads (0–500 m). The research identified 33 food plants, with 7 types showing signs of consumption, including *Symplocos stenosepala, Melastoma malabathricum, Aquilaria malaccensis*, *Helicia* sp., *Ixora* sp., *Syzygium* sp., and *Neolitsea zeylanica*. The spatial distribution of Asian tapirs forms a clustered pattern based on the presence of feces, footprints, food plants, and wallows. Asian tapir distribution is associated with distance from water sources, but not with distance from roads. These findings highlight the importance of protecting secondary forests, maintaining food resources and water availability, and strengthening regular patrols to minimize human disturbance and support long-term Asian tapir conservation.

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