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COHABITATION THE TRICOLOUR LANGUR AND MULLER'S GIBBON IN PULAU MAJANG RESORT, DANAU SENTARUM NATIONAL PARK

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ABSTRACT

The interaction between Presbytis chrysomelas ssp. cruciger and Hylobates muelleri which occurs due to the utilization of the same resources has caused the two primates to cohabitate in the Majang Island Resort Area. Information regarding resource use by cohabiting species is very important for their conservation management. The aims of this research are to identify common niches between P. chrysomelas and Muller's gibbon, to analyze the niche overlap and niche breadth; to find out the forms of spatial cohabitation and the factors that cause cohabitation. Data collection was carried out from July to December 2021. Cohabitation was identified in the use of vertical and horizontal space which is closely related to the availability of feed for both primates. There is overlapping home ranges between the P. chrysomelas and Muller's gibbon at the study site covering an area of 9.93 ha, and only B stratum (trees with a height of 18 – 30 m) which are used jointly for activity by both primates. The Jaccard index for the association of vertical space use for P. chrysomelas and Muller's gibbon is 0.33 while the Jaccard index for the number of forage plant species is 0.50. P. chrysomelas ecological niche overlaps 116% with Muller's gibbon and the H.muelleri ecological niche overlaps 65% with P. chrysomelas's. Calculation of the ecological niche area of P. chrysomelas is FT = 0.65335, the lower limit and upper limit value is 0.27033 ≤ FT ≥ 0.91288. Meanwhile, for the Muller's gibbon, the value is FT = 0.46454, the lower and upper limits are 0.04483 ≤ FT ≥ 0.79644.

Key words: *Cohabitation, Danau Sentarum, Tricolour langur, Muller's gibbon*

INTRODUCTION

Danau Sentarum National Park is a natural conservation area that occurs natural habitat for Tricolour langur (*P.c* ssp *cruciger*). Various ecosystems, including swamp forests, lowland forests, and heath forests, serve as critical areas for conservation in Kalimantan (Rosalinda 2019). Its suitable habitat and hydrological conditions make the DSNP a home to many endangered and protected species, especially the Tricolour langur (*P.c* ssp. *cruciger*) and the Muller's gibbon (*H. muelleri*). Based on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List, the Tricolour langur is included in the conservation status at the Critically Endangered (CE) level. In contrast, Muller's gibbon is Endangered (EN). Moreover, the state also protects the Tricolour langur and Muller's gibbon based on Minister of Environment and Forestry Regulation No. P.106 of 2018 Concerning Protected Wild Plants and Animals.

Majang Island Resort Area, DSNP becomes one of the habitats for Tricolour langur and Muller's gibbon, according to Odum (1971) and Schreier *et al*. (2009) in Santosa *et al*. (2012) state that the presence of different species in one habitat has the potential for utilization of the same resources, both space and feed by their respective ecological niches. Tricolour langur and Muller's gibbon interact and have the same way of life. The interspecific interaction between the two primates is a cohabitation interaction because both live sympatrically by sharing shared resources in the Majang Island Resort Area, DSNP. According to Waikidi (2013), cohabitation species share their help in the form of differences in the use of space in the habitat, methods of finding food, choosing food, and activity patterns. Interspecific interactions within and between different taxa groups are important in species distribution and community structure.

A cohabitation study of Tricolour langur and Muller's gibbon in their habitat needs to be conducted to analyze the potential for using the same resources in the Majang Island Resort Area. Research carried out (Hidayat 2022) is the cohabitation of Tricolour langur with *Macaca fascicularis* in the Bukit Semujan area of the DSNP. However, at the Majang Island location, research has yet to be conducted on cohabitation between Tricolour langur and Muller's gibbon. There is still not much data on cohabitation, so studies related to space use and utilization of food sources for cohabitation species are very important considerations in making decisions about managing primate populations, their preservation and ecological conservation processes in nature. The objectives of this study were (1) to identify common niches between Tricolour langur and Muller's gibbon; (2) to analyze the magnitude of niche overlap and niche breadth; (3) to determine the forms of spatial cohabitation and the factors that cause cohabitation.

RESEARCH METHOD

The research was conducted at Majang Island Resort Area, Danau Sentarum National Park, West Kalimantan and field data collection was carried out from July to December 2021. The research location map is presented in

Figure 1. The tools used were the Global Positioning System (GPS), Microsoft Excel 2010, Arc GIS 10.8, time stamp camera, binocular lens, office stationery, stopwatch, compass, rope, measuring tape, range finder, tagging and thermohygrometer. Meanwhile the materials were tally sheet, administrative boundary map, and satellite image.

Spatial use data collection is carried out by recording direct encounters with animals based on spatial use and vegetation stratification which are divided into stratum A, B, C, D and E. Meanwhile, observation of activity uses the scan sampling method to obtain information regarding the duration and frequency of animal activity (Lambey *et al.* 2015). The scan sampling method was chosen because it is considered an excellent method to determine the behaviors and activities of all individual groups in a short time. Recording the activities of each individual in the group is carried out by continuous recording to record activities that occur from the frequency or duration of an activity. Data collection was carried out in the morning at 06.00 WIB when the primates woke up from the sleeping tree until 18.00 when they returned to their sleeping tree or when the animals were no longer carrying out their activities.

Descriptive analysis was carried out by studying literature from several journals or research results related to data and information related to this study. While the quantitative analysis is carried out as follows:

Data were analyzed descriptively and presented in graphical form on daily activity patterns of each langur and gibbon using the daily activity proportion percentage formula:

$$Percentage\ of\ i\ activity\ frequency = \frac{the\ amount\ of\ i\ activity}{total\ of\ all\ activities}\ x\ 100\%$$

Remarks:

i = type of activity performed

Analysis of vertical space utilization data was carried out descriptively from the results of encounters with Tricolour langur and Muller's gibbon in utilizing space and their activities. The data is then presented in the form of a histogram to determine the frequency of use of Tricolour langur and Muller's gibbon tree strata in their activities. According to Soerianegara and Indrawan (1998), vegetation strata are classified into:

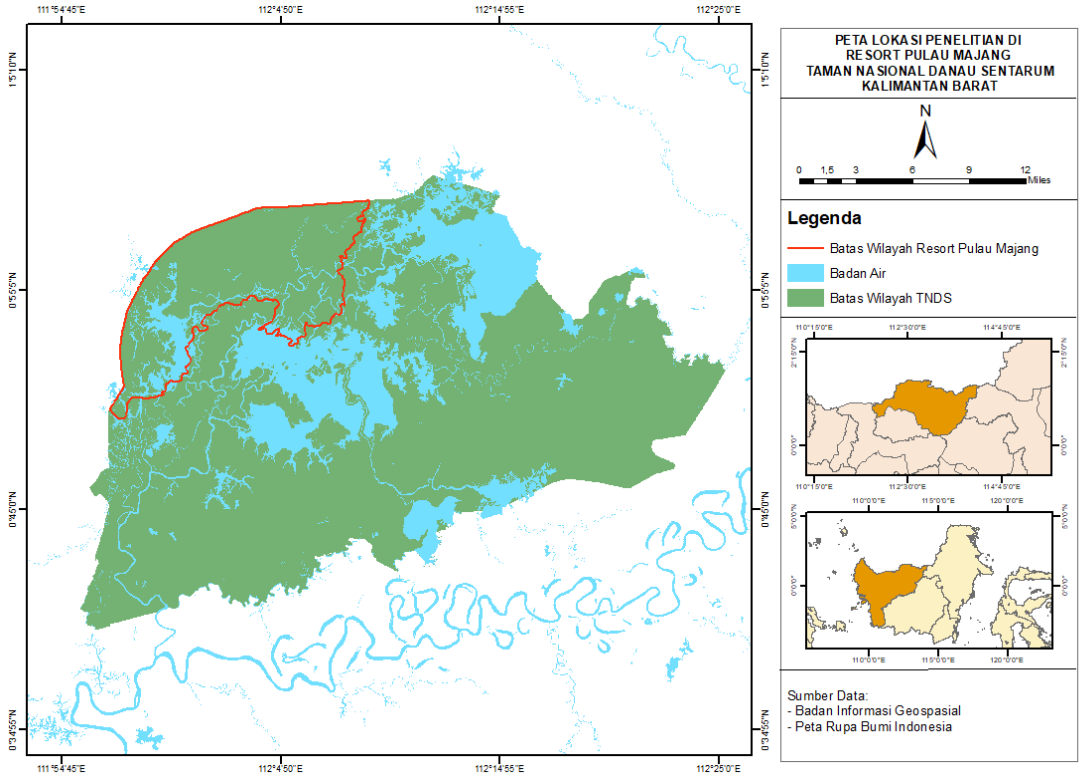


Figure 1 The research location map

Stratum A: trees with a height of > 30 meters.
Stratum B: trees with a height of 18-30 meters
Stratum C: trees with a height of 4-18 meters.
Stratum D: a layer of shrubs and shrubs with a height of 1-4 meters.
Stratum E: ground cover with a height of 0-1 meter.

Interspecific associations can be calculated using the Jaccard Index (JI) to determine whether there is an association between Tricolour langur and Muller's gibbon. The interpretation of the Jaccard Index values is presented in **Table 1** below.

Table 1 Jaccard Index Value

Value	Description
0	No association
=1	There is maximum association

The calculated interspecific associations include associations of plant species as food sources and associations with altitude of activity. Interspecific associations between langurs and gibbons were calculated using the Jaccard Index (JI). The choice of the Jaccard Index is because this index is more accurate and not biased in both large and small populations (Goodall 1967). The Jaccard index indicates whether there is an association between langurs and gibbons. Calculations are performed using the following formula:

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

Remarks:
a = the number of sampling units used by Tricolour langur and Muller's gibbon
b = number of sample units used only by Tricolour langur.
c = number of sample units used only by Muller's gibbon

Based on research conducted by Tohir (2016), the calculation of overlapping ecological niches was first put forward by Mac Arthur and Levins (1976) referred to in Krebs (1978):

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

Remarks:
Pip= the proportion of resources to the total resources used by Tricolour langur.
Pim= the proportion of resources to the total resources used by Muller's gibbon
Mpm= Overlap of langur niches with gibbon niches

Overlapping space use horizontally or home ranges is calculated using the area of overlapping niches by overlaying a map of the home ranges of langur colonies with gibbon colonies. Based on the overlay results of the two maps it will then show the overlapping areas.

Analysis of the niche breadth uses the Smith equation (1978) in Krebs (1982). The measurement of niche breadth is carried out by entering the presence of resources used by the species with the following formula:

$$FT = \sum(\sqrt{P_j} x a_j)$$

Remarks:
FT= Niche breadth
Pj= The proportion of resources used by individuals encountered
Aj=The proportion of j-resources to total resources

RESULT AND DISCUSSION

1. Horizontal Space Utilization

The use of horizontal space for wildlife can be analyzed by knowing their home ranges because they form a movement pattern in their habitat. Home range is an area that wild animals regularly visit because there are sources of food, drink and function as a place of refuge, sleeping and mating grounds (Alikodra 1990), so each wildlife has its own specific home range. A group of wildlife's home ranges can overlap with those of other adjacent groups. The area around the boundary zone is a group of adjacent territories. The term that can be used for this area is trespassing area (Kappeler 1981 in Ario et al. 2011). The overlapping maps and home ranges of Tricolour langur and Muller's gibbon are presented in Figure 2 below.

a. Tricolour langur's Horizontal Space Utilization

Langur's home range outside the national park area or inside the Majang Island Resort is 18.66 ha. The home range area is quite small because according to Supriatna (2000), the home range of one Tricolour langur species can reach and not exceed to 30 hectares. This can indicate that feed availability in a relatively narrow area is relatively abundant. According to Perdhana (2022), if the habitat conditions are supportive and have good forage vegetation continuity, the size of the langur area will be narrow and tend to stay within its range. According to Alikodra (2010), feed is the main factor that must be available to avoid competition and affect animal movements. Observations found that the composition of langur ranged from 5-12 individuals in one group observed in mixed forests. This composition is more minor compared to research conducted by Musyaffa (2020) on Semujan Island, where the langur group in the area can be 10-20 individuals. Dense vegetation and tall stands are the leading choices for determining a langur home range.

b. Muller's gibbon's Horizontal Space Utilization

The home ranges of Tricolour langur and Muller's gibbon overlap by 9.93 ha. The gibbon's home range is larger than the langur's home range because the langur's needs have been met in a smaller area, so there is no need to look for another location to meet their food needs (O'Brien and Kinnaird 1997). Another factor is the smaller body size of langurs compared to gibbons, so their home ranges tend to be smaller. This is in line with the opinion of Whitten (1982), who states that the factors that influence the range of wildlife home ranges include group size and composition, habitat characteristics such as species and distribution as well as forage tree phenology, topography, slope and altitude, species competition and human activity. There is an overlap between the home ranges of langurs and gibbons due to similarities in resource use. However, there is no competition between the two that causes conflict because, in general, wildlife tends to prefer to use their energy efficiency to carry out other daily activities.

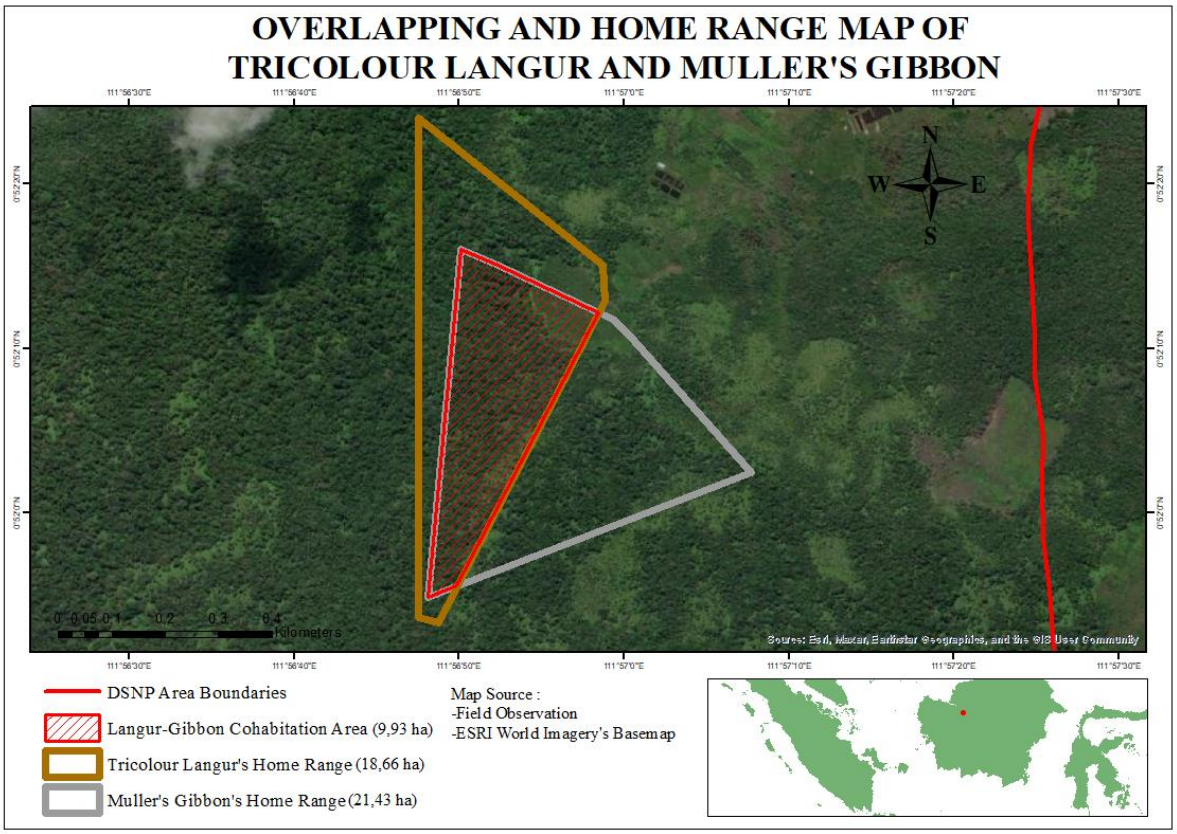


Figure 2 Langur-Gibbon overlapping and home range map

Muller's gibbon on Majang Island has a home range of 21.43 ha. This area is smaller than other Hylobates species, such as the Javan gibbon (*Hylobates moloch*) in Mount Halimun Salak National Park, which has an average home range of 33.41 ha based on research conducted by Dewi (2016). However, this area is larger than the average range of the Javan gibbon in Mount Gede Pangrango National Park, which is only 10.6 ha (Saputra 2020). One of the differences in home range area is influenced by the state of environmental resources (Bennett and Davies 1994). The Hylobates group generally consists of 4 individuals because they are monogamous primates led by one adult male (Rowe 1996); (Saputra 2020). This follows the field meeting data, where three groups of gibbons consisted of 5 individuals (adult males and their offspring) and were led by an adult male to look for food sources. The large colony size also affects the area of its home range; the more significant the group size, the more efficient it is in finding and controlling food sources. In addition, these animals' movement is influenced by their feed distribution (Wakidi 2013).

2. Vertical Space Utilization

a. **Tricolour langur's Vertical Space Utilization**

Tricolour langur activity tends to be more common at altitudes of 4-18 meters (stratum C) with a percentage of 88%. Activities often carried out by langurs in stratum C is social because the canopy intersects with each other and has many branches making it easier for langurs to play, lice and other social activities. In addition, stratum C makes it easier for langurs to move and avoid predators. This is in accordance with the statement of Suryani (2016), that langurs need tree crowns to shelter and adapt to changes in weather. Whereas stratum B is rarely used in carrying out langur's activities. The percentage of vertical space used for Tricolour langur is presented in Figure 3 below.

Tricolour langur are rarely found at an altitude of 18-30 meters (stratum B) at the study site. This is in accordance with Musyaffa's research (2020), where Tricolour langur in the Semujan area use more stratum B and C in their activities. The results of observations made langurs were not found in stratum A due to the sparse vegetation with a height of >30 m at the study site. While D and E levels were not found because langurs tend to avoid predators. According to Wakidi (2013), wild animals selection of stratum height depends on the availability of food sources.

b. Muller's gibbon Vertical Space Utilization

Most of the gibbons observed in Majang Island Resort, Danau Sentarum National Park were found at an altitude of 18-30 meters (stratum B) and less were found at altitudes above 30 meters (stratum A) (Figure 3). This shows a difference in the use of vertical space between

langurs and gibbons, where langurs carry out more activities in stratum C while gibbons are more active in stratum B. The utilization of trees at that height are accompanied by vocal activities while performing acrobatic movements. This is in line with research conducted by Dewi (2016) on gibbons at the Cikaniki Resort, which found that the majority of gibbons often use trees with a height of 21-30 meters due to the presence of a food source, namely ficus fruit. Meanwhile, trees with a crown above 30 meters apart from food trees are also used by gibbons as sleeping trees. Gibbons are primates who like to rest and sleep in the highest tree crowns among the surrounding trees, which this layer receives a lot of sunlight (Ario *et al*. 2011; Iskandar. 2007).

Gibbons rarely or even almost do not use trees below 11 meters because the source of food for gibbons is tall trees that bear fruit and lianas attached to these trees. Gibbons likes areas with tall vegetation of trees, tight crowns and interconnected canopies to carry out branchial movements or jump from one tree branch to another. In addition, trees at that height also play a role in protecting them from predators. According to Phoonjampa *et al*. (2010) in Saputra (2020), the selection of sleeping trees has several criteria, namely difficult access for predators, providing a safe way out for prey, must be tall, straight tree trunks and free from low branches.

3. Daily Activities

a. Tricolour langur Daily Activities

Langurs start their activities and wake up from their sleeping tree at 5:00 – 10:00 WIB and return to their sleeping tree at 14:00 – 18:00 WIB. It was observed that the highest activity was social activity with a proportion of 42.65%. The high proportion of social activity is due to the many times when langurs vocalize with their group whenever they are isolated to look for food trees. In addition, visible activities include playing, loquacious and sexual. Social behavior is only observed at any time when langur is not aware of the observer. In this case, the presence of the observer is known by the alpha male, hence, the langur responds in the form of vocalizations as a warning sign to other individuals as a form of threat and shows agonistic behavior towards the presence of observers. The second highest activity is moving activity which is often found in the morning and late afternoon with a proportion of 22.06%. This is because langur move more to find food sources at that time. The percentage of daily activity of the Tricolour langur is presented in Figure 4 below.

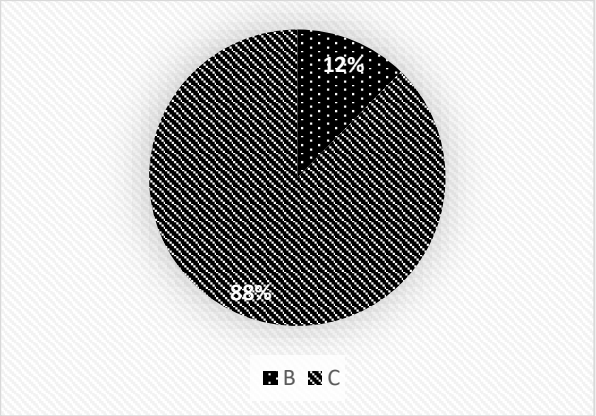


Figure 3 Percentage use of Tricolour langur's vertical space

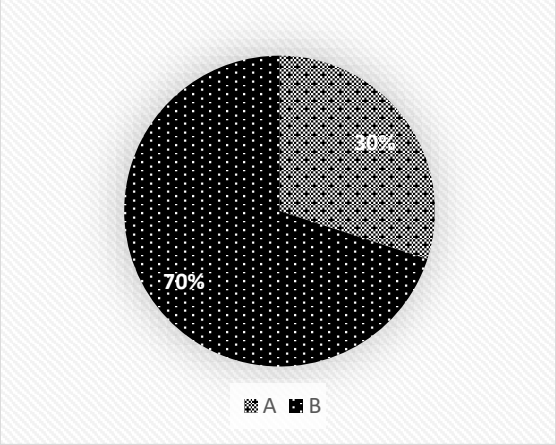


Figure 4 Percentage use of Muller's gibbon vertical space

Tricolour langur eat fruit and seeds (Nijman *et al*. 2008; Ehlers-Smith *et al*. 2014). This is evidenced by the results of observations at the study site, where the frequency of fruit was higher than eating leaves, flowers and insects. This is in line with research conducted by Laksmitha (2022) and Musyaffa (2020), who also found that the fruit is the main feed to langur. The percentage of eating activity of langur was 20.59% and the types of fruit that were often consumed were from the *Sapindaceae* and *Clusiaceae* families, such as *Nephelium* sp., *Nephelium maingayi* and *Garcinia tetrandra*. Tricolour langurs rarely use parts of the leaves at the study site. The Tricolour langur only eats the *Polyalthia insignis*'s leaves. Most resting activities are carried out during the day from 10.00-14.00. Tricolour langurs start to rest when the temperature increases and after eating activities. This is to the statement of Prayogo (2006) that the resting activity of langurs is influenced by temperature, where at relatively high temperatures langurs rest more under the tree canopy for shelter as well as a form of energy efficiency.

b. Muller's gibbon Daily Activities

The daily activities seen during the Muller's gibbon observation consisted of eating, moving and socializing. Like langurs, gibbon activities begin with social activities such as calling, which is done in the morning at 08.00. During the observation, the gibbon's daily activities were only seen in the morning, while there were no encounters with gibbons in the afternoon and evening. It can be seen in **Figure 6** that the activity with the highest percentage is moving 47.8%, while eating and socializing are 26.1%.

The pattern of activity and daily activity of gibbons begins with waking up in the morning on average at 06.00 WIB with the first activity and behavior, namely defecating, urinating and making sound activities, then continuing with searching for food, and in the afternoon looking for sleeping trees to sleep all night on at 18.00, where the average active time of gibbons is approximately 11 hours (Rahman. 2011; Purwanto. 1992). Gibbon daily activities can differ depending on the habitat they occupy; according to Rahman (2011), who researched gibbon daily activities and behaviour between the Rasamala Forest and Primate Animal Study Center, IPB, there is a slight difference in gibbon activity in both locations in terms of time starting the morning activities, eating and when resting.

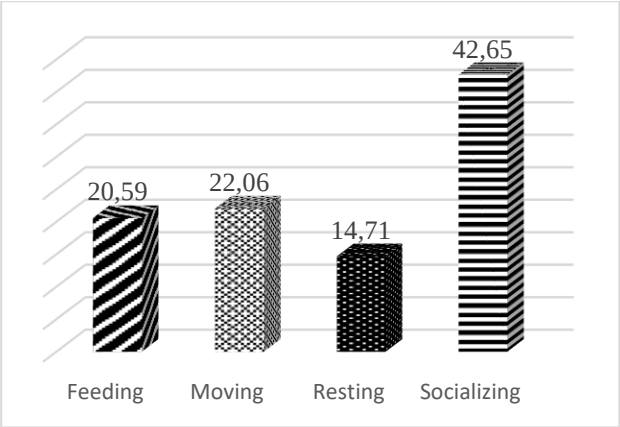


Figure 5 Tricolour langur daily activity percentage

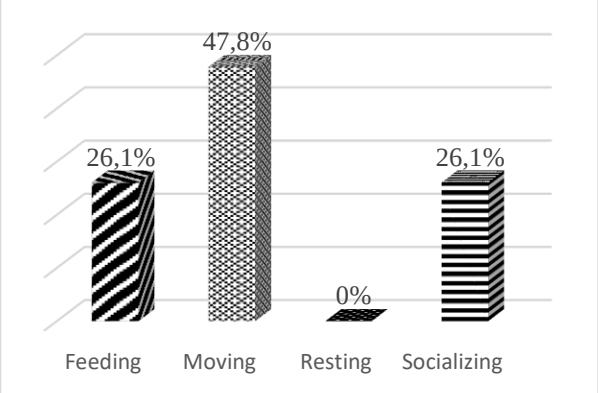


Figure 6 Muller's gibbon daily activity percentage

The Muller's gibbon is an arboreal animal, so when carrying out its daily activities, the gibbon is more often in the upper canopy and rarely descends to the ground. This is shown from the daily activity data, which is dominated by moving activity at (Figure 6) The gibbon moves by illustrating the behavior of swinging from one tree to another, jumping, climbing and walking. Gibbons forage for food in the morning and after resting during the day until late afternoon. Gibbons are frugivorous animals that eat fruits rich in sugar and contain lots of water. According to Kappeler (1984), the percentage of types of feed consumed by gibbons consisted of 61% fruit, 38% leaves and 1% flowers. Feeding activity seen in the Muller's gibbon at the study site was the *Willughbeia angustifolia*, *Willughbeia coriacea*, and *Garcinia tetrandra* found outside the vegetation plot. The gibbon forage tree, which bears a lot of fruit at the study site, causes an increase in the activity and duration of feeding in the gibbon.

The percentage of gibbon social activity observed was 26.01%. Social activities are carried out through vocalization, playing and grooming. Gibbons perform vocalizations called morning calls in the morning accompanied by acrobatic movements before looking for food (Rinaldi 1999). The sound issued marks its territory when seeing and feeling danger, meeting with other groups and when conflicts occur between individuals (Geissman *et al*. 2005). Playing activities are carried out by wildlife, including gibbons, to relieve boredom and strengthen group bonds. In comparison, gibbons carry out grooming activities to maintain social interest between individuals in groups.

As for the gibbon's resting activity in this observation, it was not found by observers, and the percentage was 0%. This is because gibbon species tend to move their sleeping trees periodically, and male and female gibbons sleep in different trees. In addition, according to Islam and Feeroz (1992), gibbons will not make a sound when they are in their sleeping trees to avoid predators. Hence, encounters with gibbons doing resting activities are quite challenging to observe. In addition, there was a relatively low number of encounters with gibbons since only one group was found and the high sensitivity of gibbons to disturbances such as the presence of observers. However, based on several studies conducted by Apriliadewi (2018); Febrissa (2016); Ilham *et al*. (2019); Rahman (2010) found results that the gibbon species' resting activity dominates its total daily activity. Activity or resting behavior can be in the form of sitting, hanging, and lying down. The difference in daily activity is also influenced by the composition of the group and its habitat.

4. Niche Overlap

Niche overlap occurs when two organisms use the same resources or environmental factors. Perfect overlap occurs when two organisms have identical niches, and no overlap occurs when the niches or positions of the two organisms separate. Usually, overlapping positions (niche overlap) occurs when only a portion of the available resources is shared and used by two organisms together (Rahayuni 2007).

Mac Arthur and Levin's calculations are used to analyzing the interspecific competition formed. The overlapping value of the Tricolour langur niche over the Muller's gibbon (Mpm) and, conversely, the overlapping value of the overlapping gibbon over the Tricolour langur (Mmp) was measured involving two parameters. These two parameters are the proportion of resources to the total resources used by the Tricolour langur (Pip) and the proportion of resources to the total resources used by the Muller's gibbon (Pim).

The magnitude of the overlapping value of the Tricolour langur ecological niche over the Muller's gibbon (Mpm) is 1.16, while the overlapping niche of the Muller's gibbon to the Tricolour langur (Mmp) is 0.65. This indicates that the Tricolour langur niche overlaps 116% with the Muller's gibbon; conversely, the Muller's gibbon niche overlaps 65% with the Tricolour langur niche. The magnitude calculation of the niche overlap results occurs because the use of food resources by the two primate species has quite a lot in common. However, using the same feed resource is carried out alternately with different periods and stratum without conflict between the two species. Several factors, such as the use of space and the availability of feed resources, cause the overlap. According to Hidayat (2022), a group's age structure can affect the primate group's use of space. The existence of baby group members causes the group's range to be more limited/narrower, increasing the chance of accidental encounters between species.

Niche segregation can still occur due to competition, increased feed efficiency in search areas, and differences in edible parts of forage plants (Beaudrot *et al*. 2013). In this case, separating niches can reduce competition and increase the likelihood that the two primates cohabitate to take advantage of areas that overlap with each other's home ranges. This statement is strengthened by Waser's observation (1976); Camillo and Gorofalo (1989) in Santosa *et al*. 2012 which states that the use of overlapping resources will not lead to tough competition if the resources are abundant to be utilized by both species.

5. Niche Breadth

From the results of the calculation of the ecological niche area of the Tricolour langur, it was found that FT = 0.65335 at the significance level (95% confidence interval), and the lower and upper limits of the value are $0.27033 \leq FT \geq 0.91288$. In gibbons, the value of FT = 0.46454 at the significance level (95% confidence interval) and the lower and upper limits were $0.04483 \leq FT \geq 0.79644$. The limit value is the value of the parameter estimate that is not focused on one point but is based on a specific range, so it has an estimated highest value (upper limit) and lowest value (lower limit). The FT value is the area of the ecological niche based on the Smith formula,

which has a value that varies from 0 (minimum) to 1 (maximum value).

These calculations show that quantitatively, the ecological niche of the Tricolour langur (FT = 0.65335) is broader than that of the gibbon (FT = 0.46454). The broader niche of the Tricolour langur indicates that there is a greater variety of forage plant species consumed by the Tricolour langur compared to the gibbon, or it can be said that the gibbon species are more specialized than the langur. Less variation in the gibbon diet makes this species' population more vulnerable to environmental changes and more threatened (Rahayuni 2007). This is supported by Slatyer *et al*. (2013), who stated that specialist species might be particularly vulnerable to habitat loss and climate change due to the synergistic effect of narrow and small niches. The number of types of food plants for an animal will affect niche area, lineage, species invasion, response to climate change, vulnerability to extinction, and the surrounding ecosystem (Carscadden *et al*. 2020).

The niche breadth of a species indicates the range of resources used and knowledge of the breadth of the ecological niche can be used to predict the vulnerability of a species to extinction so that it can assist in making decisions on the protection and management of its habitat and population. In addition, knowledge of niche breadth determines the distribution of use and availability of resources.

6. Association Degree

a. Vertical Space Association Degree

The determination of stratum consists of five stratums, namely stratum A, B, C, D and E, with a predetermined height range. Langurs and gibbons were observed for the frequency of altitude positions in their activities, so the results of the interspecific association of vertical space use by langurs and monkeys using the Jaccard Index were 0.33, indicating that the overlap value in the use of vertical space was relatively low, meaning that in carrying out their daily activities langurs and gibbons have little in common in using stratum at the same elevation. The percentage of stratum's use in daily activities by gibbons and langurs is presented in Table 2 below.

The results of calculations using the Jaccard Index show that there is little interspecific competition between langurs and gibbons. The use of space shared by langurs and gibbons is only found in stratum B because langurs rarely use stratum B and C, while the Muller's gibbon is only found in stratum A and stratum B. In vertical space, langurs and gibbons do not simultaneously occupy the same habitat and height. The use of stratum A is more common in the Muller's gibbon compared to the langur. This is thought to be due to the way the gibbon jumps farther than the langur because the proportion between the hind limbs and longer arms allows the individual gibbon to jump further than the gibbon. During the observation, it was observed that there was cohabitation which was indicated by using the same stratum or type of food between langurs and gibbons where vocalizations were heard as a form of response to the presence of the two animals, which caused the two animals to avoid each other. This can happen because there are abundant food sources and langurs and gibbons equally like them. According to Singh *et al*. (1998) and Porter (2001), cohabitation primates prefer avoiding confrontation. Therefore, the use of resources by each primate generally occurs at different times. The use of resources simultaneously generally only occurs in a short time.

b. Feed Resources Association Degree

Tricolour langur and Muller's gibbon are both frugivorous animals that like fruit as their primary food. The list of types of feed used by the two primates in the Majang Island Resort area is presented in **Table 3** below. The availability of abundant food resources indicates the quality of the habitat it occupies. This is in line with research conducted by Laksmitha (2022), who examined the characteristics of the Tricolour langur habitat in Majang Island Resort, DSNP, which stated that the availability of feed at the study site was quite good because continuity was guaranteed, as indicated by the density value and relative density of seedlings and higher stake.

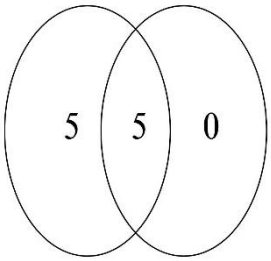
Table 2 Percentage of altitude position (stratum) on langur and gibbon activity

Stratum	Tricolour langur (%)	Muller's gibbon (%)	Jointly (%)
A	0.00	4.58	0.00
B	5.23	10.46	5.23
C	37.25	0.00	37.25
D	0.00	0.00	0.00
E	0.00	0.00	0.00
Total	42.48	15.03	42.48

The existence of cohabitation allows these two primate species to avoid or reduce interspecific competition on limited resources and the emergence of niche segregation. So, there must be some form of ecological separation to avoid competition from foraging location, feeding rate, feeding time, type of food and plant parts that are digested (Santosa *et al*. 2012). This is consistent with the findings in the field where gibbons use more stratum B in searching for food. In comparison, langurs use more stratum C; gibbons control their home ranges which tend to be more in the eastern part, while langurs control more in the western part, and langurs tend to start daily activities earlier than gibbons. This is also to the statement of Pianka (1981) in Wakidi (2013), which states that cohabitation species will adapt to avoid or reduce interspecific competition in utilizing limited resources. A comparison of the use of forage plant species is presented in **Figure 7**. Below

Table 3 List of types of feed used by langurs and gibbons in the Majang Island Resort Area

Number	Local Name	Scientific Name	Tricolour langur	Muller's gibbon
1	Sibau	*Nephelium sp*	✓	
2	Ubah milas	*Syzygium rostratum* (Blume) DC.	✓	✓
3	Keradilah	*Garcinia tetrandra* Pierre	✓	✓
4	Mujau kelik	*Nephelium maingayi* Hiern	✓	✓
5	Medang darah	*Memecylon paniculatum* Jack	✓	
6	Tekam	*Polyalthia insignis* (Hook.f.) Airy Shaw	✓	
7	Buah gita	*Willughbeia angustifolia*	✓	✓
8	Buah gita susu	*Willughbeia coriacea* Wall.	✓	✓
9	Asam kemantan	*Mangifera pajang*	✓	
10	Tengkawang	*Shorea mecistopteryx*	✓	



5 types of feed that are only used by Tricolour langur

5 types of feed that are shared by Tricolour langur and Muller's gibbon

0 types of feed that are only used by Muller's gibbon

Figure 7 Comparison of the use of plant species for the two primates in the Majang Island Resort Area

The Jaccard Index value for the association of the use of forage plants in ticolour langur and Muller's gibbon is 0.50. The calculation results of the Jaccard Index show that the types of forage plants used by these two primates intersect. However, they are only sometimes used together because each type of primate is interested in other forage plants. Tricolour langurs and gibbons prefer to eat fruits rather than leaves as their primary food. The feed preferred by Tricolour langurs and Muller's gibbons is very dependent on the fruiting season, so gibbons and langurs often vary their diet to fulfill their body's nutrition. The total feed consumed during observation by langurs or gibbons was 10 types, of which both consumed 5. Langurs use all ten types of forage plants while five types of forage plants are used by gibbons, while the other five are not forage plants. So that it can be said that there is no (0) feed specifically used only by gibbons because all ten feeds are used entirely by langurs. The similarity in the types of feed between langurs and gibbons, which both utilize *Willughbeia angustifolia*, *Willughbeia coriacea*, *Garcinia tetrandra*, *Syzygium rostratum*, *Nephelium maingayi* in their fruit and seeds, allows for overlapping in the use of

resources. The similarity in the resources used by the two primates is influenced by the location of the habitat they occupy (Hidayat 2022).

CONCLUSION

There is an overlapping home range between the Tricolour langur and Muller's gibbon of 9.93 ha. The Jaccard index for the association of vertical space use for Tricolour langur and Muller's gibbon is 0.33, while the Jaccard index for the number of forage plant species is 0.50. The Tricolour langur ecological niche overlaps 116% with the Muller's gibbon, and the Muller's gibbon ecological niche overlaps 65% with the Tricolour langur. This large value was obtained because the use of food resources by the two primate species has quite a lot in common. However, using the same feed resource is carried out alternately with different periods and stratum without conflict between the two species. The calculation of the ecological niche area of Tricolour langur is FT = 0.65335, and the lower limit and upper limit values are $0.27033 \leq FT \geq 0.91288$. Meanwhile, for the gibbon, FT = 0.46454, the lower and upper limits are $0.04483 \leq FT \geq 0.79644$.

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