Suitability for salt-lick tourism: A preliminary assessment on the natural salt-licks at Segaliud-Lokan Forest Reserve, Sandakan, Sabah

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Abstract. The natural salt-licks are visited by various species of terrestrial mammals, hence ideal for mammal watching, although the suitability for salt-lick tourism is influenced by other factors. Preliminary research was conducted on the suitability of four natural salt-licks for mammal watching in Segaliud-Lokan Forest Reserve (SLFR), Sabah. The camera trapping survey and field assessment were conducted for eight months, and then the assessment criteria applied in this study included the lick accessibility, detection frequency, species richness, viewable activity sighting probability, reliability and visibility on the terrestrial mammals, at a given lick. A total of 12 different mammal species were recorded, where Sambar Deer, Bearded Pig, Banteng, and Bornean Orang-utan were determined as the main visitor species of this study. Among the four selected salt-licks, the rating score of SL50A (Score=1.71) was significantly lower than those of SL50B, SL56 and SL59 (Score=2.57 respectively, \( \chi^2=6.794, p=0.042 \)), hence highlighting that SL50A was not suitable for conducting mammal watching activity, unlike the other three natural licks at SLFR. The assessment on the compatibility between the supply (mammalian physical availability) and demand (highly anticipated species) was excluded from this research, therefore emphasizing the need to fill up this particular research gap in the future.

Keywords: Mammal watching; salt-lick tourism; Segaliud-Lokan Forest Reserve; terrestrial mammal.

1. Introduction
Salt-lick tourism is a new form of wildlife-watching tourism, where tourists are given the opportunity to have a close-range observation upon the free-roaming mammalian individuals at a salt-lick [1,2]. The mammalian individuals visit the natural salt-licks at a regular basis to obtain both the essential and trace elements in sufficient amounts, especially in the tropical forest ecosystem of Sabah, Malaysia [3,4]. Since the probabilities of observing a mammalian individual are higher at salt-licks, when compared to other forested areas [5], therefore salt-licks are promoted as the mammal-watching hotspots at several forest reserves in Sabah, namely the Tabin Wildlife Reserve and Deramakot Forest Reserve [6,7].

Recently, natural salt-licks were discovered in Segaliud-Lokan Forest Reserve (SLFR), which was located in Sandakan, Sabah [3]. Even though the local forest cover was disturbed by timber harvesting and forest plantation activities, still the local salt-licks remained visited regularly by various species of terrestrial mammals [4]. Therefore, the local natural salt-licks can be promoted as mammal-watching hotspots, although their suitability for salt-lick tourism, in terms of the quality of experience perceived by the visitors during a mammal watching activity [8,9,10,11], are yet to be determined scientifically at this moment. Henceforth, this study was conducted as a preliminary assessment on the suitability of the
natural salt-licks presented in SLFR for salt-lick tourism. The potentials of the examined salt-licks as mammal watching hotspots at this forest reserve will be further highlighted in this research.

2. Methods

2.1 Study site

SLFR (FMU 19B) is a Class II Commercial Forest Reserve, which covers approximately 57,247 ha of the regenerating lowland mixed dipterocarp forest presented at Sandakan, Sabah [4]. A total of four natural wet-licks were discovered in the vicinity of this forest reserve, in which the selected licks were named separately as “SL50_A”, “SL50_B”, “SL56”, and “SL59”. A mineral-rich spring surrounded by rocky and muddy surfaces was presented in the vicinity of each selected lick. SL59 was situated in a selective-logged forest, and then SL56 was surrounded by a least-disturbed forest, whereas both the SL50_A and SL50_B were located in the vicinity of a plantation forest, in this forest reserve. Figure 1 displays the locations of the four selected natural wet-licks in Segaliud-Lokan Forest Reserve.

![Figure 1. The locations of the four selected natural wet-licks in Segaliud-Lokan Forest Reserve.](image)

2.2 Data collection

Camera trapping survey and field assessment were conducted onto the four selected natural salt-licks in SLFR from July 2019 to February 2020 (8 months), in this study. A unit of passive infra-red camera trap (HC-800M, HongKong Suntek International Co. Ltd.) was applied in capturing the footage of any medium to large-sized mammalian individuals that visited the given licks, through the entire sampling period [4]. There was a 60-seconds time gap between each three consecutive photographing, and then a 30-minutes time gap was applied to separate two independent detections for a particular mammal species detected at a specific lick and time. The field assessment, on the other hand, was conducted to visually examine the site condition of the given licks, in terms of the lick accessibility, and also the reliability and visibility of sighting the local terrestrial mammals by the human observers [12,13,14].
2.3 Data analysis

The suitability of each selected natural salt-lick at SLFR for mammal watching was assessed, based on seven assessment criteria, as proposed by the findings of several relevant past studies [8,9,10,11,13,14]. Three criteria (Sighting reliability, sighting visibility and lick accessibility) were assessed using direct visual observation, while the other four criteria (Sighting probability of outstanding species, viewable mammalian activity, and mammalian diversity richness and detection frequency) were verified by referring to the camera trapping data, as shown in Table 1. The species of detected mammalian individuals by the deployed camera traps were identified by using the field guide prepared by [15]. Then, the detection frequency of every recorded species at each lick was estimated, as suggested by [4]. A three-point rating score was employed in evaluating every criterion quantitatively, and then an average rating score was estimated, as representation to the overall suitability of a natural salt-lick for mammal watching, in which: 1=Low suitability; 2=Medium suitability, and; 3=High suitability [14,16], were used in this research. The difference in averaged rating score between the four selected licks was determined through the Kruskal-Wallis test, by using the statistical software PAST ver. 3.25 [17], at 95.0 % confidence interval (p=0.05).

Table 1. The assessment criteria applied in ascertaining the suitability of the four selected natural salt-lick at Segaliud-Lokan Forest Reserve for conducting mammal watching activities in this study.

| Assessment Criterion                  | Description                                                                 | Rating System                        |
|--------------------------------------|-----------------------------------------------------------------------------|--------------------------------------|
| Lick Accessibility                   | Accessibility of a natural salt-lick by visitors.                            | 1=Low; 2=Medium, and; 3=High.        |
| Mammalian Detection Frequency        | Frequency of detecting a particular mammal species at a certain natural salt-lick. | 1=Low (n≤50); 2=Medium (50<n ≤100), and; 3=High (n>100). |
| Mammalian Diversity Richness         | Diversity richness of the viewable species of terrestrial mammals at a specific natural lick. | 1=Low (sp≤3); 2=Medium (3<sp≤6), and; 3=High (sp>6). |
| Sighting Probability on Outstanding Species | Probability of sighting an outstanding species (large-sized, elusive, threatened and rare) at a certain natural salt-lick. | 1=Zero chance; 2=Low chance (n≤ 50), and; 3=High chance (n>50). |
| Sighting Reliability on Terrestrial Mammals | The actual viewing success of the individuals of terrestrial mammals by visitors and at close range, at a certain natural salt-lick. | 1=Low (Zero observation); 2=Medium (Viewed from afar), and; 3=High (Viewable at close range). |
| Sighting Visibility on Terrestrial Mammals | The actual visibility of sightings of terrestrial mammals by visitors at a specific natural salt-lick. | 1=Low (<33.3%); 2=Medium (33.3 % to 66.7%), and; 3=High (>66.7 %). |
| Viewable Mammalian Activity          | The type of activity shown by the individuals of terrestrial mammals, when visiting a certain natural salt-lick. | 1= Zero activity; 2=Low activity variation (≤5 types), and; 3=High activity variation (>5 types). |

*Note: n=number of sighting, and; sp=number of recorded species.

3. Results

A total of 12 different species of medium to large-sized terrestrial mammals were detected at the four selected natural salt-licks in SLFR, within the 8 months sampling period. The given species included five outstanding species, which were *Pongo pygmaeus* (Bornean Orang-utan), *Sus barbatus* (Bearded Pig), *Elephas maximus borneensis* (Bornean Pygmy Elephant), *Bos javanicus* (Banteng), and *Cervus unicolour* (Sambar Deer). Likewise, the medium-sized *Tragulus* spp. (Mousedeer), *Presahtis rubicunda* (Red Leaf Monkey), *Paradoxurus hermaphroditus* (Common Palm Civet), *Macaca nemestrina* (Pig-tailed Macaque), *Viverra tangalunga* (Malay Civet), *Hystrix brachyura* (Malayan Porcupine), and *H. crassispinis* (Thick-spined Porcupine), were detected at the given four licks in this study. Among these species, only the outstanding *C. unicolour*, *S. barbatus*, *B. javanicus*, and *P. pygmaeus* were observed.
at the given licks frequently, until they comprised the majority of sightings of the mammalian individuals (n=940 or 95.4 %) recorded in this study.

Regarding the suitability of the four selected licks at SLFR for mammal watching, the result was tabulated, as shown in Table 2. Actually, both the SL50_B and SL56 were determined with low accessibility by human visitors, because the forest trails that led to these licks were steep and with high potential hazards (e.g., dead wood, erosion, and slippery floor). The forest trails that led towards SL59 and SL50_A, on the contrary, were flat (<10°), but also with high potential hazards, thus the given two licks were moderately accessible by the human visitors. Next, a juvenile *S. barbatus* and a male-adult *C. unicolour* were observed at close range (<5.0 m) at SL56 and SL50_B respectively, indicating that the reliability of encountering terrestrial mammals at close range were high at these two licks. Then, a male-adult *S. barbatus* was observed from afar (>10.0 m) at SL59, while no mammalian individual was detected at SL50_A, hence emphasizing the medium and low mammalian sighting reliabilities by human visitors at SL59 and SL50_A respectively.

**Table 2.** Suitability of the four selected natural salt-licks for mammal watching at SLFR, with refer to the seven assessment criteria.

| Assessment Criteria                      | Natural Salt-Licks |
|------------------------------------------|--------------------|
|                                          | SL50_A  | SL50_B  | SL56    | SL59    |
| Lick Accessibility                       | 2       | 1       | 1       | 2       |
| Mammalian Detection Frequency            | 1       | 3       | 3       | 3       |
| Mammalian Diversity Richness             | 2       | 2       | 3       | 2       |
| Sighting Probability on Outstanding Species | 2       | 3       | 3       | 3       |
| Sighting Reliability on Terrestrial Mammals | 1       | 3       | 3       | 2       |
| Sighting Visibility on Terrestrial Mammals | 2       | 3       | 2       | 3       |
| Viewable Mammalian Activity              | 2       | 3       | 3       | 3       |
| Average Rating Score                     | 1.71    | 2.57    | 2.57    | 2.57    |

Among the given four selected licks, SL56 was the sole lick to be visited by 10 different species of terrestrial mammals (High species richness), in which only *Tragulus* spp. and *V. tangalunga* were not observed at this lick. On the other hand, SL50_B was determined with the lowest species richness (*M. nemestrina, C. unicolour, B. javanicus*, and *S. barbatus*), and then followed by SL50_A (*Tragulus* spp., *P. pygmaeus, C. unicolour, S. barbatus*, and *B. javanicus*), and lastly SL59 (*V. tangalunga, E. maximus, P. pygmaeus, B. javanicus, S. barbatus*, and *C. unicolour*). Furthermore, the probability of encountering the outstanding species were generally lower at the SL50_A (n≤50), when compared to the other three natural salt-licks (n>50). Actually, the detection frequency of terrestrial mammals was low at SL50_A (n≤50), unlike SL50_B, SL56 and SL59, which were frequently visited by the individuals of terrestrial mammals (n>100 respectively). Additionally, only three types of mammalian activity were recorded at SL50_A using camera traps (e.g., drinking water, foraging and travelling), unlike the other three licks, where more than five types of mammalian activity (e.g., courtship ritual, fighting, mating, and other social activities), were successfully being recorded throughout the sampling period.

The presence of dense surrounding forest and onsite tree stands reduced the sighting visibilities of mammalian individuals at both the SL56 and SL50_A to medium (33.3 % to 66.7 %). As for SL59 and SL50_B, the lack of onsite tree stands and presence of widely-gapped surrounding tree stands have created high sighting visibilities on the terrestrial mammals (>66.7 %) at these two licks respectively. In summary, SL50_A was verified with only medium suitability for mammal watching (score=1.71), which was significantly lower than those of SL50_B, SL56 and SL59 (score=2.57 respectively, $\chi^2=6.794, p=0.042$), in term of the averaged rating score estimated for each selected lick, in this research.

4. Discussion

The finding of this study highlighted that the mammal watching activity was suitable to be conducted at SL50_B, SL56 and SL59, but not at SL50_A, by referring to the seven assessment criteria applied in this study (refer to Table 2). Although SL50_A was more accessible to humans than SL50_B and SL56,
still the probability of observing various species of terrestrial mammals at SL50_A was lower, when compared to the other three licks. Additionally, the reliability of detecting terrestrial mammals at close-range was verified as low for SL50_A in this study. The viewing success of wildlife is the main attraction of a wildlife watching activity, and then the reliability of sighting wildlife at close range functions as a guarantee for the visitors, during wildlife watching at a certain location [8,9]. Henceforth, despite that the lick accessibility, in terms of the trail length, steepness and potential hazard, plays a crucial role in defining the suitability of a certain natural lick for mammal watching [10,12], nevertheless the salt-lick with low guarantee for the viewing success of terrestrial mammals by human visitors during mammal watching, namely SL50_A, is not suitable for promoting salt-lick tourism.

The other three licks, on the other hand, were determined with high probabilities of sighting many different species and activities of the local terrestrial mammals, especially the outstanding species, at close range. These advantages were highlighted by several past research to have positive influences on the willingness of visitors to partake in the mammal watching activity conducted at a given location [1,7]. Then, each of these three licks had their respective advantages and disadvantages, when compared with one another. SL50_B and SL56 were generally less accessible to human visitors than SL59, but then SL50_B was validated with higher visibility and reliability of sighting the terrestrial mammals at close range by the human visitors, when compared to SL59 and SL56 respectively. Moreover, species richness of the viewable terrestrial mammals at SL56 was higher than those of SL50_B and SL59. Past studies emphasized that the suitability of a certain area for wildlife watching was defined by different perspectives as a whole [10,13,16]. Based on this aspect, SL50_B, SL56 and SL59 have the potential to be promoted as the future mammal-watching hotspots in this forest reserve.

Moreover, the four selected licks were visited majorly by *C. unicolour*, *S. barbatus*, *P. pygmaeus*, and *B. javanicus* (n=940 or 95.4 %) throughout the sampling period, which aligned with the findings of past studies conducted at natural salt-licks in Sabah [3,4]. These elusive large-sized threatened species were considered as outstanding species by [18], and then visitors were reported to exhibit high expectations and preferences in wanting to encounter these mammal species during wildlife watching [8]. Additionally, high mammalian detection frequency is associated with high probability of sighting the terrestrial mammals by human visitors at a certain area [9,18]. Coincidentally, this type of mammal species could be detected frequently, especially at SL50_B, SL56 and SL59, thus further emphasizing the suitability of these licks for conducting mammal watching activities in SLFR.

Nonetheless, this study merely examined the suitability of a natural salt-lick for mammal watching, in term of the quality of supply (mammalian physical availability) available for salt-lick tourism, while the demand (highly anticipated species) was not assessed in this study. The supply must be compatible with the demand, in order for a wildlife-watching destination to attract human visitors in partaking the local wildlife watching activity [8]. Presently, the terrestrial mammal species preferred and anticipated by visitors during mammal watching at Sabah are yet to be ascertained by past studies, even though the viewing success of an individual or activity shown by a certain species were reported by past findings to have effects onto the satisfaction levels of visitors to a mammal-watching activity [9,11]. In summary, future research should be conducted to fill up the given research gap for the natural salt-licks at SLFR.

5. Conclusion

Among the four selected natural salt-licks at SLFR, only SL50_A is verified as unsuitable for mammal watching, because of its low probability and reliability of observing many different mammal species, especially the highly viewable outstanding *C. unicolour*, *B. javanicus*, *P. pygmaeus*, and *S. barbatus*, at close range by the human visitors. The other three natural salt-licks (SL50_B, SL56 and SL59), on the other hand, are suitable for conducting mammal watching activities, and then each of these licks have their respective advantages and disadvantages, which can be beneficial in motivating and attracting the human visitors to partake the local mammal watching activities. However, the compatibility between the supply (mammalian physical availability) and demand (highly anticipated species) for the salt-lick tourism that can be promoted at the natural salt-licks in SLFR are yet to be investigated in this study. Henceforth, there is a need to conduct further research to fill up this particular research gap, especially for the natural salt-licks presented at this forest reserve in future.
6. References

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Acknowledgments

The authors would like to thank both the KTS Plantation Sdn Bhd and Sabah Forestry Department for granting the permission to conduct this research at the four natural salt-licks discovered in SLFR. The anonymous reviewers that have provided their insights towards the authors, for the sake of improving the contents of this research article, are sincerely thanked as well. This research was conducted as part
of the collaboration project between Universiti Malaysia Sabah, KTS Plantation Sdn Bhd, and Sabah Forestry Department, funded by the research grants GKP0023-2018 and GUG0322-1/2019.