Wildlife Diversity Near Natural Saltlicks in the Ulu Muda Forest Reserve

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## List of Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>DWNP</td>
<td>Department of Wildlife and National Parks</td>
</tr>
<tr>
<td>FMU</td>
<td>Forest Management Unit</td>
</tr>
<tr>
<td>HCVF</td>
<td>High Conservation Value Forest</td>
</tr>
<tr>
<td>FR</td>
<td>Forest Reserve</td>
</tr>
<tr>
<td>IBA</td>
<td>Important Bird Area</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for the Conservation of Nature</td>
</tr>
<tr>
<td>KSFD</td>
<td>Kedah State Forestry Department</td>
</tr>
<tr>
<td>MTCC</td>
<td>Malaysian Timber Certification Council</td>
</tr>
<tr>
<td>PRF</td>
<td>Permanent Reserved Forest</td>
</tr>
<tr>
<td>UMFR</td>
<td>Ulu Muda Forest Reserve</td>
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ACKNOWLEDGEMENTS

WWF-Malaysia’s camera-trapping study in the Ulu Muda Forest Reserve was made possible through the support and generous funding received from The Coca-Cola Company and the Malaysian public, to whom we are deeply thankful. We would also like to extend our heartfelt gratitude to Mr. Hymeir Kamarudin of Earth Lodge in Ulu Muda, without whose tireless assistance in monitoring our camera-traps, the study would not have been possible. Additionally, we would like to thank the Kedah State Forestry Department, the Kedah Department of Wildlife and National Parks, and the Forestry Department of Peninsular Malaysia, for permitting us to conduct this research in the Ulu Muda Forest Reserve. We also thank the Muda Agricultural Development Authority for their continued support of and interest in our conservation initiatives in Ulu Muda. Last but not least, a special thank you to everyone who provided their technical inputs, suggestions and reviews to this report.

Charok Tera is one of the tributaries of Muda Lake in Ulu Muda
The Greater Ulu Muda forest complex in Kedah is the largest remaining tract of contiguous rainforest in north-western Peninsular Malaysia. The forest is home to a diverse array of wildlife which includes at least 112 species of mammals and most of the large mammals found in Malaysia. Another unique feature of Ulu Muda is an abundance of natural saltlicks. These deposits of salt or other minerals in the ground or water of mineral springs are generally believed to provide an important mineral supplement to the diets of wildlife, particularly herbivorous animals.

Relatively little is known about the utilization of saltlicks by wildlife in Ulu Muda. In order to establish baseline information on the species of wildlife that commonly visit saltlicks and the frequency and timing of these visits, WWF-Malaysia conducted camera-trapping near four natural saltlicks in the Ulu Muda Forest Reserve (one of the seven forest reserves within the Greater Ulu Muda forest complex) over a 20-month period from 2011 to 2013.

A total of 31 species of animals were detected in the vicinity of saltlicks during the study, of which 15 were observed directly at a saltlick. Our records included three species which are listed as Endangered in the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species and one species which is listed as Endangered in the Red List of Mammals for Peninsular Malaysia, further adding to Ulu Muda’s conservation value. The most frequently detected species at saltlicks were sambar deers, Malayan tapirs, Asian elephants, wild boars, barking deers and pig-tailed macaques; the first three of which visited saltlicks predominantly at night and the latter three of which visited saltlicks predominantly during the day.

In the interest of conserving Ulu Muda’s saltlicks as important resources for wildlife, WWF-Malaysia suggests the implementation of the following management recommendations to address some of the most pertinent threats to saltlicks in Ulu Muda:

- Gazetting Ulu Muda as a protected area
- Identifying all saltlicks and surrounding 2km buffer zones as High Conservation Value Forest (HCVF) and managing these as strict conservation areas
- Intensifying patrolling and anti-poaching measures near saltlicks
- Prohibiting and controlling access into the forest and to saltlicks by sealing off old logging roads and establishing check points at key entry points such as the Muda Lake jetty
- Engaging local villagers and stakeholders as informants to report potential poaching activities
- Collaborating with the Malaysian Army to apprehend foreign encroachers
- Controlling tourism activities near saltlicks by limiting public access to a single natural saltlick
- Ensuring that all visitors are accompanied by entrusted guides and adhere to set guidelines when visiting saltlicks
Kompleks hutan *Greater Ulu Muda* di Kedah merupakan rangkaian hutan hujan tropika terbesar yang terletak di bahagian barat laut Semenanjung Malaysia. Hutan Ulu Muda mempunyai kepelbagaian hidupan liar yang tinggi dengan sekurang-kurangnya 112 spesis mamalia termasuklah kebanyakan spesis mamalia besar yang terdapat di Malaysia. Di samping itu, Ulu Muda juga unik disebabkan wujudnya banyak kawasan sira semulajadi di hutan ini. Tanah ataupun mata air sira-sira ini mampu membekalkan garam galian yang penting sebagai nutrisi tambahan kepada hidupan liar, terutamanya bagi haiwan-haiwan herbivor.


Bagi melindungi sira-sira di Ulu Muda daripada ancaman-ancaman utama yang telah dikenalpasti, WWF-Malaysia mencadangkan langkah-langkah seperti yang berikut:

- Mewartakan Ulu Muda sebagai kawasan perlindungan
- Mengenalpasti kesemua sira di Ulu Muda beserta dengan kawasan penampan seluas 2km daripada setiap sira sebagai kawasan Hutan Pemuliharaan Bernilai Tinggi (HCVF), dan menguruskannya sebagai kawasan pemuliharaan yang ketat
- Mempergiatkan rondaan dan gerakan anti-pemburuan haram berhampiran sira-sira
- Mengawal kemasukkan orang luar ke kawasan hutan dan sira dengan menyekat jalan-jalan balak lama dan mewujudkan pusat pemeriksaan di pintu-pintu masuk utama seperti jeti Tasik Muda
- Melibatkan penduduk tempatan dan pihak berkepentingan lain sebagai pemberi maklumat dalam melakoni aktiviti pemburuan haram
- Bekerjasama dengan Angkatan Tentera Malaysia bagi memberkas penceroboh asing
- Mengawal aktiviti pelancongan berhampiran sira dengan mengehadkan akses awam kepada hanya satu sira semulajadi
- Memastikan kesemua pelawat ke kawasan sira diiringi oleh pemandu pelancong yang dipercayai dan mematuhi garis panduan yang ditetapkan
1. INTRODUCTION

The Greater Ulu Muda forest complex in Kedah (hereafter referred to as Ulu Muda) is the largest remaining tract of contiguous rainforest in north-western Peninsular Malaysia. Covering an area of 1,638km², Ulu Muda has long been recognised for its abundance of wildlife, especially large mammals. Ulu Muda’s wealth of wildlife was first noted in the early 1930s by the renowned conservationist, Theodore R. Hubback, in his report entitled “The Wildlife Commission of Malaya” (Hubback, 1932). Subsequent surveys by the Department of Wildlife and National Parks (DWNP) and Universiti Putra Malaysia (UPM) in the 1980s and 1990s reaffirmed Hubback’s observations, and reported an abundance of large mammals such as the gaur/seladang (*Bos gaurus*), Asian elephant (*Elephas maximus*), Malayan tiger (*Panthera tigris*), Malayan tapir (*Tapirus indicus*), sambar deer (*Rusa unicolor*), barking deer (*Muntiacus muntjak*) and wild boar (*Sus scrofa*), amongst others (Elagupillay, 1987; WWF-Malaysia, 2002). Especially noteworthy were reports of the now globally endangered banteng (*Bos javanicus*) and the critically endangered Sumatran rhinoceros (*Dicerorhinus sumatrensis*) in Ulu Muda (DWNP, 1989). Unfortunately, the banteng has since become extinct in Peninsular Malaysia (DWNP, 2010), while the Sumatran rhinoceros is likely to have suffered the same fate (Clements et al., 2010).

![Figure 1: The Greater Ulu Muda forest complex](image-url)
To date, at least 112 mammalian species (Appendix 1) have been recorded in Ulu Muda, representing approximately 50% of mammal species found in Peninsular Malaysia (DWNP, 1993; WWF-Malaysia, 2002; Mariana et al., 2005; Sharma et al., 2005; Shukor et al., 2005; DWNP, 2010). Ulu Muda has also been recognised as an Important Bird Area (IBA) (Birdlife International, 2014) and is home to over 300 species of birds, including large flocks of the globally threatened plain-pouched hornbill (*Aceros subruficollis*). It is one of only two sites in the country where all 10 species of Malaysia’s hornbills have been recorded. Following the discovery of Ulu Muda’s exceptional faunal diversity, several proposals were made for the area’s protection beginning with a letter from Theodore R. Hubback to the then Raja Muda of Kedah, emphasizing the importance of protecting Ulu Muda (Elagupillay, 1987). Over the following decades, the forest was also proposed as a Wildlife Reserve (Stevens, 1968), a National Park (DWNP, 1989) and a State Park (MOCAT, 1996). In 2009, the Kedah State Government finally announced plans to gazette approximately 272km² of Ulu Muda as state park (Bernama, 2009), although the official gazettement has yet to ensue.

Apart from its faunal diversity, another feature that has added to the conservation value of the Ulu Muda forest is its abundance of natural saltlicks (Stevens, 1968). According to the Wildlife Conservation Act 2010, saltlicks are defined as mineral springs or ground containing salt or other minerals, the consumption of which is conducive to the health or wellbeing of wildlife. In tropical rainforests, where plants are generally deficient of sodium (Vitousek and Sanford, 1986), saltlicks serve as natural mineral supplements for wildlife, particularly for herbivorous mammals and birds (Matsubayashi et al., 2007). Saltlicks are thus an important feature of Ulu Muda’s forest landscape which presumably contribute to the wellbeing of its wildlife populations.

While the importance of saltlicks is generally recognised, relatively little is known about how these resources are being utilized by wildlife in Ulu Muda. The objective of this study was hence to establish baseline information on the species of wildlife that commonly visited saltlicks in the Ulu Muda forest, as well as the frequency and timing of these visits. It is hoped that a better understanding of saltlick utilization trends by wildlife will allow for the formulation of effective management recommendations to improve the preservation of these important resources.

*Sira Air Hangat, which combines the properties of a natural saltlick and hot spring, is one of the more well-known saltlicks in Ulu Muda*
2. STUDY LOCATION

Ulu Muda (1,638km²) consists of seven permanent reserved forests (PRF); namely the Bukit Keramat Forest Reserve (FR), Padang Terap FR, Pedu FR, Chebar Besar FR, Chebar Kecil FR, Bukit Saiong FR and Ulu Muda FR (Figure 2). The current study was conducted in the Ulu Muda FR (UMFR), along the lower section of Sungai Muda.

Sungai Muda originates from the convergence of Sungai Bahoi and Sungai Lasor in the UMFR and drains into Muda Lake. Muda Lake is one of three large man-made lakes found in Ulu Muda, the other two being the Pedu and Ahning lakes, which supply water for irrigation, industrial and domestic usages to the states of Kedah, Penang and Perlis. While a certain portion of the UMFR has been proposed for gazettement as Kedah’s very first state park, a large part of the PRF is classified as production forest reserve and is currently undergoing selective logging in certain areas.

Unlike in many other large forested areas in Malaysia, there are no indigenous people or local communities living in Ulu Muda. Several Malay and Thai villages which used to be situated in the forest were relocated during the communist insurgency. Today the closest settlements are located on the fringes of the Ulu Muda forest. The communities residing in these villages are engaged, amongst others, in agricultural activities such as rubber tapping and tending to fruit orchards, and in fishery activities at Muda Lake. Some of the fishermen also double as boatmen for visitors going into Ulu Muda. While tourism is presently low in Ulu Muda, a consistent small number of tourists visit a local nature lodge in the UMFR which offers activities such as visits to saltlicks, caving and birding.
Figure 2: Study location within the Ulu Muda Forest Reserve
3. **STUDY METHODS**

3.1 **Camera-trapping**

The non-invasive method of camera-trapping was used to record wildlife near four natural saltlicks in the UMFR. Infra-red Reconyx HyperFire HC500 camera-traps were used in this study, which were triggered by heat-emitting objects such as wildlife, humans and vehicles which passed in front of their sensors. A total of five camera-traps were set up within the vicinity of the saltlicks, with a single camera-trap deployed at each location. Out of the five camera-traps, two were facing saltlicks directly while the remaining three were set up along forest trails leading up to a saltlick. Each camera was mounted on a tree at a height of approximately 50-70cm off the ground, depending on the distance from the saltlick or trail. All camera-trap locations were within 3km from each other and were located in lowland dipterocarp forest, over elevations of 110-150 m a.s.l. (above sea level).

Camera-traps were deployed over a 20-month period, from November 2011 – June 2013. Each camera was checked on average once every six weeks to retrieve digital photographs, replace batteries, check for damage/functionality, and remove any vegetation which may have obstructed the camera’s view. All camera-traps were operational for 24 hours a day during the monitoring period, with the exception of events of camera-trap malfunction or loss.

*WWF-Malaysia staff inspecting a camera-trap during a routine photo retrieval and battery change*

*A camera-trap facing one of the saltlicks in the study area*
3.2 Data analysis

All photographs obtained during the monitoring period were entered into a camera-trap database developed by WWF-Malaysia for further data management and analysis. Each photograph was labelled with the date and time of capture and the species detected. Photographs in which animals could not be identified to genus or species level, including those that were too dark or unclear due to the camera-trap having been obstructed by vegetation, were omitted from the analysis. All analysis was conducted using independent detections, defined as a photograph (either a wildlife species or human/s) being taken at least 30 minutes apart at the same camera trap location (O’Brien et al., 2003).

Records of wildlife which was detected at the two locations where camera-traps were directly facing a saltlick (hereafter referred to as “saltlick locations”) were analysed further to establish information on the frequency and timing of saltlick visitation by wildlife. Encounter rates (also referred to as relative abundance) were established for all species that were detected at saltlick locations to provide a relative measure of how frequently a given species visited saltlicks in relation to other species. The encounter rate was calculated by dividing the total number of independent detections of the species over the total sampling effort, which was the number of days that camera-traps were functional at saltlick locations (a.k.a. trap-nights). In this study, encounter rates were given as the number of times a species was detected at the saltlicks over 100 trap-nights (O’Brien et al., 2003; Kawanishi and Sunquist, 2004). Based on the encounter rates of wildlife detected at saltlicks, species that were inferred to be common saltlick users were identified. The timing of saltlick visits by these species was then examined by plotting the number of detections of each species at different hours of the day.

Records of human detections across all camera-trap locations were analysed in a similar manner, in order to establish the frequency and timing of human presence near saltlicks in the UMFR.
4. FINDINGS

4.1 Wildlife diversity near saltlicks

A total of 3,393 records of wildlife which could be positively identified to at least genus or species level were obtained from a sampling effort of 3,260 trap nights during the study. Overall, 31 species of wildlife were identified, consisting of 25 species of non-volant mammals, five species of birds and one species of reptile (Table 1). Of these, a total of 15 species were observed to visit saltlicks (i.e. recorded at saltlick locations). The most frequently recorded mammals were the sambar deer, wild boar, Malayan tapir, Asian elephant, pig-tailed macaque (*Macaca nemestrina*) and barking deer, which collectively made up 90% of wildlife detections across all camera-trap locations. The most commonly detected birds were the great argus pheasant (*Argusianus argus*), crested fireback pheasant (*Lophura ignita*) and red jungle fowl (*Gallus gallus*).

A list of recorded species, classified by order and accompanied by their status in the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species, is presented in Table 1. Wildlife which could not be positively identified, including several birds, bats, treeshrews and squirrels, were excluded from this list. Of the recorded species, three were classified as Endangered in the IUCN Red List, namely the Malayan tapir, Asian elephant and the Sunda pangolin (*Manis javanica*); while a fourth species, the crab-eating mongoose (*Herpestes urva*), was classified as Endangered in the Red List of Mammals for Peninsular Malaysia (DWNP, 2010). All four species are listed as Totally Protected under the Malaysian Wildlife Conservation Act 2010, which prohibits their hunting and trade. Amongst the less frequently recorded species, which were classified as Vulnerable in the IUCN Red List, were the Malayan sun bear (*Helarctos malayanus*), clouded leopard (*Neofelis nebulosa*), marbled cat (*Pardofelis marmorata*), binturong (*Arctictis binturong*), banded civet (*Hemigalus derbyanus*) and smooth otter (*Lutrogale perspicillata*).

Our photographs of a crab-eating mongoose are the first records of the species in Ulu Muda. Despite being classified as endangered by the DWNP (2010), recent studies suggest that the species may not be as rare as previously reported (Rayan and Shariff, 2008; Hedges *et al.*, 2013).
Table 1: Wildlife species photographed by camera-traps near saltlicks in the Ulu Muda Forest Reserve

<table>
<thead>
<tr>
<th>Order / Scientific name</th>
<th>Common name</th>
<th>Detections</th>
<th>Saltlick</th>
<th>IUCN status*</th>
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<td>123</td>
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*IUCN Red List status: EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern
Our results indicate that Ulu Muda’s saltlicks and their immediate surroundings host a diverse array of mammalian fauna. The 25 species of mammals recorded during the study represented approximately 40% of the total number of non-volant mammal species (i.e. excluding bats) known to occur in Ulu Muda (DWNP, 1993; WWF-Malaysia, 2002; Sharma et al., 2005; Shukor et al., 2005). These included seven out of the 11 species of large mammals that are thought to be present in the area, which made up the vast majority of wildlife detections during the study. Elephant herds were also regularly observed to contain young calves, signifying the UMFR’s importance as a breeding and rearing ground for these gentle giants.

One large mammal which was recorded during previous wildlife surveys in the UMFR, but not during the current study, was the gaur (DWNP, 1993; WWF-Malaysia, 2002). Since an animal’s utilization of saltlicks is affected both by its ranging behaviour as well as the distance it needs to travel to the saltlick (Tobler et al., 2009), it is possible that the gaur may not have visited the saltlicks within the study area due to its spatial distribution in the UMFR. Being a known saltlick user (Conry, 1989), the species would have been expected to be detected during the current study had it occurred in the study area. While the gaur’s absence from our records suggests that it may not currently inhabit the study area, the species may nevertheless continue to occur in other parts of Ulu Muda.

Apart from the gaur, three other large mammals which were also known to occur in Ulu Muda but were not detected by our camera-traps were the Malayan tiger, leopard (Panthera pardus) and Southern serow (Capricornis sumatraensis) (DWNP, 1993; WWF-Malaysia, 2002; Sharma et al., 2005). This was not surprising however, as carnivores do not commonly utilize saltlicks (Matsubayashi, 2007) while the serow is usually associated with steep terrain (Francis, 2008), instead of the relatively flat lowland forests that made up our study area. Moreover, the small size of the study area and low camera trapping efforts were also likely to have attributed to the absence of these species from our records. Nevertheless, serows are believed to be present near the Gua Labu limestone caves in the UMFR, where locals occasionally discovered their droppings during the study period (pers. comm.). Local villagers also reported encountering tiger pugmarks in the UMFR in 2013 (pers. comm.), however these claims could not be verified, leading to the belief that the iconic species might still exist in this area at low numbers.

The Asian elephant, Malayan tapir and Sunda pangolin are classified as Endangered in the IUCN Red List of Threatened Species. The presence of these species in the UMFR adds to the conservation value of Ulu Muda.
4.2 Frequency of wildlife visits

In tropical rainforests such as Ulu Muda, soils are often depleted of major cations (Jordan, 1985) resulting in plants in these areas having low foliar concentrations of minerals (Vitousek and Sanford, 1986). Herbivorous animals may subsequently suffer a lack of essential minerals, particularly sodium (Matsubayashi, 2007). The consumption of soil or water at saltlicks, primarily by herbivorous and frugivorous mammals and birds, is thus believed to address this deficiency; as saltlicks are often rich in minerals such as sodium, calcium, magnesium and potassium (Jones, 1970; Klaus et al., 1998; Matsubayashi, 2007). In 2005, Chong et al. demonstrated that Sira Air Hangat in the UMFR contained relatively high concentrations of calcium, magnesium and sulphur. Apart from mineral supplementation, the consumption of soil or water at saltlicks has also been suggested to aid wildlife in the detoxification of plant secondary compounds (Klaus et al., 1998) and the alleviation of digestive disorders (Davies and Baillie, 1988).

During our study, saltlicks were visited by a total of 15 species of animals. Large (>20 kg, Morrison et al., 2007) and medium sized (5-20 kg; Bourliere, 1975, Morrison et al., 2007) mammals made up 99% of all wildlife detections at saltlicks (Table 2). Encounter rates were calculated to compare the frequency at which different species visited saltlicks over a 100-day period. While encounter rates provided a relatively reliable representation of saltlick visitation rates by large and medium sized mammals, it should be noted that the measure may be unreliable for smaller animals as well as for arboreal animals. This is because the height and placement of camera traps in this study was unsuitable for the detection of small sized and arboreal animals, thus their probability of being detected and captured by a camera-trap was low (Tobler et al., 2008). As a result, the number of times these species were photographed may not have been representative of their relative abundance in the study area.

<table>
<thead>
<tr>
<th>Species</th>
<th>Detections</th>
<th>Encounter rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sambar deer</td>
<td>766</td>
<td>76.12</td>
</tr>
<tr>
<td>Malayan tapir</td>
<td>454</td>
<td>44.62</td>
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<tr>
<td>Wild boar</td>
<td>271</td>
<td>26.57</td>
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<tr>
<td>Asian elephant</td>
<td>208</td>
<td>20.75</td>
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<tr>
<td>Barking deer</td>
<td>69</td>
<td>6.72</td>
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<tr>
<td>Pig-tailed macaque</td>
<td>55</td>
<td>5.49</td>
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<tr>
<td>Common palm civet</td>
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<td>0.50</td>
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<tr>
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<td>Great argus pheasant</td>
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<td>0.29</td>
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<td>Long-tailed macaque</td>
<td>3</td>
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</tr>
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<td>Mousedeer</td>
<td>2</td>
<td>0.20</td>
</tr>
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<td>Clouded leopard</td>
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</tr>
<tr>
<td>Crab-eating mongoose</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>Dusky langur</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>Monitor lizard</td>
<td>1</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Table 2: Number of detections and encounter rates for medium and large-sized wildlife species detected at saltlicks in the Ulu Muda Forest Reserve
Sambar deer, tapirs, wild boars and elephants visited saltlicks an average of 20 – 76 times over the course of 100 trap-nights, distinctly more frequently than any other species. These four species visited saltlicks between 3 to 11 times more often than the fifth most abundant species, the barking deer. We concluded that the sambar deer, tapir, wild boar and elephant were amongst the most active saltlick users in the UMFR, but that the intensity of saltlick utilization varied between the species (Figure 3). Barking deer and pig-tailed macaques were also found to regularly utilize saltlicks, although to a lesser extent.

Each of the aforementioned six species has been reported to visit saltlicks in previous studies (Abdul Kadir, 1992; Chong et al., 2005; Matsubayashi, 2007; Hon and Shibata, 2013; WWF-Malaysia, unpublished data). In the current study, all except for the pig-tailed macaque were observed to drink water or engage in what was assumed to be geophagy, reinforcing our assumption that these animals visited the saltlicks for mineral supplementation. Geophagy has however also been reported in pig-tailed macaques (Krishnamani and Mahaney, 1999). It is possible that some of the species which visited saltlicks less frequently may not have been active saltlick users. Carnivores for instance (e.g. clouded leopard) may have potentially visited the saltlick to hunt for prey (Matsubayashi, 2007; Blake et al., 2011) or were simply passing by, as they do not have a particular requirement for sodium supplementation.

It was interesting to note that sambar deer visited saltlicks substantially more often than barking deer, given that both ungulates are herbivorous and therefore assumedly in similar need of mineral supplementation. Moreover, barking deers are generally thought to be the more common species amongst the two in Peninsular Malaysia (Kawanishi et al., 2012; Rayan et al., 2013). Two previous studies on saltlicks, in the Royal Belum State Park (WWF-Malaysia, unpublished data) and the Deramakot Forest Reserve (Matsubayashi, 2007), have rendered opposing results. While the former reported higher visitation rates by barking deer as compared to sambar deer, the latter reported a high visitation rate by sambar deer and no visits by barking deer – although this was arguably due to barking deer occurring at generally low abundances in the study area. Moreover, both species were detected at similar frequencies at non-saltlick locations during the current study, while a rapid camera-trap
assessment along Sungai Lasor in the UMFR rendered approximately twice as many photographs of barking deer as compared to sambar deer (Sharma et al., 2005). It is thus possible that the high visitation rate by sambar deer during our study may have been attributed to intensive saltlick utilization by a small number of individuals, potentially due to a strong demand for sodium by the species (Matsubayashi, 2007).

The intensive utilization of saltlicks by certain species, specifically ungulates and elephants, suggests that saltlicks are important resources for wildlife in the UMFR. It also indicates that minerals obtained from saltlicks may potentially be an important part of the diet of these species. Since several studies have demonstrated that sources of minerals, such as saltlicks, may influence the spatial distribution of mammals in their habitat (Weir, 1972; Tankersley and Gasaway, 1983; McNaughton, 1988), it is possible that species which commonly utilize saltlicks in the UMFR may be distributed more densely around these than elsewhere in the forest. This would make the preservation of saltlick areas particularly important for the conservation of wildlife. Hence, while further studies are required to substantiate this hypothesis, measures should nevertheless be taken to ensure that any form of disturbance to saltlicks and their surrounding areas in the UMFR is minimized.
4.3 Timing of wildlife visits

The timing of saltlick visits was established for the six most common saltlick users – the sambar deer, tapir, wild boar, elephant, barking deer and pig-tailed macaque (Figure 4). Since nocturnal species (i.e. active at night) visited the saltlicks more frequently than diurnal species (i.e. active during the day), overall saltlick utilization was higher during the night and in the early morning as compared to during the daytime. Saltlick visitation peaked between 0500 – 0600 hours and decreased rapidly towards dawn. It then remained relatively low during the daytime and gradually increased again after dusk.

![Figure 4: Saltlick visitation (i.e. percentage of detections at different times of day) by six common saltlick users](image)

Sambar deer, tapirs and elephants predominantly visited saltlicks at night, with 91% of visits being recorded between 2000 – 0800 hours (Figure 5). Activity for all three species peaked in the early morning with the highest numbers of saltlick visits recorded between 0300 – 0400 hours for the tapir, 0400 – 0500 hours for the elephant and 0500 – 0600 hours for the sambar deer. In general, saltlick visitation by the three species became very low after dawn, however, Asian elephants continued to visit the saltlicks sporadically during the daytime.

The wild boar, barking deer and pig-tailed macaque visited saltlicks primarily during the day. However, wild boars were occasionally recorded in the early hours of the morning before 0700 hours. Wild boar activity at saltlicks remained relatively constant throughout the daytime, with a slight fall around midday. Barking deer on the other hand visited saltlicks noticeably more frequently in the morning and less in the afternoon, while visitation by pig-tailed macaques peaked both in the early morning and again in the late afternoon. The pig-tailed macaque was the only species that was strictly diurnal, and was never detected at saltlicks during the night.
Figure 5: Timing of saltlick visitation (right) by six common saltlick users (left)
### 4.4 Human presence near saltlicks

The frequency of human detections near saltlicks in the study area was relatively low and spread evenly between the four saltlicks. During the study, 143 independent detections of humans were recorded, with roughly 3-6 instances of human presence being detected at each saltlick per 100 trap-nights. Overall, the vast majority of human detections near saltlicks were recorded during the daytime between 0700 and 1900 hours (Figure 6).

![Figure 6: Human activity across all study sites](image)

Most human detections were recorded during guided visits by tourists of a nearby nature lodge and during camera-trap inspections. The nature lodge, which is located at Kuala Labua along Sungai Muda, is currently the only permanent tourism operator in the UMFR. Suspected encroachers, local villagers, the local DWNP patrolling unit and other unidentified individuals made up the remaining small portion of human detections near saltlicks, and also accounted for two detections which were recorded at night.

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*Charok Nyih is a popular spot for sighting large flocks of the globally threatened plain-pouched hornbill*
5. THREATS TO SALTLICKS

5.1 Poaching and encroachment

Since saltlicks are frequently visited by wildlife, they are unfortunately also often targeted by poachers. Several signs of suspected poaching activity, including the discovery of a hunting platform (commonly referred to as a “hide”) and three detections of individuals carrying firearms by our camera-traps, suggest that illegal hunting is indeed taking place near some of the saltlicks in the UMFR. This raises a red flag for wildlife conservation since hunting activities at saltlicks can badly impact wildlife populations, as saltlicks are often visited by a large number of individuals from a given animal population (Tobler et al., 2009).

While there is some form of protection for saltlicks under the Wildlife Conservation Act 2010 (Box 1), the sheer size of the UMFR and large number of saltlicks within it creates a challenge for authorities in terms of monitoring and enforcement. Moreover, there are no dedicated rangers to control entry into the UMFR at its main entrance points such as the Muda Lake jetty. Hence, while permission from the KSFD is required to enter the UMFR, poachers may still enter the forest reserve illegally via boat from Muda Lake jetty or other access points such as old logging roads. Furthermore, a number of saltlicks in the UMFR occur near river banks making them particularly easy to be accessed by boat. Although periodic patrols are being carried out by the DWNP, man-power seems to be limited in comparison to the size of the monitored area.

We also detected several groups of individuals suspected of illegally extracting agarwood (gaharu) and discovered vehicle track marks, suspected to belong to off-road motorbikes, at Sira Air Hangat. Off-road activities do not only cause disturbance to wildlife but can also be potentially damaging to saltlicks, rendering them unattractive or unsuitable for wildlife.

*Hunting platform discovered at saltlick*

*Suspected poacher captured on camera-trap*

*Suspected foreign agarwood*
Under **Section 81**, any person, whether he is a licensed hunter, a holder of a special permit or otherwise, who —

(a) hunts any wildlife within four hundred meters of a salt lick;

(b) is in possession of any arms, bow and arrow, blowpipe, spear, catapult or any other article, which is capable of being used in hunting any wildlife within four hundred meters of a salt lick; or

(c) waits in any place, builds any platform or shelter or sets or places any trap, poison, poisoned bait, birdlime or net for the purpose of hunting any wildlife within four hundred meters of a salt lick or within any access road to a salt lick,

commits an offense and shall, on conviction, be liable to a fine not exceeding RM50,000 or to imprisonment for a term not exceeding two years or to both.

Under **Section 85**, any person who disturbs —

(a) any salt lick; or

(b) the land in the immediate vicinity of any salt lick, which land if disturbed would render the salt lick unattractive or unsafe to any wildlife,

commits an offence and shall, on conviction, be liable to a fine not exceeding RM50,000 or to imprisonment for a term not exceeding two years or to both.

For the purposes of this section, “disturb” includes to remove or agitate any soil, mineral, water, tree, shrubs, undergrowth or other vegetation in or on the salt lick or in or on the land in the immediate vicinity of the salt lick.

This section shall not apply to —

(a) the Federal Government; or

(b) any State Government,

acting, as the case may require, in pursuance of any rural development scheme, urban development scheme, forestry management scheme or industrial undertaking.
5.2 Unsustainable land-use

Even though the Wildlife Conservation Act 2010 provides provisions for the protection of saltlicks, it does not apply to parties authorized by the Federal or State governments to carry out development or forestry management projects (see Box 1 under Section 85). In the UMFR, which is predominantly classified as production forest reserve, logging activities could potentially degrade or even destroy saltlicks (Chong et al., 2005), rendering them unsuitable for wildlife. Disturbances caused by logging may also deter wildlife from approaching saltlicks, while unsustainable logging practices may create a less suitable habitat for species of wildlife which prefer high vegetation densities (Rayan et al., 2013). Furthermore, the construction of extensive logging road networks and logging camps in the forest may promote poaching activities by easing access into the forest and to saltlicks, thereby increasing the likelihood of poaching both by outsiders as well as by workers of logging concessionaires.

The Malaysian Timber Certification Scheme – MC&I (Natural Forest) (MTCC, 2012) in line with Criterion 6.2 of Principle 6, does in fact dictate forest managers to implement measures to safeguard features of special biological interest, including saltlicks, in order to maintain the forest's ecological functions. For this purpose, the Malaysian Timber Certification Council (MTCC) proposes the establishment of conservation zones and protection areas which reflect the uniqueness of the resource being affected by logging operations, as well as the scale and intensity of the operations. While the criterion is good in principle, it remains to be seen whether sufficient measures are in fact being taken by forest managers to determine the presence of saltlicks in a given area prior to making management decisions for the area. Likewise, if saltlicks were in fact identified, the lack of a guideline on how to adequately protect the saltlick would still make it difficult for forest managers to fulfil the criteria.

5.3 Unsustainable tourism

Saltlicks are frequently perceived as valuable points of interest for nature tourism activities. While it is important to minimize all forms of disturbances near saltlicks, low-impact nature tourism could arguably provide overarching benefits for wildlife conservation by promoting the protection of forested areas which would otherwise be at risk of exploitation for natural resources. Nature tourism which is based on the exploration of forested areas and allows for economic gains to be made, while retaining the forest in a relatively undisturbed state, is therefore increasingly perceived as a viable compromise to other, potentially more damaging, economic activities such as timber extraction (Chong et al., 2005).

While current nature tourism activities in the UMFR are of relatively low-impact, unsustainable future developments could have profound negative impacts on Ulu Muda’s saltlicks and wildlife. Sira Air Hangat, which combines the properties of a natural saltlick and hot spring, is amongst the most popular saltlicks for tourism in the UMFR, but unfortunately also one that is at a higher risk of development. Like many other hot springs in Malaysia that have been converted into recreational areas and bathing pools, which allow visitors to benefit from the widely-believed curative properties of the hot spring (Chong et al., 2005), Sira Air Hangat too has been proposed for similar development in the past (The Star, 2014).
Such development would not only cause major disturbances to the area but would render the saltlick inaccessible to wildlife. While it could be argued that wildlife could compensate their mineral requirements by visiting other saltlicks, too little is known about the mineral content of Ulu Muda’s saltlicks to come to such conclusions. This is because saltlicks, including Sira Air Hangat, may be unique in terms of mineral composition, potentially making each one an irreplaceable resource for wildlife. All saltlicks should thus be retained in their original state, and any tourism activities which are to take place in their vicinity should be carefully monitored and controlled as to minimize their impact on wildlife.

*The floodplains of Sungai Teliang, one of the two major tributaries of Muda Lake*
In the interest of conserving saltlicks as one of the important resources for wildlife, the following management recommendations have been formulated to address some of the most pertinent threats which are currently faced by saltlicks in the UMFR and likely also elsewhere in Ulu Muda.

6.1 Strengthen anti-poaching measures

6.1.1 Intensify patrolling around saltlicks
Considering that saltlicks are often targeted for hunting activities (Tobler et al., 2009) and at least one hide suspected of being used for poaching was discovered near a saltlick during our study, patrolling should be intensified near saltlick areas by the KSFD or the Department of Wildlife and National Parks (DWNP). To allow for the development of an effective patrolling plan which includes and accentuates saltlicks, all saltlicks in Ulu Muda should be identified and mapped.

6.1.2 Seal off unused logging roads
Old logging roads which are no longer in use, especially those which extend far into the forest reserve, should be sealed off by constructing barriers or ditches (Linkie et al., 2008). This is to prevent unauthorized vehicular access to saltlicks, specifically by poachers and off-road enthusiasts. The move may also deter any encroachers, local or foreign, from entering the forest for possible illegal activities.

6.1.3 Prohibit off-roading activities
Since movements of off-road enthusiasts cannot be monitored in the forest, it is in the KSFD’s best interest to completely prohibit access into Ulu Muda for recreational off-roading activities, including for four-wheel drives and off-road motorbikes. This is hoped to prevent vehicular access to saltlicks, which could degrade or damage natural saltlicks and render them unsuitable for use by wildlife.

6.1.4 Establish check-points at Muda Lake jetty and other major access points
A check-point should be established at Muda Lake jetty (main access point) as well as at other major access points into Ulu Muda. The check-points should be manned 24-hours a day, potentially by the KSFD or DWNP. Details of all boats and people entering and exiting Ulu Muda via these access points should be recorded, and only those with approved permits should be allowed entry (with the exception of local fishermen holding a valid license from the Department of Fisheries). All boats should be searched upon entry and exit for illegal items such as firearms, wildlife parts, etc. The relevant authorities could also train and encourage local fishermen, boat owners and tour operators, to be vigilant in renting out their boats or providing their services to individuals suspected of illegal activities, for instance those carrying illegal items such as firearms into the forest.
6.1.5 *Engage local stakeholders as informants*

The KSFD and DWNP should engage local villagers and other local stakeholders, such as tour operators and fishermen’s associations, as informants to report poaching activities. To encourage collaboration, incentives should be duly given to any party which provides such information.

6.1.6 *Collaborate with the Malaysian Army*

The KSFD and DWNP should establish collaboration with the Malaysian Army to work together to apprehend foreign encroachers entering the Ulu Muda through the Thai-Malaysian border. Such collaborations between enforcement agencies have been established in other forest landscapes to address the issue of resource limitations, especially for the patrolling of an area. Examples include the collaboration between the DWNP and Malaysian Army in Taman Negara Pahang and the formation of the Belum-Temengor Joint Enforcement Task Force involving a total of ten agencies.

6.2 *Control land-use activities near saltlicks*

6.2.1 *Identify saltlicks as HCVF areas*

Our study demonstrated that saltlicks in the UMFR are focal points for wildlife including for endangered and threatened species of mammals. As such, any form of disturbance which could potentially degrade saltlicks or discourage wildlife from approaching them, should be minimized. We recommend that all saltlicks in Ulu Muda (inclusive of a 2km buffer zone, see Section 6.2.2) be protected by identifying them as High Conservation Value Forest (HCVF) areas in line with Principle 9 of the MC&I (Natural Forest) (MTCC, 2012), within the Malaysian Timber Certification Scheme applicable to the Kedah Forest Management Unit (FMU). To date, none of the saltlicks in Ulu Muda have been identified as HCVF by the Kedah State Forestry Department (KSFD, 2013).

6.2.2 *Establish 2km buffer zones around saltlicks*

The demarcation of HCVF areas should not be limited only to saltlicks, but encompass a buffer zone of surrounding forested area in which any type of disturbance is minimized. A buffer size of 2km is suggested based on a sambar deer occupancy model from a study in Temengor Forest Reserve, Gerik, Perak, which predicts that a 2km minimum distance from human disturbance is required to ensure a 60 – 80% likelihood of sambar deer occupying an area within the vicinity of a saltlick (between an elevation zone of 300-500m a.s.l.) (Rayan et al., 2013). The buffer area will represent the outer boundary of the HCVF.

6.2.3 *Manage HCVFs as strict conservation areas*

Identified HCVFs (i.e. all saltlicks and their 2 km buffer zones) should be maintained as strict conservation areas in order to safeguard their function for wildlife, as required under Criterion 9.3 and Criterion 6.2 of the MC&I (Natural Forest) (MTCC, 2012). No land-use change or infrastructure development should be allowed within the HCVF, with the exception of existing infrastructures, namely a nature lodge near Kuala Labua and a wildlife hide at Sira Air Hangat.
Identified HCVF areas should also be off-limits to visitors, except to researchers and scientists whose activities shall be strictly monitored by the KSFD. In the interest of tourism and environmental awareness, public access may be granted to a limited number of visitors and under strict guidelines, to a particular saltlick which has been selected for this purpose, as detailed in Section 6.3.

### 6.2.4 Gazettement of Ulu Muda as a protected area

Given the large number of natural saltlicks found in Ulu Muda and the area’s abundant and diverse fauna, we recommend that all remaining forested areas within Ulu Muda should be retained as natural forest. Logging should also be prohibited as this poses direct and indirect threats to wildlife. Ideally, all PFRs in the Greater Ulu Muda forest complex should be reclassified as protection forest reserves under the National Forestry Act 1984, or other appropriate act or enactment. The establishment of a protected area, such as a state park or a national park, would also provide better resources to control access into the forest and for patrolling of areas at high-risk of poaching, such as saltlicks.

In addition, the protection of the Greater Ulu Muda forest would safeguard the area’s function as the largest water catchment in northern Peninsular Malaysia, which supplies water to the states of Kedah, Penang and Perlis. This would ensure water security in these states for domestic consumption as well as for industrial use and irrigation; as the Muda catchment supplies water to the industrial areas in Bayan Lepas and Seberang Perai in Penang and the Kulim Hi-Tech Park in Kedah, as well as the rice fields of the Muda Irrigation Scheme. The vast rice fields of Kedah and Perlis, coined the “rice bowl of Malaysia”, which are supplied by the Muda Irrigation Scheme, provided a staggering 50% of Malaysia’s rice supply in 2011 and are thus pivotal in ensuring the nation’s food security (DOA, 2012).

### 6.3 Regulate tourism activities near saltlicks

#### 6.3.1 Limit access to natural saltlicks

Access to natural saltlicks for the purpose of tourism should be restricted to a single saltlick, potentially Sira Air Hangat, at which a wildlife hide currently exists and which could be utilized for wildlife observations. The number of tourists who are allowed to visit the saltlick over a given period of time should be controlled by the KSFD with the assistance of entrusted local guides or tour operators, and tourists should only be allowed to visit the saltlick in their presence. In order to determine the maximum viable number of visitors that can be allowed to visit Sira Air Hangat over a set period while minimizing the potential effects to wildlife, an ecological carrying-capacity study should be conducted. Since saltlicks remain an important feature for nature tourism, it is recommended that artificial saltlicks be created for this purpose in areas that have been identified for limited and controlled access by visitors to Ulu Muda.
6.3.2 Timing of saltlick visits

Saltlick visits by tourists should be timed to minimize any disturbance to wildlife. Since most tourist visits are conducted during the daytime, tourists should be encouraged to visit the saltlick when visitation by diurnal wildlife such as wild boars, barking deer and pig-tailed macaques is relatively low, i.e. from 1100 – 1300 hours. Visitors who wish to observe wildlife from the wildlife hide at Sira Air Hangat, which may involve staying in the hide overnight, should take sufficient measures to reduce disturbance to wildlife, especially since species such as elephants and tapirs, which are of high conservation concern, visit saltlicks predominantly at night. Such measures include abstaining from wearing perfume or other scented substances such as insect repellent, smoking and making noise.

An existing wildlife hide at Sira Air Hangat that could be used to observe animals that visit the saltlick
REFERENCES


Bernama. 2009. More than 121,000 hectares in Kedah gazetted as forest reserve. Newspaper article: 08th October 2009.


## Appendix 1: Inventory of mammals recorded in Ulu Muda

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific name</th>
<th>Common name</th>
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<td>Artiodactya</td>
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*Sources: DWNP (1993); Mariana et al. (2005), Shukor et al. (2005); Sharma et al. (2005); WWF-Malaysia (2002); current study.*
Appendix 2: Wildlife camera-trapped near saltlicks in the UMFR

Barking deer
*Muntiacus muntjak*

Mousedeer
*Tragulus sp.*

Sambar deer
*Rusa unicolor*

Wild boar
*Sus scrofa*

Malayan tapir
*Tapirus indicus*

Asian elephant
*Elephas maximus*

Banded civet
*Hemigalus derbyanus*

Banded linsang
*Prionodon linsang*

Common palm civet
*Paradoxurus hermaphroditus*

Masked palm civet
*Paguma larvata*

Binturong
*Arctictis binturong*

Crab-eating mongoose
*Herpestes urva*

Photos on this page: © WWF-Malaysia
Yellow-throated marten  
*Martes flavigula*

Malayan sun bear  
*Helarctos malayanus*

Clouded leopard  
*Neofelis nebulosa*

Golden cat  
*Pardofelis temminckii*

Leopard cat  
*Prionailurus bengalensis*

Marbled cat  
*Pardofelis marmorata*

Smooth otter  
*Lutrogale perspicillata*

Long-tailed giant rat  
*Leopoldamys sabanus*

Malayan porcupine  
*Hystrix brachyura*

Dusky langur  
*Trachypithecus obscurus*

Long-tailed macaque  
*Macaca fascicularis*

Pig-tailed macaque  
*Macaca nemestrina*

Photos on this page: © WWF-Malaysia
Sunda pangolin
Manis javanica

Crested fireback pheasant
Lophura ignita

Great argus pheasant
Argusianus argus

Red jungle fowl
Gallus gallus

Green-winged pigeon
Chalcophaps indica

White-rumped shama
Copsychus malabaricus

Clouded monitor lizard
Varanus nebulosus

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WWF-Malaysia (World Wide Fund for Nature-Malaysia) was established in Malaysia in 1972. It currently runs more than 90 projects covering a diverse range of environmental conservation and protection work, from saving endangered species such as tigers and turtles, to protecting our highland forests, rivers and seas. The national conservation organization also undertakes environmental education and advocacy work to achieve its conservation goals.

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