RELATION BETWEEN GRASSES AND LARGE HERBIVORES AT THE ULU MUDA SALT LICKS, PENINSULAR MALAYSIA

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CHEW MY, HYMEIR K, NOSRAT R & SHAHFIZ MA. Relation between grasses and large herbivores at the Ulu Muda salt licks, Peninsular Malaysia. Ulu Muda Forest Reserve is known for its salt licks and grassy floodplains. Previous studies largely overlooked the floristic component of Gramineae in this herbivore-rich forest. This paper reports on the dominant grass species present at Sira Bongor, Sira Keladi and Sira Air Hangat salt licks, namely, *Hymenachne amplexicaulis, Centotheca lappacea* and *Oryza ridleyi* and describes the niches occupied by grasses at the three sites in relation to signs of large herbivore activities. Preliminary evidence indicated that the salt licks and adjacent *H. amplexicaulis* swamps were dynamic habitats, plausibly created and maintained by large-bodied herbivores including elephants. The presence of grasses that extended the role of salt licks as places for both minerals and nutritive food intake for large herbivores was discussed.

Keywords: Salt lick vegetation, Gramineae, herbivore, Asian elephant

INTRODUCTION

The Ulu Muda Forest Reserve (105,060 ha) of the state of Kedah consists of mainly lowland to hill dipterocarp forest and riverine forest with distinct dry periods (Sharma et al. 2005). It is slightly south of the Kangar–Pattani border that divides the lowland evergreen rainforest in the floristic zone of the Malay peninsula from the semi-evergreen rainforest in the Isthmus of Kra (Saw 2010). The combined effects of logging from the 1960s to the 1990s and the impoundment of three catchments for dams and reservoirs gave rise to seasonally inundated floodplains at lower elevations dominated by grasses, sedges, herbaceous creepers and climbers (Suksuwan 2008). Although extensive surveys on various plant groups have been carried out during the Ulu Muda Scientific Expedition in March 2003 (Shaharuddin et al. 2005), the family Gramineae was overlooked and not reported. Prior to 2010, only one Gramineae specimen (*Scrotochloa urceolata*) from Gua Labu in Ulu Muda was deposited at the Kepong Herbarium, Forest Research Institute Malaysia.

Almost all extant Peninsular Malaysian large herbivores are found in Ulu Muda (PERHILITAN 1993, Sharma et al. 2005), which include Asian elephant (*Elephas maximus*), Malayan gaur (*Bos gaurus*), Malayan tapir (*Tapirus indicus*), sambar deer (*Rusa unicolor*), barking deer (*Muntiacus muntjak*) and historical records of the critically endangered Sumatran rhinoceros (*Dicerorhinus sumatrensis*) as well as the endangered banteng (*Bos javanicus*). Studies pertaining to local wildlife habitats often acknowledge salt licks (sites with localised natural concentrations of minerals such as sodium and/or calcium and/or magnesium within or arising from soils or rocks) as a key component limiting species distribution and abundance (Caldecott 1988, Payne 1990, Novarino 2005, Matsubayashi et al. 2007). An area around Gerik in the state of Perak was known to hold one of the densest elephant populations in Peninsular Malaysia, attributed to its large number of salt licks (Khan 1969, Olivier 1978). Under Section 85 of the Wildlife Conservation Act 2010 (Act 716) for Peninsular Malaysia, salt licks and

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land in its immediate vicinity are protected against disturbance of soil and vegetation to ensure the attractiveness and safety of the salt licks for wildlife (Laws of Malaysia 2010). However, information on vegetation cover at and near salt licks is scanty. Ulu Muda is known for having numerous salt licks (Suksuwan 2008). More than 12 salt licks are recorded along the stretch of Sungai Muda from the tourist jetty to the Kuala Labua base camp (K Hymeir, personel observation).

Malaysian wildlife cannot be compared with the abundant African wildlife that has become the basis of an important and lucrative tourist industry (Olivier 1978). In Malaysia, large mammal viewing is largely restricted to salt licks. Management recommendations have been formulated for salt licks in Ulu Muda, suggesting a wildlife-sensitive area with a buffer area of 400 m radius. The surrounding vegetation of Sira Air Hangat, in particular, was recorded as secondary growth regenerated after being logged in the 1980s, with the mention of a patch of grassy bank (Chong et al. 2005). This paper aims to describe the vegetation make-up of three salt licks with particular reference to grasses, the presence of which extends the role of salt licks beyond the provision of minerals to include grasses as part of the food intake for large herbivores.

MATERIALS AND METHODS

On 26–28 February 2010, the Malaysian Nature Society, Selangor Branch, Nature Guide Special Interest Group organised a field excursion to the Ulu Muda Forest Reserve (100° 50'–101° 3' E, 5°49'–6°12' N). Three salt licks close to Kuala Labua Base Camp along the Sungai Muda, namely, Sira Bongor (Figure 1), Sira Keladi and Sira Ayer Hangat (Figure 2) were visited. Physical properties, vegetation structure and evidence of large herbivore activity were recorded. Fertile samples of grasses with clear signs of them being consumed by herbivore were collected from the salt licks and adjacent open swamps. Less abundant grasses at the forest edge and grasses of riverbanks were, however, not included in the study. Plant specimens were identified to species based on leaf and spikelet characters. Mounted herbarium specimens were deposited at the Kepong Herbarium, Forest Research Institute Malaysia and National Herbarium Netherlands, Leiden. Nocturnal sentries were set up at the elevated hide at Sira Ayer Hangat on 26–27 February from 19:00 to 07:00 hours to observe large herbivore activity. Large herbivore tracks noted on the muddy substrate surrounding the salt lick were identified based on the guide by PERHILITAN (2010).

Figure 1 The Sira Bongor salt lick seepage drains into a stagnant pond, which is adjacent to a stretch of open, inundated *Hymenachne amplexicaulis* grassland interspersed with stag-headed dead trees of various sizes

Figure 2 View of Sira Air Hangat from the hide overlooking the open thermal patch bordered by a stream with small patches of *Centotheca lappacea* with tall secondary forest beyond

RESULTS

Salt lick environment and herbivore activity

The salt licks of Sira Bongor and Sira Keladi had similar vegetation. These semi-open microhabitats covered about 25 m × 30 m and 40 m × 25 m of open, non-canopy-covered spaces respectively. They were surrounded by logged, tall secondary forest that separated them from the river banks. The main salt lick areas were situated to one side of these clearings and centre on mineral springs. These salt lick areas were mostly devoid of vegetation except for scattered tufts of short grasses on muddy substrates, as a result of heavy trampling evident from the large herbivore footprints including those of elephant, tapir, sambar deer and barking deer. The salt lick seepages drained into stagnant ponds, the peripheries of which were littered with elephant dung. The salt licks were lightly shaded on one side by the tall forest and increasingly exposed to full sun towards the ponds. The pond at Sira Keladi has been documented to be churned and excavated by elephants (K Hymier, personal observation), with floating dung boli and clear tracks of elephants and other herbivores leading to and from it.

Sira Air Hangat is a thermal spring that differs geophysically and vegetatively from Sira Bongor and Sira Keladi but is similar in being surrounded by tall secondary forest. It is approximately 48 m × 24 m in area, with a shallow stream flowing along its boundary. The predominant feature is an open area of river sand and laterite that constantly emits hot steam, with several scalding springs that flow only a short distance before mixing with the cool (23.3–25.7 °C) stream water. The resulting lukewarm (41.5–60.3 °C) flow then channels through a stretch of typical lowland riverine vegetation towards Sungai Muda. Plant life is restricted to the boundary beyond the hot air and water vents, with thick undergrowth and a layer of climbers smothering the low trees at the edge of the salt lick, broken in places by animal trails. Grasses colonised the cooler stream banks and salt lick periphery in small patches. Small animal wallows were present but did not develop into conspicuous ponds.

A small herd of elephants was heard walking, feeding, drinking, bathing and actively vocalising from 22:00 to 02:00 hours at Sira Air Hangat on 26–27 February. They were moving in the forest surrounding the salt lick and spent about 1 hour splashing around the lower stretches of the stream before moving on towards Sungai Muda.

Unexpectedly, they circumvented the open central thermal area visible from the hide. The following morning, fresh dung and footprints of several adults (the largest front print 32 cm long) and the hind print of a young animal (17.6 cm) were seen next to the stream, indicating the presence of a small matriarchal breeding unit.

Extra salt lick feeding tracts

The adjacent grassy swamps of Sira Bongor and Sira Keladi were relatively extensive, covering ⅔ to ¾ of the open spaces, with dense stretches of single-species, semi-aquatic grasses. A few erect, debarked, stag-headed dead trees dotted the swamps while toppled trees occurred close to the peripheries. These were mainly pole size (2.5 cm ≤ diameter at breast height ≤ 15 cm) or slightly larger, indicating that the open habitats were formerly part of the surrounding regenerated secondary forest. The swamps, comprising open-watered pond as well as grass-covered marsh, appeared to be of recent origin and could have begun with the formation of depressions by trampling activity of large-bodied animals, followed by inundation and fatal waterlogging of roots of the existing tree stands, leading to the eventual colonisation by grasses. However, no grassy swamp was observed adjacent to Sira Air Hangat that had an open central thermal area largely devoid of vegetation. Unlike the grassy swamps of Sira Bongor and Sira Keladi, the opening at Sira Air Hangat did not have toppled or recently dead trees, indicating signs of a dynamic, on-going formation. The opening in Sira Air Hangat has probably been in existence far longer than those of Sira Bongor and Sira Keladi due to the thermal activity unfavourable for plant growth.

Large bodied herbivores are keystone species in which their feeding behaviours can alter ecosystems, at least on the level of habitat patches (Owen-Smith 1988). In Peninsular Malaysia and Sumatra, elephants were recorded to push over trees up to 10 cm diameter at breast height (Olivier 1978). Daily routines of large herbivores, through the combined effects of excavation and compaction, create and enlarge mud wallows, mineral pits, seepage wells, streambeds as well as other landscape and hydrological features (Haynes 2006). Conversion of originally wooded areas to open scrub and sphagnum bogs by elephant activities has been reported from the highlands of the east coast state of Kelantan (Yao et al. 2009). Sira Bongor, Sira Keladi and other salt licks of Ulu Muda with similar vegetation are presumed to be a seral plant community created by a combination of geophysical and zoogenic factors. The removal of large herbivores from the system could result in a change in vegetation, with a tendency to succession towards tree cover.

In Peninsular Malaysia, although grass (including Cyperaceae and Gramineae but excluding bamboo) availability is merely 0.01% in the primary forest studied in Taman Negara, Pahang, the percentage of occurrence in the diet of an elephant is as high as 33.1%, and while rainforest trees are generally avoided, palms (including rattans), herbs (including gingers and bananas) and most grasses are actively sought out relative to availability (Olivier 1978). Grass contains more carbohydrates than browse from dicotyledonous plants and is more accessible to elephants of all age classes (Field 1971, Easa 1989). Elephants occupy larger home ranges in primary forest compared with secondary forests, as biomass in the former is mostly trapped in large trees unavailable to elephants (Olivier 1978, Easa 1988, Sukumar 1992). Asian elephants prefer deciduous forest to evergreen forest and early seral forest with open canopy to climax forest with closed canopy (Olivier 1978, Karoor 1992). Grasses are found naturally in riverine forest, a habitat reportedly favoured by elephants in Peninsular Malaysia (Olivier 1978).

Prominent grasses

Hymenachne amplexicaulis

Hymenachne amplexicaulis is the most prevalent ground cover around the three salt licks. It is a robust, rhizomatous herb to 1.6 m tall, erect or ascending from a prostrate base, spreading on dry land or floating in water. Naturally occurring in the shallow water at the margins of freshwater swamps and slow rivers with muddy or clayey soils, this species has a wide distribution from India to Borneo (Gilliland 1971, Duistermaat 2005). It is adapted to fluctuating water levels and massive regeneration by seed may occur after drought. Empty patches were noticeable among the *H. amplexicaulis* swamp. They probably had been uprooted and consumed by elephants. Dispersal of seeds and vegetative propagules is recorded

to be aided by water flow, mammals and birds (Hunter et al. 2010).

Centotheca lappacea

Centotheca lappacea species was found at the three salt licks. At Sira Bongor and Sira Keladi, this species grows mainly in a partially shaded zone fringing the swamp, on soils that are above the water table. At Sira Air Hangat, it forms small tufts fringing the stream. At hardly 15 cm tall, *C. lappacea* specimens here were rather dwarfed with small, rounded leaves, possibly attributable to some extent to frequent trampling and grazing by large herbivores. Traditionally regarded as good fodder for cattle (Heyne 1927), it is commonly called barbed grass because of its prickly spikelets that adhere to animal fur and are so dispersed. This grass has wide distribution across the Paleotropics. In Peninsular Malaysia, it is often found at forest margins on moist soils (Duistermaat 2005).

Oryza ridleyi

Oryza ridleyi species was found at Sira Bongor and Sira Keladi but not at Sira Air Hangat. It forms tall tufts to 1.5 m, stoloniferous, scattered among much shorter *C. lappacea* close to the forest margins. *Oryza ridleyi* is a type of wild rice distributed from Myanmar to Papua. It prefers shaded forest margins and river banks with soft and highly organic soils but does not survive well in full sun and swamps (Duistermaat 1987).

DISCUSSION

The grassy environment of Sira Bongor and Sira Keladi are dynamic habitat patches, plausibly created and maintained by the activity of elephants and other large herbivores. Human disturbance at the Ulu Muda salt licks should be strictly regulated and kept to a bare minimum so that large herbivores are encouraged to continue using the salt licks. Substantial herbivore activity maintains the open environment necessary for grasses to grow, which attract more herbivores, which in turn complete the feedback loop. Managing the remaining habitats well is more cost effective and benefits a wide range of animals that occupy different niches, compared with capturing and translocating animals once the habitats have been degraded.

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