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Rarity and Extinctions of Large Mammals in Malaysian Rainforests

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ABSTRACT

The past and present distribution and abundance of large mammals in Malaysia is reviewed. Hunting, habitat loss and timber extraction – factors commonly believed to have contributed to the present patterns of distribution and abundance – are discussed, with the orang-utan in Sabah as the main example. It is concluded that human activities only partly account for the present restricted distributions and numbers of some of the species. It is suggested that the amounts and availability in the environment of certain chemical elements, especially sodium, strongly influence large mammal populations. Implications for conservation are discussed.

INTRODUCTION

The natural vegetation of the great majority of Malaysia's land area, including swamps, is evergreen tropical moist forest of a wide variety of types, often summarised as "rainforest". Large mammals occur at naturally low population densities in rainforest habitats in comparison to the same or similar taxa in more open or seasonal habitats. The major reason for low abundance of large mammals in Malaysia is believed to be the low productivity and availability of food. For example, monocotyledonous plants, the main food items of elephants (Olivier, 1978) are very scarce except in logged forests. Likewise, artiodactyls feed primarily on grasses, herbs and the leaves of some small woody plants, which are sparsely distributed and have low productivity in closed-canopy forests. In contrast, the Malaysian tapir and rhino, which occur at very low population densities, feed primarily on the mature leaves of a wide variety of woody plants, a food supply which is seemingly superabundant.

Numerous experiences throughout South-east Asia have shown that large-scale loss of forest cover is accompanied by eventual extinction of large mammals, irrespective of intensity of hunting pressures. Viewed on a world basis, in the long-term, the conservation of extensive tracts of Malaysian rainforests is likely to be of major importance to the continued existence of such species as Asian elephant *(Elephas maximus)*, Asian two-

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horned rhinoceros *(Dicerorhinus sumatrensis)*, Malayan tapir *(Tapirus indicus)*, the wild cattle species – seladang (gaur, *Bos gaurus*) and banteng *(B. javanicus)*, serow *(Capricornis sumatraensis)*, sun bear *(Helarctos malayanus)* and orang-utan *(Pongo pygmaeus)*.

MATERIALS AND METHODS

Published and unpublished information relevant to the distribution and abundance of large mammals in Malaysia was reviewed. Information on the distribution of large wild mammals in Malaysia during the nineteenth century is available from many sources, most of which are given in the references and bibliographies of Medway (1977, 1983). Information on present distribution patterns of large mammals was obtained during the past twelve years from many unpublished sources (for Peninsular Malaysia and Sarawak) and during surveys conducted jointly by the Sabah Wildlife and Forestry Departments with the World Wide Fund for Nature (WWF) Malaysia (Davies and Payne, 1982; Payne, 1988, 1990; WWF Malaysia, undated). The distribution and general status of the orang-utan *(Pongo pygmaeus)* in Sabah in relation to forest cover has been documented in detail for conservation purposes (Payne, 1988). Additional information on large mammals in similar forest habitat in Sumatra was obtained from other sources (van Strien, 1985; Whitten *et al.*, 1984). The pattern and rate of reduction in forest cover in Malaysia since the last century has not been documented in detail, but can be inferred from a range of published literature, along with personal observations.

RESULTS

1. The lowlands in the west and south of Peninsular Malaysia lost much of their forest cover in the early decades of this century, while the present pattern of forest distribution in other parts of the Peninsula has come about mainly since the 1960's. Sabah began to lose significant amounts of forest cover only during the 1960s, and the greatest loss occurred after 1980. Sarawak still maintains more forest than any other part of Malaysia.

2. Only two mammal species have become extinct in Peninsular Malaysia since the last century: the banteng and Javan rhinoceros. Both exhibited highly restricted distribution and abundance, and both became extinct well before extensive forest loss, logging or widespread availability of guns. No large mammal species have become extinct in Sabah or Sarawak during the past century (although there are unreliable reports pertaining to tapir and Javan rhino).

3. With the exception of the Asian two-horned rhinoceros, there is no evidence – on a country-wide basis – that any large mammal species in Malaysia has been significantly reduced in numbers or distribution by human hunting. Locally, prolonged and intense hunting pressure has certainly reduced or wiped out some species (for example, both wild cattle

species), but these effects are generally trivial to the species' survival. Nowadays, the relevance of hunting to species' survival in Malaysia is commonly over-emphasised. Hunting has become a factor to be reckoned with because large mammals are isolated into forest areas which are too small for them and because road access and guns are available.

4. With very few exceptions large mammals are not adversely affected to any significant extent by logging (that is timber extraction) as practised in Malaysia (for example, Davies and Payne, 1982; Johns, 1983, 1987; Payne, 1988).

5. Large herbivorous wild mammals in Malaysia, as elsewhere, visit concentrated natural mineral sources (often known as "salt licks"). In Sabah, there is a close correlation between the distribution of salt licks and of both elephants and rhinoceroses. Sodium appears to be the major, but not sole, element sought by large mammals at natural concentrated mineral sources in Sabah. The same finding has been demonstrated for large mammals in many other habitats, temperate and tropical (for example, McNaughton, 1988). It is likely that elephants and rhinos especially, having a high body mass: surface area ratio, are seeking sodium at salt licks, because evaporative loss of water through the skin, acting as a coolant, results in high sodium losses. (Mature female rhinos, either pregnant or with young, repeatedly visit salt licks, a factor which facilitates hunting and has contributed to the species' demise through selective removal of breeding females (van Strien, 1985; Payne, 1990).

6. The concentrations of sodium and phosphorus in Malesian rainforest leaves are below the dietary requirements of mammals (for example, van Strien, 1985; Payne, 1988). Thus, strict herbivores must obtain these elements from other sources.

7. The occurrence of fossil and sub-fossil remains of orang-utan at Niah caves in northern Sarawak suggest that this species was much more widely distributed than is presently the case in Sarawak, from at least 40,000 years to a few thousands of years ago. Orang-utans were hunted and eaten by people throughout that period. Although numbers of orang-utans have decreased in Sarawak during this century, the species' distribution is about the same now as it was in the middle of the last century. Orang-utans occur as breeding populations in southern Sarawak, the region where there are the most people, but not in the sparsely-inhabited northern interior regions.

8. In Sabah, orang-utans are abundant only in parts of the eastern lowlands and are absent from most of the west and north (Map 1). Such distribution patterns have been assumed to be a result of human hunting and forest loss (for example, Rijksen, 1978), but there is no evidence for this assumption. Orang-utans in Sabah achieve greatest population densities (averaging 3 individuals per square kilometre) in freshwater swamp forest and

adjacent lowlands, areas which were under sea water about 6,000 years ago (Tjia, 1980), and accordingly are expected to be richest in sodium. Population densities decrease greatly, on average, with increasing altitude, slope and distance from the sea and large rivers, to about 0.3 individuals or less per square kilometre in hill dipterocarp forests up to about 500 metres above sea level. With a few exceptions, breeding populations cease to exist above that altitude. Orang-utans appear to have always been absent from forests on the volcanic soils of south-eastern Sabah. However, they appear to achieve greater abundance on hills of ultrabasic rocks than on sedimentary rocks. Although the species may have been wiped out or reduced in numbers locally by hunting (notably in parts of southern Sarawak), there is no consistent relationship between the occurrence of orang-utans and of hunting peoples. Selective logging appears to have little effect on orang-utan numbers or breeding in Sabah (although contrary results have been reported for Sumatra and Sarawak). Two areas where orang-utans were studied intensively in the late 1960's, before logging, were revisited in 1987, after logging, and population densities were estimated to have remained about the same. The long-term effects of logging on orang-utan populations will not be clear for many decades, but observations in Sabah for the period which would seem to be most traumatic, during logging operations and the first decade thereafter, do not reveal any decrease in the proportion of young animals.

9. Excluding regions which have supported cultivation for a very long time and regions of basaltic soils, the present distribution of orang-utans in Sabah and Sarawak shows a fairly close inverse relationship with rainfall. High rainfall on slopes causes severe leaching of some minerals, especially sodium, the most soluble cation.

10. Most of the forests which support the greatest concentrations of elephants in Sabah were logged during the period mid 1950's to mid 1970's, leading to an unmeasured but clearly vast increase in availability of elephant food plants. While much of this forest land was subsequently cleared and converted to agricultural plantations, there was never any indication of an increase in elephant population size or distribution. Moreover, despite the existence of large areas of seemingly suitable habitat unoccupied by elephants, the species distribution in Sabah is about the same as it was more than a century ago.

DISCUSSION

It has been stated above that the abundance of large mammals in Malaysian rainforest is low in comparison to that of similar taxa in more open and seasonal forested habitats. Actual population density estimates for terrestrial herbivores in Malaysia remain to be made, but existing information on the arboreal leaf-eating monkeys, *Presbytis* (ecologically rather similar in their diet of leaves and seeds) reveals some interesting pointers. The population density of these monkeys varies greatly from

place to place but, on average, forests in Peninsular Malaysia appear to support a much greater biomass of *Presbytis* than superficially similar forests in Sabah. For example, lowland dipterocarp forest at Kuala Lompat (Pahang) supports about 880 kilograms of leaf monkeys/square kilometre, while lowland dipterocarp forest at Sepilok (Sabah) supports about 64 kilograms/square kilometre (Waterman *et al.*, 1988). Comparing Peninsular Malaysia and Sabah generally, forests in the former appear to support between five and ten times more monkeys than forests in the latter (Marsh and Wilson, 1981; Davies and Payne, 1982). Hunting pressure on the monkeys is absent or very low in the forests compared in these two studies. Waterman *et al.*, (1988) suggest that greater concentrations of nitrogen (largely proteins) and lower concentrations of fibre and phenolics at Kuala Lompat account for the greater monkey biomass. The same authors suggest that this difference is largely a reflection of a greater biomass of dipterocarp trees in Borneo forest, which in turn tends to be manifested on soils of relatively low fertility. In addition, the productivity of fruits and of new leaves, the foodstuff of these animals, is likely to be closely correlated with soil fertility.

The factors influencing leaf monkey population density cannot be entirely the same as those influencing large terrestrial herbivores, because the monkeys are widespread in almost all Malaysian forests, while the largest terrestrial mammals are restricted to certain areas. However, the monkey data do indicate that the term "low" abundance may span 5–10 fold differences in actual population density, presumably reflecting 5–10 fold differences in the availability of limiting resources. This point is especially relevant to the status of large carnivores, which depend mainly on larger herbivores as their food. If average population densities of all herbivorous mammals, like those of leaf monkeys, are much lower in Borneo than in Peninsular Malaysia, food supplies for tigers and leopards may be below the threshold required to support breeding populations of these large carnivores.

While the evident importance of natural salt licks to large mammals is well-known to wildlife biologists in tropical rainforest ecosystems, few have ventured to suggest that the availability in the environment of essential minerals might be the key factor limiting species distributions and abundance. The data for Sabah suggest that the availability of concentrated sodium sources may be such a limiting factor for elephants and rhinos. Banteng and smaller ungulates (deer and bearded pigs) visit natural salt licks in Sabah, but they also occur in areas where elephants and rhinos are absent, so other factors must be involved in determining their distribution.

The tapir and Javan rhinoceros *(Rhinoceros sondaicus)* were once present in Borneo but both became extinct in relatively recent times (Cranbrook, 1986). The period of these extinctions is unknown, but it was certainly before both the advent of guns and the clearance of forest for permanent agriculture. In contrast, the Asian two-horned rhinoceros, under great hunting pressure over the past few centuries in Borneo (Medway,

1977), still survives. Since the tapir was probably never under the hunting pressure experienced by rhinos, Cranbrook (1986) seeks alternative explanations for its disappearance, and suggests that the spread of closed canopy rainforest after the last ice age has eliminated the habitat required by this species. The survival of the tapir under similar conditions in Peninsular Malaysia then becomes a greater mystery.

The extinction of the orang-utan in northern Sarawak and of the tapir throughout Borneo, may have coincided with – or come about as a result of – a period between 9,000 and 6,000 years ago, when sea levels were at least 3.5 metres higher than now, and higher than at any other time during the past 100,000 years (for example, Anon., 1990; Tjia, 1980). If, as indicated by the studies in Sabah noted above, orang-utans achieve high population densities only on flat, fertile lowlands, then this period of high sea levels which marked the beginning of the Holocene would have wiped out much of the Borneo population. The same period is believed to have been characterised by increased temperatures, less pronounced seasonality and greater rainfall (for example, Cranbrook, 1986), the latter a factor noted above as reducing sodium levels in the environment. Now, annual rainfall in Borneo averages higher than in Peninsular Malaysia, and rainfall in those parts of Sarawak where orang-utans have become extinct is amongst the highest in the world. It is possible, therefore, that high sea levels and high rainfall in combination acted to wipe out orang-utans both in the flat lands and hills of northern Sarawak.

In most ecosystems and regions of the world, there is a tendency for large mammals to become extinct before smaller ones. In tropical rainforests, there are two reasons why this general rule might not always apply. Firstly, large herbivores can generally subsist on a coarser diet than smaller ones within the same taxonomic grouping, enabling the large ones to tolerate closed-forest conditions. Secondly, it is reckoned that within a taxonomic grouping, energy costs per unit distance of travel are less for larger taxa. Thus, it is conceivable that in Borneo the larger rhinoceros could cope with a poorer quality diet, and with having to travel further to obtain sufficient mineral-rich food items and supplementary sodium, than the smaller tapir.

It is widely believed that the elephant is not native to Borneo, but was introduced by humans at some time between the 16th and 18th centuries (Medway, 1977). This belief seems to have come about as an attempt to explain the highly limited distribution of the species in Borneo, which in Sabah is very similar to that of the orang-utan, but excludes the northwestern parts of the shaded areas in Map 1. Elsewhere in Borneo, elephants occur only in a small part of northern East Kalimantan. Various kinds of evidence suggest that elephants may actually be native to Borneo. Firstly, in those areas of Sabah where elephants occur, there are local names for the species (including *gadingan, haringan, kimayok* and *liman*), whereas elsewhere it is known only by the Malay name of *gajah*. It is unlikely that several new names evolved within the space of a few hundreds of years. Secondly, ivory was being exported from the Kinabatangan River (eastern

Sabah) through the nineteenth century from at least 1812 (St. John, 1863; Warren, 1981), an unlikely occurrence for a slowly-reproducing, recently-introduced species. Thirdly, the distribution of elephants in Sabah in the 1870's was about the same as it was in 1949 and 1982; at both these latter times the total population size was believed to be about 2,000 individuals (Medway, 1977; Davies and Payne, 1982). Thus, the population size was probably about 2,000 in the 1870's. At a typical annual net increase in population size of less than 2% under conditions of empty, suitable habitat (Sukumar, 1989), a few Asian elephants would take at least two hundred years to multiply to this number. While such an increase is just plausible, it is difficult to see why the population did not continue to increase in distribution from the 1870's until the middle of the present century, since when there has been a gradual loss of elephant habitat. As an alternative to assuming that elephants are not native to Borneo, the restricted distribution can equally be explained by assuming that a previously widespread lowland population was wiped out as sea levels rose through Sundaland after the last ice age. The east Sabah population may have remained because of an adequate array of salt licks.

Large herbivorous mammals are more likely to be limited by sodium than small ones because (a) smaller mammals include in their diet some animal tissues which, apart from salt licks, are the most concentrated sources of this element in rainforests, and (b) they need to replace that sodium lost with water in evaporative cooling processes. The distribution and abundance of all herbivorous mammals, large and small, may be influenced by availability of essential trace elements, especially those which are not concentrated by plants. These elements include copper, molybdenum, iodine, selenium, cobalt, fluorine, chromium and zinc (for example, Robbins, 1983). To date, no studies have been done to investigate the availability of these elements to mammalian herbivores in rainforests. Phosphorus is well-known as a factor limiting plant growth in the tropics (for example, Jordan, 1985). While this element may be concentrated in animal tissues and seeds, it is almost certainly a limiting factor for rainforest folivores.

If large mammals in Malaysian rainforests are limited even partially by the availability of sodium, phosphorus or trace elements, there are several implications for conservation.

1. Reserves, Parks and other areas set aside for conservation of large mammals must be where large mammals exhibit naturally high population densities. Extensive forested areas in which signs of occasional use by large mammals are found may be outside critical areas rich in minerals, and therefore inadequate to sustain breeding populations. The reservation of even very large tracts of forest for timber production or water catchment protection does not necessarily ensure that large mammals will survive as breeding populations.
2. Apart from obvious, known salt licks, critical mineral-rich areas may remain unidentified. Areas exhibiting frequent use by large mammals tend to be in the lowlands, where soils are generally richest in mineral concentrations. Most lowland forests have been lost in Peninsular Malaysia. The few

areas that remain are still under pressure for conversion to agriculture. It may be difficult, even impossible, to demonstrate that any particular area of lowland forest is critical to large mammal survival. If there is to be any hope of preserving the full array of Malaysia's large mammal fauna in the future, however, this pressure on remaining lowland forests must be resisted in all cases where large mammals are still present, and especially where there are extensive contiguous tracts of upland forest habitat.

3. In Malaysia, only Sabah has a large, gazetted permanent forest estate (PFE). The state has shown remarkable foresight in incorporating two wildlife reserves, mainly for large mammals (Tabin and Kulamba), into the Forest Reserve system. Similar action is needed in all the large states of Peninsular Malaysia. It is crucial that in planning the entire PFE, the needs of large mammals are recognised and incorporated. It is inadequate to mark areas as "Parks" and "Wildlife Reserves" and assume that these will ensure the survival of large mammals. Even though data may be inadequate to design an ideal PFE for large mammals, common sense and professional judgement are very valuable.
4. No salt licks still under or close to forest cover should be excluded from the PFE.
5. Some large mammal species may still be declining through natural processes. This is not apparent if the process is very slow and exacerbated but concealed by loss of forest through human activities. Captive breeding programmes, while expensive and fraught with problems, will help to guard against this possibility, and deserve support wherever they do not compete for funds available for wild populations. The natural decline in distribution since the last ice age of tapir and orang-utans suggests that these taxa may fall into this category.
6. While there may be as many as several thousands of orang-utans in Sabah's PFE, the great majority are on the fringes of the species distribution, in habitat believed be "marginal". A new conservation area of modest size in the floodplain of the Kinabatangan River, where the species achieves naturally high population densities, would contribute greatly to long-term survival prospects for the orang-utan. Such a reserve would also be important for the proboscis monkey *(Nasalis larvatus)* and, if contiguous with the existing PFE, for the Asian elephant. However, the prospect of rising sea levels is a source of great concern in relation to the conservation of this region.
7. The value of translocating large wild animals from one forest area to another merits critical appraisal. Apart from being expensive and of uncertain efficacy, translocation projects have the unfortunate effect of falselv assuring government and public alike that this is the way to conserve wildlife.

Finally, it is to be noted that the loss of large mammals has serious implications for the survival of many species of plants in the Malaysian forests. Rhinos are possibly the main dispersal agents for wild mangoes, for example, while Galdikas (1982) recorded that orang-utans at Tanjung Puting in Kalimantan acted to disperse the seeds of at least 27 tree species and 4 liana species during a six-month period.

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