Humans and Forests in Pre-colonial Southeast Asia

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SUMMARY

Until about fifteen centuries ago the interaction of humans with the Southeast Asian rainforest was primarily one of interdependence. Trees were felled for food and aromatic woods, and in dryer zones to burn in a process of shifting cultivation, but population pressures were low enough for routine regeneration. Before the modern era of plantation agriculture and mechanised logging, two great changes had already affected the environment profoundly: (1) the elaboration of permanently irrigated rice fields in upland valleys, creating substantial areas of permanent agricultural land progressively from about the 8th Century, and making possible greater concentrations of population, both agricultural and urban; (2) the rapid growth of commercial agriculture from the fifteenth century, primarily in pepper but later also sugar, cloves, gambier and coffee, which permanently deforested large areas of Sumatra, Java, Borneo, Vietnam and the Malayan Peninsula. Parallel with this development was the increased commercial felling of forest trees for the export of sandalwood from Timor and sappanwood from Siam. The retreat of large mammals, notably elephant and rhinoceros, was one measure of these changes.

A REGION OF FOREST AND WATER

The ethnolinguistic diversity of Southeast Asia is paradoxically one of its striking common themes. Although the Austronesian language family, to take the extreme case, extends over a wider area than any other in the world, it is spoken in scores of distinct local languages. The region possessed no vast plains or river basins like those of the Yangtse, Hwang-ho, Ganges or Indus, and generated no pre-modern empires capable of imposing a single civilisation over a broad area. Until this century upland areas were not fully incorporated into any state system, and retained different patterns of agriculture and social organisation to the peoples of the valleys. Beneath even the more successsful civilisations which have become the basis for modern states lies a mosaic of ethnic, linguistic, and cultural diversity.

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Nevertheless Southeast Asians live in a sub-continent more clearly demarcated by nature than most. Its boundaries are formed by the collision of continental plates, the northwardmoving Australian and Indian plates, and the westward-moving Pacific plate, pushing upwards the chain of volcanic mountains that almost surrounds the region. Within these mountains lies the relatively stable Sunda shelf, which united Sumatra, Java and Borneo with the Mainland during periods of low water levels such as occurred about 18,000 years ago. As the world's largest area of monsoonal humid tropics, it shared a pattern of rainforest and water which provided a background for all the economic and social activity of humans.

CLIMATE AND SOILS

Southeast Asia lies wholly within the tropics, and enjoys relatively even temperatures around or a little below 30 degrees centigrade throughout the year. The exceptions are the northernmost parts of Vietnam, Laos and Burma which do experience a mild winter in December/January when temperatures can fall below 20 degrees. Rainfall is everywhere generous, between 100 and 300 cm a year, so that the deserts which mark the continental tropics are here unknown.

Seasonality and variety within this pattern is marked above all by the monsoon winds. The warming and cooling of the great land mass to the north creates dependable winds from the northeast across the South China Sea in November-March, but in the opposite direction in the middle of the year. In the Bay of Bengal the winds are easterlies in November-March, and westerlies in the middle of the year. This dependable pattern of alternating wind-flows was highly favourable for sailing to or within Southeast Asia, as we shall see. The same monsoonal alternation governs the variable patterns of rainfall.

The centre of the region – southern and eastern Sumatra, Malaya, Borneo and western Java – as well as the eastern Philippines, has predictable high rainfall all year round. This nonseasonal climate supported a lush growth of evergreen forest, through which the sun seldom penetrated. For human settlement it was in general discouraging, especially in the coastal marshes. The soils in this region are clays of poor fertility except where improved by recent volcanic activity – as in Java and west Sumatra. The nutrients falling as leaves are more quickly broken down in tropical conditions, and recycled through the forest biomass, rather than building up topsoil suitable for agriculture. The equilibrium of these forests is therefore precarious, and removal of the canopy can quickly lead to leaching of the remaining nutrients and subsequent erosion by the combined effect of sun and torrential rain. Such forests also contain relatively few edible wild plants and suitable game. Without a dry season clearing and burning the forest presented a major obstacle, and many crops could not ripen satisfactorily (Fisher 1966: 50; Bellwood 1992: 59). Until the late nineteenth century era of immigration and

commercial agriculture, therefore, most of this central equatorial zone remained very thinly peopled.

In the mainland now occupied by Thailand, Cambodia, southern Vietnam and central Burma, on the other hand, there is a marked dry season around January-April, when almost no rain falls. In the mountainous parts of this region the streams continue to run through the dry season, because the mountains attract more rain and groundwater returns to the streams as their level drops. The dry season and the cooler temperatures provide a more open forest pattern with lower bushes, ferns and grasses suitable for a variety of larger mammals. The higher land of these Mainland dry-season zones supported a large population of deer, pigs, elephants, tigers and rhinoceros as well as smaller animals. To a much greater extent than in the equatorial forests of perennial rain or the smaller islands, these Mainland regions provided both meat for hunters and deerskins, ivory and rhinoceros horn for the export trade.

In the deltas of the great rivers of this zone, the land dries out completely during the dry season except in immediate proximity to the great rivers themselves. These deltas provide excellent conditions for rice-growing, as the alluvial soil is annually enriched by flooding and the wet season provides abundant water for one or even two crops. At least since the sixteenth century large surpluses were garnered from varieties of rice which grew two or three metres tall as the flood waters rose in the flood-plains of the Mekong, Chaophraya, Salween and Irrawaddy rivers (Kyuma 1978; Reid 1988: 20-21).

Unfortunately, however, these deltas are not so suitable for human settlement. In the wet season vast regions disappear completely under water. A million hectares are annually flooded in the Chaophraya delta alone. In the dry season there is no water at all. Only along the natural banks of the rivers was settlement convenient before the era of modern drainage and irrigation methods (Takaya 1978). What population there was in these deltas before 1800 was concentrated almost wholly along the river-banks.

The eastern part of Java and the Lesser Sunda Island chain to its east experience an even more marked dry season from May to September, in places extending to more than six months. The volcanic soil of some of these islands is highly suitable for agriculture, and in Bali and Lombok in particular there are streams and springs flowing throughout the year which have for many centuries been directed into bunded rice-fields on the sloping foothills of the mountains. Further east rice is more difficult to sustain in the progressively drier terrain, and Flores, Sumba and Timor subsisted largely on tubers and sago until the advent of American maize. For commercial crops such as cotton, however, the prolonged dry season was a distinct advantage.

While the eastern Philippines facing the Pacific enjoys year-long rain comparable to Malaya and Sumatra, the western areas of the Archipelago have a pattern similar to the Mainland with a marked dry period between December and March. The volcanic soils and the gently sloping terrain of the central valley

of Luzon provided excellent conditions for rice-growing in river-fed bunded fields, and a pre-colonial population density roughly commensurate with that of Sumatra and most of the Mainland.

THE RICE REVOLUTION AND POPULATION CONCENTRATION

The major concentrations of population known to us before the tenth century were urban trading and administrative centres, such as were built by the Mon, Khmer, Pyu and Javanese. By the thirteenth century we can however point confidently to some irrigated areas of intensive wet rice agriculture, producing rice surpluses which in many cases supported complex urban life and culture. It seems likely that especially in northern Southeast Asia these developed as part of the process which Mark Elvin has described as an 'agricultural revolution' in southern China, whereby more intensive rice-growing techniques were developed and then generalised in roughly the ninth to thirteenth centuries. These changes were much better documented in China than in Southeast Asia, but it is clear that improvements were not limited to one written culture (though Chinese agricultural manuals may have helped generalise techniques in China and Vietnam), but passed back and forth across boundaries. Some techniques, including doublecropping, terracing, and some irrigation techniques, were almost certainly older in parts of Southeast Asia than in China. The best-known new variety of rice in South China was from Champa (in what is now south-central Vietnam), introduced through Vietnam and Fujian, and popularised widely on imperial orders in the eleventh century because it ripened faster and could cope with poorer soils and dryer conditions than other types (Elvin 1973: 121).

The chief elements of this agricultural revolution were the plough, capable when pulled behind a buffalo of turning over the soil, not simply scratching it; transplanting seeds from a carefully-prepared and protected seed-bed; quick-ripening strains of rice making doublecropping easier; improved techniques of damming streams, bunding fields for flooding, and moving water through a variety of bucket devices or pumps. The effect of these improvements in rice cultivation in China was to shift the balance of population from the wheat-growing north, which contained three-quarters of China's population in the third to fifth centuries, to the ricegrowing south, which contained more than three-quarters by the thirteenth century (Elvin 1973: 113-45, 203-10). In Southeast Asia similar improvements may have been carried by Tai peoples who moved into the Mainland part of the region in this period, or simply generalised between Southeast Asia and south China by the greater extent of interaction in trade and tribute which these centuries brought.

Although little is known about either the size or distribution of population prior to the fifteenth century, some patterns do begin to become clear. The earliest centres of intensive rice-growing appear to have been in intramontane

basins of the higher land of the dry-season zone, and in the sloping foothills of the island massifs. In the first category are the Kyaukse area of upper Burma, well watered by four permanent rivers, and with irrigation systems in place for a complex wet-rice agriculture by the 8th century AD (Luce 1940: 32-28); as well as the Minbu valley in central Burma; the northern tributaries of the Chaophraya around Chiang Mai, Nan, and Sukhothai by the thirteenth century; and the upper Mekong valley basins centred on Vientiane and Luang Prabang. By the thirteenth century all these valleys were practising a form of wet-rice agriculture in bunded fields watered by these upland rivers (Ishii 1978: 19-26; Takaya 1978: 179-91). The early development of such centres of irrigated rice fields supports the view that the bulk of the Tai (the language family embracing modern Thai, Lao and Shan) population up until the fifteenth century was far up these rivers, not in the lower Chaophraya as it is today. The ruler of Luang Prabang enumerated 300,000 male Laos subject to corvée as well as 400,000 non-Tai under his authority in 1376, while another successful Lao ruler around 1640 enumerated 500,000 male subjects capable of bearing arms (Wyatt 1982: 83,121). Such f1gures suggest a Tai population well over a million in the intramontane valleys at a time when the lower Chaophraya was principally one vast swamp.

In the Archipelago the earliest evidence of wet-rice agriculture in irrigated fields comes from inscriptions in upland parts of Java and Bali, where small rivers, especially the higher tributaries of the Brantas river in east Java, point to the co-operative digging of irrigation canals as early as the ninth and tenth centuries. As in the Mainland, these are intramontane valleys in an upland area with a substantial dry season. In the Java uplands there is the additional factor of nearby active volcanoes (Mounts Kelud, Kawi, Arjuno, Penanggungan), which added to the fertility of the soil but caused periodic traumas which included changes to the rivercourses (Lombard 1990, III:17-25; van Setten van der Meer 1979: 1-41). In Bali there is evidence for the existence of the self-regulating irrigation associations or guilds *(subak)* as early as 1022, while analogous guilds among the Ilocano of northern Luzon are thought to be at least preSpanish (van Setten van der Meer 1979: 41-45). In Sumatra the shorter dry seasons of the intramontane valleys of the Toba Batak and Minangkabau uplands may have been slightly less favourable to early elaborations of irrigation systems. When the first European observers penetrated into these valleys in the early nineteenth century, however, they were astonished at the sophistication and intensity of irrigated rice fields, which they believed supported over a million people in each case (Raffles 1830, I: 403, 426, 432; Burton & Ward 1827). The location of the principal (Tantric) Buddhist temple remains far in the interior at Padang Lawas and Pagarruyung points to the existence of irrigated intramontane complexes there at least as early as the thirteenth century, though swidden agriculture in highland Sumatra is at least 3,000 years older (Raffles 1830 I: 422-26; B. Andaya 1993: 14; Schnitger 1989: 66-81).

CASH CROPS FOR THE WORLD MARKET

Because the region was a major crossroads of world trade, Southeast Asia's products found their way onto world markets very early. Striking evidence comes from the excavation of a pantry securely dated to 1700 BC in the Mesopotamian town of Terqa. This contained the remains of cloves, which until the eighteenth century grew only in eastern Indonesia. Literary evidence for a trade in clove as a medicinal item in tiny amounts is available from Ancient Rome and Han China (L. Andaya 1993: 1-2).

Until the fifteenth century, however, the overwhelming majority of Southeast Asian exports derived from foraging rather than plantation agriculture. Even the cloves and nutmeg traded around the world had been plucked from trees growing wild in the islands of Maluku, according to the earliest European witnesses. Only in the fifteenth century, according to Tome Pires, did production gradually shift from wild to cultivated trees, 'in the same way that wild plums become cultivated plums and wild olives become cultivated olives' (Pires 1515: 219; also Varthema 1510: 244). The other products shipped to China, India and the Muslim World were largely aromatic woods (sappanwood, gharu, sandalwood, cinnamon); gums and resins (camphor, benzoin, frankincense, dammar) collected from trees in the forest; or the product of forest-dwelling fauna (lac, rhinoceros horn, ivory, bird of paradise, birds-nest). The same foraging process delivered a variety of products of the sea, notably pearls and tortoise-shell.

In the list of 43 Southeast Asian exports listed by Chau Ju-kua in the mid-thirteenth century, only pepper and cotton were definitely cultivated. Cotton was exported in small amounts to China from the Philippines and Burma, and pepper from Java. Chau's description of how 'the natives grow [pepper] on frames made of bamboo or other wood' may be the earliest reference to Southeast Asian cultivation of this vital export crop (Chau Ju-kua, c. 1250: 222 and passim). But it appears probable that the majority of China's pepper imports before the fifteenth century originated in the Malabar coast of India, then the overwhelmingly dominant world supplier, even though it was often transshipped in Southeast Asian ports. The impact on the Southeast Asian environment of commercial cultivation of tiny amounts of pepper and cotton was negligible before the fifteenth century.

The change to a totally different scale of commercial agriculture appears to have begun around 1400. The last years of the fourteenth century provide the first evidence of regular and substantial shipments of clove and nutmeg into Europe's Mediterranean ports – at about 30 tons of clove and 10 of nutmeg each year (Reid 1990; Wake 1979). Pepper, which was not among the exports of northern Sumatra in the 1350s, had begun its spectacular career there by the 1420s. Though numerous factors contributed to a global increase in trade at this time, the most important single development for Southeast Asia was the unprecedentedly active southern policy of the first and third Ming emperors in China. Six Chinese

fleets were sent to Southeast Asia and beyond by the Yongle emperor (1402-24), each comprising hundreds of ships and tens of thousands of men. Tien Ju-kang (1981) has shown that these expeditions brought back such large amounts of Southeast Asian produce that some of them, notably pepper and sappanwood, became no longer exotic luxuries but items of mass consumption. It seems likely, therefore, that the demand represented by these fleets was instrumental in having Indian pepper plants grown for the first time in northern Sumatra, much closer to China along the long-established trade route (Reid 1993: 10-14).

Between 1400 and 1650 the expansion of pepper and Malukan spice exports from the region was spectacular. Europe alone was importing about 200 tons of cloves and nearly 100 tons of nutmeg in the early 1600s. European pepper imports in the same period grew from about 800 tons to 5000 tons, and whereas all had come from India in 1400 only a small minority did so by 1620 (Reid 1993: 13-21; Reid 1990: 25-27). All three of these items became organised plantation crops covering a large amount of land – clove first in northern Maluku and later Ambon; nutmeg in the Banda Archipelago; pepper spreading from northern

FIGURE 1
The extension of pepper growing

Sumatra to central and South Sumatra, west Java, the Malayan Peninsula and south Borneo. In addition, cane sugar became an important cash crop in Central Vietnam, Siam, Cambodia and Java in the seventeenth century, as did benzoin on northern Sumatra and Laos.

At the same time, the increase in shipping in the Archipelago, and the growing demand for goods to feed the China market, also increased greatly the destruction of aromatic wood trees. The white sandalwood *(Sanlalum alburn)* of Timor was particularly valued in both China and India, and profits of 150 to 200% were to be had by shipping it to China in the early seventeenth century (Villiers 1985: 595). Early Chinese sources suggest that sandalwood was so common on the island that the inhabitants used it for firewood, but conditions were turbulent and there were only certain times when it was safe to trade (ibid: 579). In the early sixteenth century, when annual exports were reckoned at 270-360 tons, the Portuguese still believed the supply was inexhaustible. A century later twice as much (c. 660 tons) was being cut to supply Chinese traders operating out of Dutch Batavia, as well as the Portuguese. The competition was such that trees were being cut before they matured, and scarcity began to be mentioned (ibid: 593, 598).

Of all the elements in the Southeast Asian export boom of the early modern period, however, pepper was the largest by a factor of at least ten, and it was pepper which had the greatest impact on the environment. Pepper-growing was established by 1500 along the north coast of Sumatra, in what is now Aceh province, though smaller amounts were produced in west Java, and in Kedah, Patani and Pahang on the Malayan Peninsula. By 1600 the original Aceh north coast gardens were virtually finished, and the main source was along the west coast of what is now Central Sumatra, and in Lampung (southern Sumatra) and west Java. In the subsequent half-century pepper-growing was taken further inland by Minangkabau growers who now exported their crops through Palembang and Jambi. The older pepper-fields on the west coast were finished by 1700, though new sources of supply had opened up further south around (British) Bengkulu, in the Banjarese area of Borneo, around Nakhon Sithammarat (Ligor) in the Peninsula, and in what is now southern coastal Vietnam.

By 1800 the gardens of Palembang, Jambi, west Java and south Sumatra had virtually died, but new sources had begun in the southwest corner of what is now Aceh province, on the coast south of Meulaboh, around modern Medan in east Sumatra, and in Penang. By 1850 Aceh was still the biggest single world supplier, but its gardens had shifted to the coast *north* of Meulaboh, and in the following decade to northeast Aceh around Langsa and Idi. Meanwhile Lampung was making a comeback, and became the leading world supplier for the whole period 1900-40, while Aceh's production declined to very little. New sources of supply were the Chinese intensive gardeners of Bangka and Sarawak, the latter becoming the main competitors of Lampung in the post-war period (Rutgers 1949; Bulbeck et al., forthcoming).

The primary reason for this constant shifting of the areas of production was the exhaustion of the soil on which pepper was grown. Sumatrans always sought primary forest where possible to open a new pepper garden, on sloping, well-drained land of mixed sandy clay, and of course as near as possible to some export port. The forest would be cut down and burned, and a crop of dry rice *(Ladang)* grown in the first year. Stakes of chingkareen or *dadap duri* would then be planted to provide living support and shade for the pepper vines. The pepper vines would begin yielding in their third year, and yield at their peak in the 7th-10th year. Thereafter they would decline steadily, and would never last beyond twenty years. A new patch of forest would therefore be cut down some time about the tenth year to replace the deteriorating old one. Pepper would never be replanted on the old garden, which no longer had enough nutrients to sustain cultivation. It was left either to regenerate slowly as secondary forest, or very frequently to turn into grassland *(alang-alang,* Imperata cylindrica) (Marsden 1783: 134-38; Rutgers 1949: 630-33).

The only way to estimate the extent of land consumed by this type of pepper-growing is to calculate from export levels. I have elsewhere estimated that the total Southeast Asian export rose from about 4000 tons in 1600 to a peak of about 7,000 tons in 1670, before falling back to around 5,000 tons in 1700. Production climbed again from the late eighteenth century, rising to perhaps 15,000 tons in 1800 and continuing to climb to 25,000 tons by 1900 (Reid 1990: 1719; Bulbeck et al., forthcoming). Most of this production, perhaps 80% for most of this period, was in Sumatra.

If productivity by the extensive 'Malay' or Sumatran method was similar elsewhere to what was recorded by the British in the Bengkulu area in the late eighteenth century, this was only 310 pounds per acre or 350 kg per hectare (Forrest 1780: 382; Bastin 1960: 55). If we allow that more was produced than exported, more being lost through spoilage than local consumption, Sumatra's production of pepper might be estimated to have averaged 5,000 tons a year in the seventeenth century, 7,000 in the eighteenth and 20,000 in the nineteenth. Assuming that each garden was producing for an average of 12 years, Table 1 shows the amount of forest that might have been felled for new gardens during each of the centuries in question.

	17th Century	18th Century	l9th Century
production p.a.	5000 tons	7000 tons	20,000 tons
area required	14,000 ha	20,000 ha	57,000 ha
forest felled	120,000 ha	165,000 ha	475,000 ha

TABLE I
Forest felling for pepper in Sumatra (estimate)

A total of 7600 square kilometers, or about 1.6% of the total land area of Sumatra, might be estimated to have been felled for pepper gardens in Sumatra during these three centuries, a significant proportion of which appears to have reverted to permanent grassland.

Total production has been much higher in the twentieth century, but the profligate pattern of the past has gradually had to be abandoned with the retreat of primary forest. The Chinese, who dominated pepper cultivation in Sarawak, Malaya and Bangka, had always used far more intensive methods, clean-weeding, turning the ground twice each year, and fertilising assiduously, and they were able to re-use inferior land by the use of fertilisers. Their yields were in excess of 2000 kg per hectare, though with far greater production costs. These Chinese methods accounted for an ever increasing share of Southeast Asian production in the twentieth century (Rutgers 1949: 622-43). The Lampung pepper farmers of today, although still using the main elements of the low-capital 'Malay' method, also farm more intensively than in the past on rich land particularly well suited to continuous pepper cultivation. They now produce an average of 1500 kg per hectare and frequently have to re-use old gardens for lack of forest to fell (Benoit et al. 1989: 200-05). Hence the above type of calculation would be quite inappropriate for the twentieth century, in which rubber, tobacco and tea have been far more extensive consumers of the Sumatran forest than pepper.

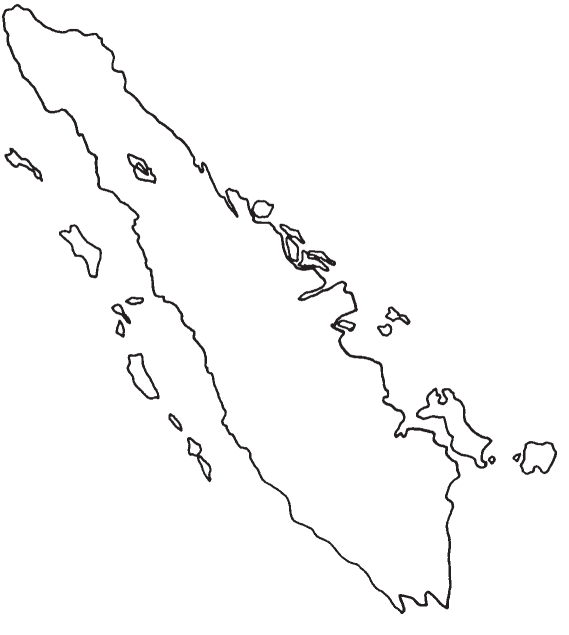

FIGURE 2
Grasslands in Sumatra (from modern mapping)

Nevertheless the role of pepper seems to have been a major one in giving rise to the extensive grasslands of Aceh and Lampung, and rolling back the forests from those and other areas. In modern maps some of the most extensive grasslands in Indonesia occur in the former Sumatran pepper-export areas. The *Atlas van Tropisch Nederland* (1938) shows two of the most extensive patches of such land in the hills behind the coastal plain of northern Aceh, and in sloping land east of the Barito in South Borneo – two long-term pepper-growing areas. The colonial map-makers classed as secondary forest most of the other pepper-growing areas in the Bengkulu and Lampung foothills. A much more detailed recent land-use map of Sumatra (Toulouse 1986) distinguishes more carefully. It restricts grasslands proper to the hills between Banda Aceh and Sigli (Pidie) in the northwest comer of the island, in pockets around the pepper-growing centres of west Aceh, especially Teunom and Seneu'am, and through much of southeast and Central Lampung. Most of the remaining ex-pepper areas on the north and west coasts of Sumatra are classed as 'secondary and derived types, mainly shrubs'.

LARGE MAMMALS AND THE RETREATING FOREST

Of course maps do not help us very much before 1900, although the Dutch military maps of the fighting in Aceh in 1873-4 show substantial grasslands in the hills to the west and south of the capital (Kielstra 1883). There is, however, some interesting descriptive evidence of the steady retreat of the forest from the coastal and populated areas. The earliest detailed descriptions of Aceh, beginning around 1600, indicate that there were some grasslands near to the capital to support the 'horses, buffaloes, oxen and goats', as well as sheep, with which the city was well supplied (Davis 1600: 146-7; *Hikayat Aceh*: 97). Some pepper was still being grown at that time near the capital, though this was banned a few years later (Reid 1993: 299), and by 1660 the sultanate of Aceh had no pepper more for export. That grasslands must have extended markedly is indicated by the increasing stock of horses sustained by pasture. Aceh was importing horses from Arabia and Persia in the first half of the century, to build up the sultan's cavalry. In 1642, on the other hand, the stock had built up sufficiently to begin exporting locally bred horses to India throughout the remainder of the century (Ito 1984: 37-39).

We cannot say how far these were of Acehnese provenance, as implied by Ito, and how far re-exports of introduced Batak ponies, which were exported on a much greater scale in the nineteenth and twentieth century. We should note here that the areas of Indonesia famous for an abundance of horses from at least as early as the late eighteenth century were also the areas of extensive man-made grasslands – the Toba Batak area around the Lake, South Sulawesi (especially Jeneponto, Bulukumba, Wajo and Enrekang), Sumba and west Sumbawa, and Timor. In the Philippines a similar pattern of horse-carrying grasslands had

developed in parts of Luzon by 1800. These areas, unlike Aceh, were not deforested by pepper. Deforestation must have occurred on a large scale at about the same period (17th-19th centuries), but the cause should rather be sought in the excessive exploitation of sandalwood in Sumba and Timor, excessive attempts to grow cotton on the drier parts of all these islands, and of course the pressure of population pushing a system of shifting cultivation beyond the limits which could be born by a long dry season and, in the east, relatively poor soils. All these areas were renowned for their horses by around 1800, and provided most of the ponies for the growing colonial cities in the following century. The Bataks and Makassarese relied substantially on horsemeat in their diet, and all these groups incorporated horse contests and horse sacrifice into their rituals (Marsden 1783:115, 381; Loeb 1935: 88-92; Crawfurd 1856:153-5). Although the extensive grasslands presumably arose in most cases as an unintended consequence of agricultural activity, we cannot rule out the deliberate creation of grasslands, or more likely their retention by burnoffs, by peoples who had already adapted to reliance on the horse. Crawfurd (1820 I: 118-19) reports that the Makassarese and Bugis were 'passionately fond of the chace', pursuing deer and wild pig on horseback as a sport as well as food source. Given the ardour of Crawfurd's Sulawesi informants, who claimed to forget wife and chidren wholly in the passion of the hunt, and guarded their hunting grasslands so jealously as to kill outsiders who poached there, one could well imagine that these grasslands were deliberately extended at the expense of forests.

The changing role of the elephant in Southeast Asian life is a particularly interesting index of the retreating forest. For most of the early modern rulers of the region, elephants were the emblem par excellence of royal power. On the Mainland wars were fought for possession of magically-endowed white elephants. Each king measured his military power and charisma by the number and bravery of his elephants. In Sumatra and Malaya, where cities were not walled, rulers explained that they did not need such protection because of the prowess of their elephants *(Hikayat Aceh*: 165-6) – though they proved rather ineffective in defending Melaka against the Portuguese. The prominence of elephants in warfare was indicated by their occupying the place on the chessboard (at least in Burma and the Archipelago) which bishops play in the European game. Contests involving elephants were one of the most spectacular elements of the state theatre of Burma, Siam, Cambodia, Champa/southern Vietnam, the Malayan Peninsula and Sumatra. Sometimes elephants fought each other, incited by a female; sometimes military champions (notably including the Acehnese hero Iskandar Muda and the Thai equivalent Naresuen) rode them in tournaments; almost everywhere they were also pitted against tigers. The importance which was attached to ensuring that the regal elephant defeated the savage tiger makes clear that the elephant symbolically represented the king and the forces of order (Reid 1988: 183-91). The king travelled by elephant on every state occasion, while

letters and emissaries from foreign rulers were also brought to the court by elephant (Reid 1989: 25-38).

Sundaland (Sumatra, Java and Bomeo) was of course connected to Mainland Southeast Asia as recently as the last ice age, so that elephants then probably roamed freely throughout these islands. In Java, however, elephants appear no longer to have occurred naturally in historic times, and in Borneo only in the northeast (Raffles 1817 I: 46; Crawfurd 1856: 135-6). Presumably the forests of Java had already been so reduced by the seventeenth century that they could not sustain elephants. The powerful rulers of these two islands (notably Brunei, Tuban and Mataram), and of Makassar in Sulawesi, had to import elephants to sustain their grandeur in the sixteenth and seventeenth centuries. In the 1720s the Surakarta ruler still received presents of elephants from coastal tributaries, including the Dutch, so that he could display two pairs on the *alun-alun* on tournament days (*senenan* – Ricklefs 1993: 212).

It is from Aceh that we learn most, however, about the gradual retreat of elephant sustaining forests. In the early 1600s elephants were still found so close to the major urban centres of Banda Aceh and Pidie that the rulers were said to hunt them as a 'daily exercise' (Martin 1604). The *Bustan as-Salatin* of Raniri (1643: 54-6) described how Sultan Iskandar Thani paused at several points on his journey along the coast from Pidie to Pasai to hunt elephants. Hundreds of elephants were on show in the city for royal events, the king himself was said to possess about a thousand of them, and they were employed for a variety of construction and transportation tasks in the city, as well as for certain executions (Mundy 1667: 332-4; Reid 1989).

The first Dutch evidence for an export of elephants comes in 1628 (though it is possible that Siam was filling the Indian demand before this). In the following year the Dutch noted the arrival in Pulicat (southeast India) of 23 Aceh elephants in one (presumably large!) ship (Coen 1953: 1649). At this point elephants were still deemed a royal monopoly, so that the sultan must have had a hand in the shipment. In the 1640s this royal control broke down, and the leading *orangkaya* (merchant aristocrats) began to possess their own elephants and to draw great profit from exporting them. In the middle of the century the elephant-trade to India became Aceh's principal export as control over supplies of pepper and tin was gradually lost to the Dutch. Takeshi Ito (1984: 415) has documented from Dutch sources an average of about 30 elephants a year in the period 1640-1663, with a tendency to rise above this in the 1660s. Still larger numbers were caught in southern Siam, with over a hundred being exported from Tenasserim in 1651 (GM 1651, in Coolhaas II: 448). Elephant-hunting became no longer a royal sport, but a major industry. Buffalo-skin suddenly became very scarce and expensive in Aceh about 1642 because it was twisted into a rope strong enough to catch and restrain elephants. The export of buffalo-skin was prohibited in 1644. As an alternative, requests for the strongest Dutch rope

became frequent. Hunting expeditions ranged further and further afield. A Dutch factor recorded one hunt in 1644 that netted 11 elephants over a three-week period, and another which returned with 18 elephants after six months away. A ten percent export duty on the elephants ensured that the Queen drew a large profit from the trade (Ito 1984: 367-72).

The demand for these elephants was generated particularly by the rulers of Bengal and south India, who sought a supply of the largest Southeast Asian elephants for their own greater glory. The Governor of Dutch Malacca claimed in 1642 that the price had risen tenfold in six years, partly because the Siamese supply had been interrupted by 'the incessant troubles' there (van Twist, quoted Ito 1984: 419). The other particular demand factor appeared to be the 'insatiable' demand of some of the Mughal governors in Bengal, notably Mirza Malikbeg of Pipeli, for large and handsome beasts which could earn them favour with their Mughal superiors. Having reluctantly tried to take a share of this very troublesome trade, in which many ships were lost through the movement of the elephants even when specially built for the trade, the Dutch were somewhat relieved when Malikbeg got into trouble in 1654. One of his ships sank with 17 Aceh elephants aboard as well as 125 tons of tin, a disaster from which he was not expected to recover (Coolhaas II: 796).

The *supply* of elephants came from those parts of the forests of Sumatra and the Malayan peninsula close enough to the ports of Aceh, Malacca, Kedah and Tenasserim to make the capture, taming and shipment of elephants practicable. The Dutch factors of the VOC, our main sources of information about this trade, regarded it as a particular nuisance. The elephants were extremely expensive at up to 1000 reals (Spanish dollars), and the dangers of their dying, injuring themselves or the crew, or wrecking the boat, were very severe. In one of the first Dutch shipments of four elephants from Kedah in 1640, one died on the voyage and another fell in the water and drowned during transshipping, ensuring that a loss was made on the transaction (*Daghregister Batavia 1641-1642:* 81). Nevertheless the demand from Indian princes was such that the VOC felt obliged to enter the market, first by buying in Siam, Kedah and Aceh. When that proved difficult, a major effort was made to 'harvest' elephants from the forests around Malacca, conquered by the Dutch from the Portuguese in 1641. Dutch attempts to emulate the Acehnese and Siamese by using tame elephants to lure the wild ones were signally unsuccessful. 'Wild elephants are still observed daily in Malacca's territory, where [we are] undertaking to capture [them] with tame ones, but up to now not succeeded. Some were, not long ago, caught in traps but escaped; another was captured in a hole but died, regrettably.' (GM 1644, quoted in Ito 1984: 421).

By the end of the century this elephant export trade was dead. In 1740 the Dutch even brought elephants the other way, from Coromandel to Batavia, which is a striking indication of their scarcity in Sumatra and the Peninsula

(Laarhoven 1994). No doubt part of the change was on the demand side, since modes of warfare and of theatrical display were changing in India, and elephants were no longer needed to the same extent. There is no doubt, however, that the supply was also disappearing, The hunting itself must have diminished herds adjacent to these port cities, while the advance of agriculture reduced the food and forest cover for them. In the eighteenth century elephants were not only not exported, they were not even seen in Aceh and Malacca where once they had performed many critical tasks. In 1655 there was 'very great mortality' even among the normally abundant elephants of Siam (GM 1655, Coolhaas III: 26). From the eighteenth century onward the elephants of Sumatra were hunted only for their ivory, and thus killed with firearms rather than captured *(ENI* III: 71). The decline in Sumatran ivory exports to relatively insignificant amounts by the mid-nineteenth century is no doubt another index of retreating forests.

Another casualty of commercial 'harvesting' was the deer of Siam, Laos and Cambodia. With the introduction of effective hand-guns in the seventeenth century the potential for killing deer and other game rose enormously. A market for their deerskin arose with the entry of Japanese merchants into Southeast Asian trade in the late sixteenth century. Japan generated an extraordinary demand for deerskin at this time, to serve in gloves and the soft inner lining of armour. Already, perhaps, Japanese rulers could see the advantages of protecting their own forest population by buying elsewhere. By 1635, when the Japanese traders were forbidden to take to the seas, they were taking 70,000 to 100,000 deerskins a year from Cambodia to Japan (Coolhaas I: 592-3). Many of the deer would have been shot by Lao or minority hunters higher up the Mekong and its tributaries and traded downriver. The VOC took over the trade, and was still shipping about 100,000 a year to Nagasaki until troubles in Cambodia forced the Dutch out in the 1640s *(Daghregister Batavia 1640-1641:* 124-5). With ongoing difficulties in Cambodia the trade tended to shift to Siam thereafter, both Chinese and Dutch shipping large quantities to Nagasaki each year. In the 1690s, however, the collection of deerskins in the northern forests of Siam was also encountering repeated difficulties. In 1693 a mysterious disease was given as the reason why countless deer had died and the skins were not forthcoming as before. Three years later there was a drought and pestilence killing thousands of humans in the same area, which this time was held to explain the reduced flow of skins (Pombejra 1993: 257). Since the decline was a permanent one, however, with deerskins no longer a significant export in the eighteenth century, one must presume that the deer population was permanently reduced in the Mainland forests by the slaughter of so many million animals.

None of this environmental change was on the same scale as that which plantation agriculture and population pressure wrought in the nineteenth and early twentieth century. In comparison with what had occurred for millenia before the 'Age of Commerce'', however, it was indeed a devastating onslaught.

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