

# On the Declining Fauna of Peninsular Malaysia in the Post-Colonial Period

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*Great species diversity is characteristic of Peninsular Malaysia, especially of the lowland dipterocarp-dominated forests. In recent decades, however, land clearance for agriculture, selective logging, hunting and collecting, and pollution of water bodies have taken a heavy toll of the region's fauna. Conservation, which is pursued on an ad hoc basis, is underfunded and there is a shortage of trained personnel. Environmental awareness is growing but lack of co-operation between Federal and State authorities is a major problem.*

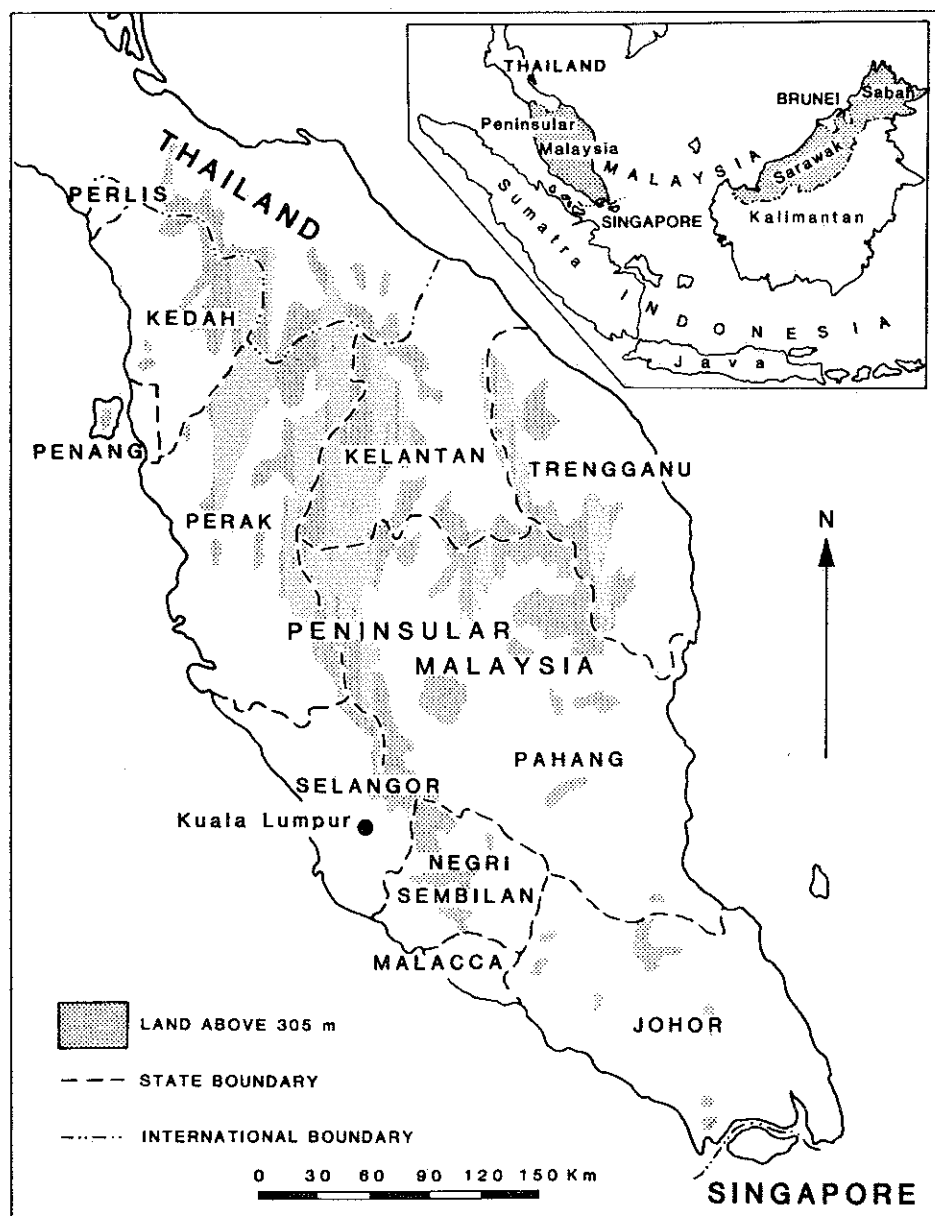


Figure 1. Peninsular Malaysia and its neighbors.

Some 40–50 percent of the estimated 3–10 million species on earth occur in tropical rain forests. This great renewable cornucopia of life, however, is rapidly being expunged by human activities. Each year a vast area of forest, variously estimated at between 119 000 km<sup>2</sup> and 200 000 km<sup>2</sup>, is cleared or degraded (1). Nothing in the long history of man's role as an agent of change in nature can compare with the current pace of forest conversion in the humid tropics; nothing that has happened to date is likely to have more far-reaching biological consequences. Habitat destruction is the major threat to the natural heritage of mankind. As we write, a species somewhere in the tropics is probably becoming extinct; a million more may follow by the end of the century (2).

Peninsular Malaysia is among the world's most biologically diverse regions. Many species, however, are now threatened by habitat destruction. Outside of a few parks and reserves, virtually all of the lowland forests of the region will have been logged over or converted to agricultural land by about 1990 (3). There is, therefore, an urgent need to conserve what remains of the primary and secondary lowland forests, to extend unlimited security of tenure to the parks and reserves that now exist and to create new ones.

The Federation of Malaya, comprising the region now called Peninsular Malaysia, became an independent state in 1957. The new country did not include Singapore, which remained a Crown Colony. In 1963, the Federation of Malaya, the two Borneo colonies of Sabah and Sarawak, and Singapore joined to form the Federation of Malaysia. Singapore was ejected from the Federation in 1965 and since then has been an independent republic. The two parts of the Federation of Malaysia—Peninsular Malaysia in the west and Sabah and Sarawak in the east—are separated from each other by the South China Sea. Kuala Lumpur is the federal capital (Figure 1).

Peninsular Malaysia, the more economically developed of the two parts and the focus of this paper, is itself divided, by the Main Range, into two major regions: a highly developed west-coast lowland zone and a less developed eastern lowland area. The western zone is characterized by plantation agriculture, tin mining, well-developed road and rail networks, a hierarchy of urban places with densely populated hinterlands and a plural society comprising Malays, Chinese and Indians. Largely made over by man, the region is the hub of the Malaysian economy, the nation's vital center and seat of power.

The region east of the mountainous spinal column of the peninsula is mainly rural, poor, conservative, dominated by Malays, in places isolated and still given over mostly to small-scale farming and fishing. The pace of development in the region, however, has quickened in recent

years, and a number of land development schemes have transformed huge areas of forest into cultivated landscapes. In short, much of lowland Peninsular Malaysia has been greatly altered by human activities, and only remnants of the luxuriant forests that once clothed the region now remain, mostly in upland areas (see Box 1). Man's impact on the fauna of the region is the theme of this article.

#### VEGETATION, FLORA AND FAUNA

The natural vegetation of Peninsular Malaysia belongs to the Indo-Malayan (or Indo-Malesian) rain forest formation and forms part of the Malesian floristic region of archipelagic Southeast Asia, that is, of Malaysia, Indonesia, the Philippines and Papua New Guinea. The characteristic rain forest vegetation of the peninsula is divided into several forest types or ecosys-

tems. Lowland and hill dipterocarp-dominated forests are the most extensive type and by far the richest in plant and animal life. Among other lowland ecosystems are peat swamp, fresh-water swamp and mangrove forests of varying extent. Above about 1000 m the dipterocarp hill forest gives way to montane forest in which the families Fagaceae (the oak family) and Lauraceae (the cinnamon family) are more abundant.

The flora of Malesia is remarkably rich. In Peninsular Malaysia alone there are approximately 7900 species of flowering plants, of which some 2000 are trees. Great species richness is characteristic of small lowland areas, or in other words, many species are thinly distributed. For example, in one 20-ha area of forest in Pahang, Peninsular Malaysia, in which all trees reaching the canopy (mainly those over 0.9 m in girth) were enumerated and

## Box 1: Vanishing Forests

In the early 1900s, Sir George Maxwell described the inhabited area of what is now Peninsular Malaysia as "infinitesimal compared with the extent of the forest that remains untouched" (4). Such is no longer the case. The rapid expansion of rubber plantations after the turn of the century was a major cause of forest clearance in the western half of the peninsula. The pace of change was remarkable, the area under rubber increasing from about 4500 ha in 1903, to 810 000 ha in 1921, and then to 1.4 million ha in 1940 (5), which is equal to 11 percent of the total land area.

Habitat losses associated with the expanding plantation frontier, growing numbers of hunters and greater use of firearms combined by the 1920s to cause a disconcerting decline in the numbers of many animal species, and in 1930 a Wild Life Commission was appointed to assess the situation (6). The commission made a number of recommendations aimed at protecting and conserving wild animal life, including the formation of a national park in the central part of the peninsula. The park, now known as Taman Negara, was created in 1938 and remains the only national park in Peninsular Malaysia.

Following a period of recovery after World War II, the pace of forest clearance began to pick up speed, and since independence in 1957 vast areas of forest have been converted to agricultural use by the Federal Land Development Authority and by various state agencies (7). Vigorous land development over the past three decades has been the major cause of forest loss and has posed the greatest threat to the fauna of the peninsula.



Rubber plantation in Selangor.

Of the total land area of the peninsula, 13.1 million ha, an estimated 84 percent (the figure is almost certainly too high), was still under forest in 1958 (8). Comparable figures for 1971 and 1976, however, were 65 percent (9) and about 55 percent (10), respectively,

though the latter figure tells only part of the story, because in 1976 only 1.8 million ha, or 13.7 percent of the entire area of Peninsular Malaysia, were considered virgin forest. What this means, in essence, is that a very large part of the remaining forest area has already

mapped, Poore recorded 2773 trees of 375 species of 139 genera of 52 families (13).

The land masses of the Sunda Shelf of western Malesia have a distinctive fauna. It is related to, but quite distinct from, the fauna of Sahul Shelf land masses from which it is separated by deep-sea trenches. During the Pleistocene, large areas of what is now the South China Sea were periodically exposed as dry land, thus affording many faunal affinities between the present, now fragmented, land areas. Even during the Pleistocene, however, the Sunda and Sahul shelves were not connected and the former remained on the fringe of continental Asia (14). The mammals provide an example of the distinctiveness of the Sunda region. Excluding bats, they are placental and of Asian ancestry, whereas the mammals of the Sahul Shelf region are marsupials of Australian affinity.

The animal life of Peninsular Malaysia is typically forest-dwelling and of great richness. There are 199 known species of mammals in the region (including 81 species of bats), among them the elephant (*Elephas maximus*), tiger (*Panthera tigris corbetti*), tapir (*Tapirus indicus*), Malayan gaur or seladang (*Bos gaurus hubbacki*) and the extremely rare Sumatran rhinoceros (*Dicerorhinus sumatrensis*), to mention only a few of the large land mammals. Some 459 species of birds are known to or are thought to have bred in the region during the present century. There are many species of amphibians, lizards and snakes, about 250 species of fresh-water fish and, among a variety of other faunas, an estimated 150 000 kinds of insects and 25 000 species of other invertebrates, including a large number of butterflies (15).

Animal life differs both between and within the forest ecosystems of the region,

the lowland primary forests, as intimated above, harboring the majority of animal species. These forests are structurally complex, the crowns and foliage of the trees forming several strata or stories each with its own microclimate, food resources and other living conditions, and each supporting its own assemblage of animal life (16). For example, certain species of mosquitoes, bats, birds, butterflies and monkeys are confined to the upper canopy of the forest, while other animals live at intermediate levels or on the forest floor.

The characteristic co-existence of many animals in small areas is facilitated by time, space and food partitioning, by the use of many breeding sites and by mutual plant-animal associations that have given rise to interdependence and co-evolution, although the relative importance of these different factors is poorly understood (17). Because most of the animal species have evolved in the primary lowland forest, many of them cannot survive elsewhere. While it is true that certain animals, such as grazers and browsers, may thrive on man-made conditions, many other species disappear when primary forests are replaced by secondary forest, grassland or agricultural land. There are also variations in animal life between natural forest ecosystems, as discussed, for example, by Whitmore (18). In this article, however, we focus on the extensive dry-land rain forests of the lowlands.

## IMPACT

### Endangering Processes

Species are endangered both directly and indirectly. The direct processes include overexploitation of animals for food or for their tradable skins, horns, shells or other parts, collection of animals for zoos or medical research, and control of predators. Species are also endangered indirectly or unintentionally, especially by habitat damage or destruction. Among the processes involved are urbanization, expansion of agricultural land, widespread use of pesticides and herbicides, soil erosion and the siltation of rivers and near-shore waters, disposal of industrial wastes, ecological disruptions resulting from the transfer of species from one ecosystem to another, the impact of tourists on sensitive habitats and, of particular importance in the context of this article, conversion of tropical forests. The direct and indirect processes listed above are not mutually exclusive; rather, their spatial distributions may overlap, and their effects are often cumulative (19).

The major threat to the animal life of Peninsular Malaysia in the post-colonial (since 1957) period has come from forest clearance for agriculture, that is, from loss of habitat (Figure 2; see Box 1). Land cleared for agriculture is often completely denuded, leaving behind a veritable wasteland in the interim between forest removal and the establishment of plantation crops, mostly rubber and oil palm. Rapid and widespread forest conversion adversely affects animal life in several ways: loss of habitat means that regional carrying capacities are reduced, access to remaining forest areas for hunting and collecting is

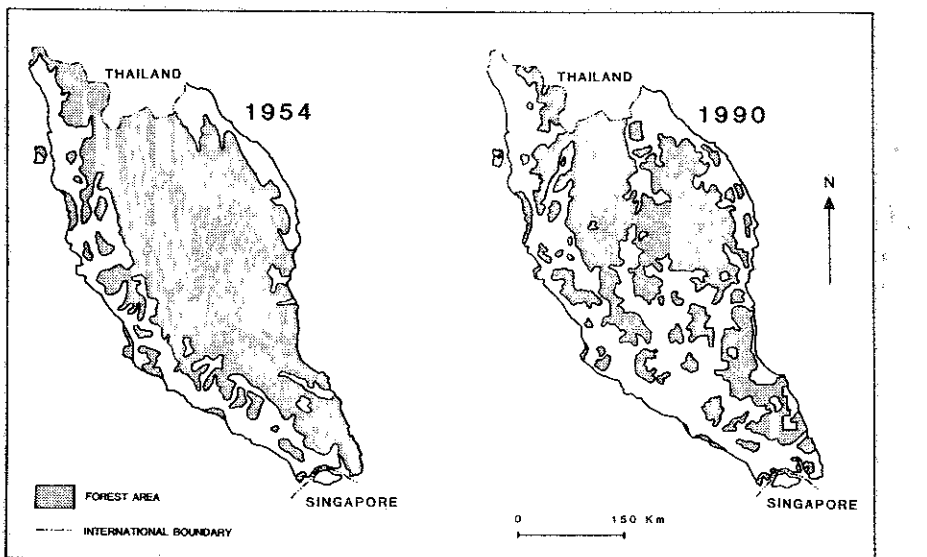


Figure 2. Peninsular Malaysia: Estimated forest area, 1954 and 1990. (Source Ref. 5, pp 161-162).

been logged over. By the end of 1983, the forest area had been further reduced, to about 49 percent, if FAO estimates of conversion rates of 80 000 ha per year for 1976-80 and 90 000 ha per year for 1981-83 are accepted (11). Forest clearance for agriculture, which means mostly oil palm and rubber, will continue apace because the current Fourth Malaysia Plan calls for further extensive land development (Figure 2).

The agency of man in Peninsular Malaysia is most clearly revealed in the densely settled west coast lowlands, where very little of the natural vegetation has survived. Since the late 1960s, however, the agricultural frontier has been extended into the previously heavily forested region east and south of the Main Range, where huge areas of forest have been cleared, or are in the process of being cleared, in the states of Trengganu, Pahang and Johor. The scale of land development schemes has increased markedly.

Selective logging has also taken its toll of the primary forests, especially of the extensive stands of commercially

prized species of the family Dipterocarpaceae. Peninsular Malaysia is the world's leading exporter of sawn hardwood and of growing importance as a supplier of plywood and veneer (12). At present rates of exploitation, however, it is unlikely that the remaining primary forests will survive beyond about 1990 at the latest.

Land clearance for agriculture and selective logging, both of which have been facilitated by motorized equipment and the chain saw, have resulted in a number of environmental problems: among them are habitat destruction, soil erosion, river siltation and flooding, and pollution of watercourses by effluent from palm oil mills. These and other problems have caused the numbers of certain species of animals to dip sharply. It can be expected that the area under forest will shrink yet further, that landscape diversity will continue to yield to uniformity (Figure 3) and that a growing number of species will be pushed to the brink of extinction—or beyond.

enhanced, while animals that stray into, or attempt to settle in, agricultural areas are generally considered to be pests that should be eliminated. Those species that require very large territories, such as the tiger, are severely affected by forest clearance, while some other species simply disappear.

Agricultural expansion has had other deleterious effects on the fauna of the region. The greatly intensified use of pesticides poses threats to certain species of birds; chemicals from agricultural land are washed into stream courses where, together with effluent from palm oil mills and rubber factories, they affect fresh water fishes; and the discharging into near-shore waters of polluted, frequently sediment-laden, rivers is a growing threat to corals and other aquatic species.

In addition, hunting and collecting, a growing number of tourists, the selective and often careless logging of primary lowland forests, and the extension of the area under secondary forests all pose a variety of threats to a growing number of species. One fact is inescapable: widespread removal of the lowland forests will result in extinctions. Some 52 percent of all mammals live below 300 m, 81 percent below 600 m, and the majority of species are primary forest dwellers (20). It is precisely in the species-rich lowlands, however, that man's activities are concentrated.

### The Consequences of Selected Processes

#### *The Impact of Forest Clearance*

The importance of this process is revealed by figures given for non-human primate losses by Khan, who estimated the populations of seven species of primates for the two years 1958 and 1975. For his calculations he used primate density data reported by Southwick and Cadigan and assumed an 84 percent forest cover in 1958 and a 51 percent cover in 1975 (21). It was shown that absolute losses ranged from 2000 for the silvered leaf monkey to a staggering 408 000 for the banded leaf monkey, although the simiang experienced the highest percentage loss (Table 1). Khan appears not to consider any of the seven species to be endangered, although the Malayan Nature Society considers two of the species—the white-handed gibbon and the simiang—to be endangered and the other five to be vulnerable (22). Several species of primates can undoubtedly adapt to agricultural areas; they are, however, generally considered to be pests, although for some species this designation is probably unwarranted. Both offenders and non-offenders are destroyed, for as one estate manager commented, to "an average estate watchman, a monkey is just a monkey..." (23).

Many other species of mammals are drawn to agricultural areas, oil palm plantations being particularly attractive. Most are unwelcome, none more so than the elephant with its voracious appetite, huge bulk and tendency to travel in small herds. Damage caused by elephants can reach disastrous proportions. For example, a 1982 report claimed that a herd of elephants had destroyed some 11 000 young oil palm trees on a land development scheme in the state of Pahang (24).

Table 1. Estimated population losses for some primate species between 1958 and 1975.

Species		Population In 1958	Population In 1975	Losses in population	Percent loss
<i>Macaca fascicularis</i>	Long-tailed macaque	415 000	318 000	97 000	23.37
<i>Macaca nemestrina</i>	Pig-tailed macaque	80 000	45 000	35 000	43.75
<i>Presbytis cristatus</i>	Silvered Leaf-monkey	6 000	4 000	2 000	33.33
<i>Presbytis melalophos</i>	Banded Leaf-monkey	962 000	554 000	408 000	42.41
<i>Presbytis obscurus</i>	Dusky Leaf-monkey	305 000	155 000	150 000	49.18
<i>Hylobates lar</i>	White-handed Gibbon	144 000	71 000	73 000	50.09
<i>Hylobates syndactylus</i>	Siamang	111 000	48 000	63 000	56.75

Source: Reference 21, p. 44.

The number of confrontations between elephants and humans has increased, because the elephant appears to have a particular liking for oil palms, and because the area devoted to the oil palm has increased dramatically—from only some 54 000 ha in 1960 to more than 700 000 ha in 1980 (25)—while the area under forest has declined (Figure 2; see Box 1).

The traditional solution to the problem of elephant depredations has been to destroy the marauding animals; thus, for example, between 1960 and 1969 the Perak Game Department shot 30 elephants, and between 1967 and 1977 the state game departments shot 120 animals (26). More recently, other control techniques have been implemented, including the digging of perimeter ditches around newly opened forest land, for it has been shown that elephants will not cross such barriers.

Since independence, the game departments have also shot a large number of tigers, which, under certain circumstances, will prey on livestock and attack humans. The villagers' fear of the tiger is longstanding and deep-rooted and not entirely without justification. When a tiger does attack livestock or villagers the authorities have little choice but to track and destroy the animal, as was the case in late 1981 when a tiger killed an aboriginal woman and her child near their home in the Kuala Lipis area of Pahang (27). Once abundant and widespread in the peninsula, the tiger is now restricted mainly to areas of primary and secondary forest in Perak and to similar forests in the east coast states of Kelantan, Trengganu and Pahang.

The ability of many species to survive forest clearance depends to a certain extent on the type of agricultural use that ensues. Particularly unfortunate for a number of species has been the replacement over the past two decades of large areas of forest with oil palm rather than with rubber. This is so because it would appear that more species can adapt to rubber than to oil palm plantations and that more species are tolerated in the former than in the latter (28). Rubber trees, unlike oil palms, are generally not planted in wet areas, with the result that on many estates pockets of forest or scrub remain to serve as refuges for breeding, shelter and resting; in addition, rubber trees provide suitable nesting sites for squirrels and birds, whereas the fronds of oil palm trees

offer no comparable sites.

A number of species that are quite harmless on rubber estates, such as squirrels and porcupines, cannot be tolerated on oil palm plantations because they eat the fruit of the oil palms. On the other hand, snakes thrive on oil palm estates, a major attraction being the several species of rats that are commonly found in such areas. Since they do less damage than the rats, the snakes are often protected by estate managers. According to Khan, oil palm plantations also "appear to support jungle fowls, leopard and flatheaded cats... and a few species of birds of prey" (29).

#### *The Impact of Selective Logging*

It is often assumed that the selective logging of humid tropical forests results in a very depauperate fauna. Recent observations in Peninsular Malaysia and Indonesia suggest, however, that this is not necessarily the case. While it is true that some species are unable to adapt to secondary forest, many others are equally at home in primary or secondary forest, and some species show a marked preference for logged-over areas (30). Observations made over a two-and-a-half-year period at the Sungai Tekam Forestry Concession in central Pahang showed that many species with large territories—for example, tigers, elephants and certain hornbills—simply move away from areas where logging is in progress and return when operations have ceased (31). Species with flexible diets, such as primates, bird species with wide dietary ranges, and species with a preference for vegetation characteristically found in more open areas, were observed to adapt best to the altered forest environment. It is interesting to note that four relatively rare large mammals, the elephant, tapir, seladang and sambar deer, were found to be three to four times more common in logged-over forests than in primary forests.

Some species, however, do not adapt well to logged-over forests. Of the 56 "large" species recorded at Sungai Tekam, nine percent were found exclusively in primary forest, while of the 223 species of birds recorded, 23 percent were restricted to tall primary forest. Species with specialized diets seem least able to adapt, and birds in particular appear to be adversely affected by logging. The number of

species present in primary forest areas suggests that food resources are finely partitioned and that any modification of the forest could affect some species; for example, the removal of the understory with its insect life could seriously disadvantage many insectivorous species. At Sungai Tekam, two groups of insectivores, cuckoos (*Cuculus* spp.) and trogons (*Harpaetes* spp.) were not observed in the logged-over areas.

#### *The Impact of Hunting and Collecting*

Big game hunting, once a popular sport in the Peninsula, is no longer common, although many small mammals and birds are hunted for food or for cash. Wild pigs, deer (including the protected mousedeer), scaly anteaters or pangolins (also protected but avidly sought after for their skins), squirrels and game birds are favored targets (32). Monkeys are also killed by certain aboriginal groups (collectively known as the Orang Asli) and by Chinese. The Aborigines use blowpipes or the more effective shotgun (33). According to one estimate, aboriginal groups in areas of primary forest are capable of killing up to about nine monkeys per km<sup>2</sup> per year, which is a significant mortality rate (34). In recent years hunters have been aided by the land development process and by the ever increasing network of logging tracks, both of which have facilitated access to forest areas.

There are four main categories of collecting: for food, as in the case of turtle and terrapin eggs; for display, as in the case of fish and coral for aquaria; for collections, as in the case of shells and butterflies; and for biomedical research. The systematic collection of turtle and terrapin eggs, which are considered to be delicacies, together with habitat modification, has resulted in serious declines in all four Peninsular Malaysian species. Take the example of the river terrapin (*Batugars baska*), which was once common along the Perak River. In the 1930s it was not unusual for collectors to obtain some 5-7000 eggs in a single night, whereas today a whole season is required to collect an equivalent number of eggs (35). Although laws exist to protect the terrapin, they have not been adequately enforced, and this fact largely accounts for the rapid decline in terrapin numbers (36).

Collectors seeking shells, coral specimens and colorful fish have devastated coral reefs along the coast and around offshore islands. The reefs off the southeast coast have been the most severely affected, one observer commenting that "Club divers from Singapore turned commercial shell collectors have stripped the islands along the Malayan East Coast, particularly Pulau Tioman and Pulau Aur. Many stretches of once-populated and viable reefs have been so ecologically disturbed as to have become barren rubble" (37). There are unfortunately no signs of recovery (38). The once abundant mourning cowrie (*Cypraea mauritina*) appears to have been eliminated from Peninsular Malaysian waters, and in a number of areas several species of reef fish have become scarce, among them the cleaning fish (*Labroides dimidiatus*).

Butterflies are collected for local sale, particularly to overseas tourists, and for export. That it is a flourishing enterprise is evident from the many display cases that crowd roadside stalls on the way up to Cameron Highlands. Another activity is the trapping of small animals and birds; some are sold locally, but most are smuggled out of the country, particularly to Singapore. In an effort to combat smuggling, Malaysia acceded to CITES in 1979.

Since the 1950s, tens of thousands of primates, particularly macaques, have been exported from the Peninsula for biomedical research. As many as 70000 specimens per year may have been exported during the 1950s and 1960s, and in the 1970s the annual average was probably on the order of 20000 (39). An export quota of 5000 primates per year was established in 1979, but in early 1984, following a report that some monkeys were being treated cruelly and used in nuclear and chemical warfare experiments in the United States, a five-year ban on further exports from Malaysia was proclaimed (40).

#### *The Impact of Pollution*

Pollution of various kinds has undoubtedly affected the wild animal life of the peninsula, although quantitative evidence of its effects is generally lacking. Soil lost from land development schemes has greatly increased the sediment loads of many rivers and resulted in excessive siltation along many watercourses and also offshore. Siltation has contributed to the decline, for example, of the river terrapin along the Perak River and has killed coral reefs around the west coast islands of Pulau Pangkor and Pulau Sembilan (41).

Chemical pollution of rivers and other water bodies has also taken its toll of aquatic life. During the 1960s and 1970s virtually untreated effluent from rubber factories and palm oil mills was discharged into watercourses, with disastrous results. Aquatic life along many streams and rivers was decimated, and many village dwellers found they could no longer rely on a traditional source of water for domestic use. Oil spills in the Straits of Malacca also cause a variety of environmental and social problems.

The rapid growth of the palm oil processing industry has been a major cause of water pollution. Unlike rubber factories, which are usually located in urban centers, palm oil mills are strung out along watercourses in rural areas, close to the plantations. Rivers supply fresh water needed in industrial processes and are used for disposing of effluent. The mills have rural rather than urban locations because transportation facilities are limited and because the fruit of the oil palm must be processed within 24 hours of being cut, otherwise free fatty-acid levels will reach unacceptable concentrations. In short, the "palm-to-plant" distance must be relatively short (42).

The magnitude of the palm oil effluent problem in the late 1970s is revealed by an estimate for 1978, which suggested that the total biochemical oxygen demand from effluent discharged by the processing mills in that year alone would have been equivalent to the demand from wastes produced

by a population of 16 million people (43). Controls introduced in 1978, and progressively strengthened thereafter, have greatly reduced the severity of the effluent problem, although they have certainly not eliminated it.

A less obvious, though potentially more dangerous, form of chemical pollution results from the widespread use of herbicides and insecticides. Chlorinated hydrocarbons—DDT, Aldrin, Dieldrin, for example—are commonly used to control insect numbers in agricultural areas, but for the most part their effects on animal life can only be inferred. High fish mortalities, however, have been reported from padi areas where chlorinated hydrocarbons have been used. Just what their effects are on other forms of animal life, particularly birds and small amphibia, are unknown. Also unknown is the impact on different faunas of the widespread use of sodium arsenite as a herbicide and an abocide, although seven elephants are known to have died from sodium arsenite poisoning between 1960 and 1969, including all four cows in what may have been the only remaining herd in the state of Kedah (44).

#### **Species at Risk**

In 1982, the Malayan Nature Society published reports on the conservation status of Malaysian mammals and birds (45). The Society reported that 61 species of mammals and 16 species of birds have populations of less than 1000, and are hence considered to be endangered, while a further 130 species of mammals and 148 species of birds are considered to be vulnerable, because they have populations of less than 3000. Of the endangered species, 17 of the mammals and 13 of the birds are similarly listed in the IUCN Red Data Books. Many of the endangered and vulnerable species listed by the Society inhabit Peninsular Malaysia. If endangering processes persist, several species will probably become extinct in the near future, a fate that has almost certainly already befallen the banteng (*Bos javanicus*) and the white-winged wood duck (*Cairina scutulata*).

Though of concern for many years, the status of the large mammals now appears to be reaching a critical stage. Almost all are considered to be endangered. In late 1982, the Department of Wildlife and National Parks estimated that only 250 tigers (*Panthera tigris corbetti*) remained, which compares unfavorably with an estimated 500 in 1975 and 3000 in the early 1950s (46). The status of the Sumatran rhinoceros (*Dicerorhinus sumatrensis*) is even more critical, an estimate suggesting that only between 52 and 80 animals still survived in 1982. As far as numbers are concerned, the seladang (*Bos gaurus hubbacki*) and the elephant (*Elephas maximus*), with estimated populations in circa 1980 of 480 and 671 respectively, would appear to be in a somewhat better position than the tiger and the rhino (47). Numbers alone, of course, are not necessarily a good measure of a species' chances of survival.

The plight of the large land mammals tends to attract the most attention. But many other species, as we have shown, are at risk, among them certain species of pri-



mates, birds, turtles and terrapins, corals and other marine organisms. No doubt a considerable number of invertebrates—worms, beetles, spiders, butterflies and the like—are also at risk, but as yet we know all too little about their status. In the Malaysian rain forest, according to one source, “the biomass of termites alone is 2–6 times that of the mammals and birds” (48). The invertebrates, which perform so many essential ecological functions and economic roles, should be taken more seriously by conservationists.

It behooves those with an interest in conservation to demonstrate that wild animals (and plants) are vitally important to humans everywhere, while in Third World

countries especially, conservation must be shown to contribute to economic development and the eradication of poverty (49). There are, as outlined in Box 2, a number of good reasons for conserving the fauna of Peninsular Malaysia.

### CONSERVATION AND AWARENESS

The many environmental problems that have accompanied the rapid removal of the lowland rain forest have been discussed elsewhere (59). Here we deal only with the growing awareness of the need to protect what remains of the region's remarkable natural heritage. That conservation is of mounting interest is clear from the ac-

tivities of the Malayan Nature Society, some of the policies of the federal government and, most encouraging of all, the emergence in recent years of a number of community-based environmental action groups.

The Malayan Nature Society has supported conservation for several decades. In its major publication, the *Malayan Nature Journal*, the Society has called for rational conservation policies, including the establishment of a network of parks and reserves (60). The Society has extended membership to schools and universities, released press statements on environmental issues and in recent years played a key role in mobilizing public

## Box 2: The Value of Wild Animals

We believe that the remarkably rich wild animal life of Peninsular Malaysia should be protected, for the following reasons:

1. **Food Value.** Wild animals, including aquatic species, are an important source of dietary protein. For example, among the Orang Asli are the forest dwelling, hunting and gathering Batek Negrito, whose diet includes monkeys, gibbons, civets, squirrels, birds and fish (50). Sedentary communities also rely on protein from the wild, a notable example being the importance of near-shore and fresh-water fish in the diets of the predominantly coastal and riverine Malays.

2. **Economic Value.** The hunting, trapping and collecting of animals for their skins, ivory, horn, eggs, or for other reasons has long been a source of income. In most cases, however, these activities have resulted in overexploitation and endangerment. An alternative is to harvest certain species on a sustainable basis, following the example, perhaps, of the wild turtle farms of the Cayman Islands or the crocodile farms of New Guinea (51).

3. **Biomedical Value.** Primates are of vital importance in biomedical research. The most significant research species are the macaques, the rhesus monkey, which is used in testing polio and other vaccines, being the animal most in demand. Prior to a recent five-year ban on further exports of primates, Malaysia had been an important supplier of research specimens to developed countries (52). The terrestrial and aquatic ecosystems of Peninsular Malaysia probably harbor many species of medicinal significance, but their properties—even the species themselves—remain very largely unknown.

4. **Genetic Value.** The wild genetic resources of Peninsular Malaysia's many ecosystems are exceptionally diverse. In the rain forests of the region are potentially important new drugs and industrial products, animals that might be domesticated, natural pest controls and the raw stuff of evolution.

Because the destruction of such ecosystems would lead to a spate of extinctions, their conservation should be given high priority (53). The protection of the region's genetic resources will require both *ex situ* and *in situ* gene banks and an emphasis on saving both species and populations (54).

5. **Service Value.** Wild animals, along with the plants and micro-organisms from which they are inseparable, provide a variety of free ecological services that are of great value to man, among them the maintenance of ecosystem structure and function, formation of soils, waste disposal and nutrient cycling, natural pest and disease control and pollination (55). The role of pollinators, for example, underscores a more general point, namely, that the mesh of ecological relations in the rain forest is so complex that the disruption of any particular strand of the web of life may have quite unforeseen consequences.

6. **Scientific Value.** There is still a great deal to be learned about tropical forests, man's adaptation to them and how they have been variously transformed in the course of human history (56). Only research sites in protected primary forests will reveal how rain forest ecosystems function; only primary forests can provide the urgently needed benchmark information against which we can measure the consequences of human intervention in forest ecosystems. Badly needed is more conclusive information on the long-term effects on animal life of selective logging, tree poisoning and the conversion of primary forests to all kinds of other uses.

7. **Aesthetic Value.** All manner of people find joy and inspiration in the colors, shapes, sounds, textures and behavior of the animal world. In recent years, the rich fauna of Taman Negara, Peninsular Malaysia's only national park, has attracted a growing number of both local and foreign tourists (57). In short, the aesthetic justification for protecting the region's fauna has at

least three strands: wild animals are a focus of growing local interest, they attract overseas visitors, who in turn are a source of foreign exchange, and they inspire writers, artists, sculptors and other persons of creative imagination.

8. **Symbolic Value.** Animals are frequently used as symbols. Here are three brief examples from Peninsular Malaysia. First, the tiger figures prominently in the national ensign of Malaysia. Secondly, in 1977 the rhinoceros was adopted as the symbol of a public protest against the logging of the core area of the proposed Endau-Rompin national park in the southern part of the peninsula. And thirdly, animals have been depicted on a variety of Malaysian postage stamps.

9. **Indigenous Experiential Value.** Hunters and gatherers have lived in rain forests for thousands of years. The Batek Negrito, for example, possess remarkably accurate and detailed knowledge of the plant and animal life of their rain forest surroundings. There is much still to be learned from the forest peoples, but their knowledge will survive only for as long as the great forests survive. Conservation policies should take into account the environmental knowledge, attitudes and values of indigenous forest dwellers.

10. **Intrinsic Value.** The nine points outlined above add up to a powerful justification for the conservation of wild animals. Yet they remain naggingly incomplete. Each point has an anthropocentric bias, suggesting that wild animals should be conserved as a means to some valued end (such as scientific knowledge), not as an end in themselves. The distinction here is between instrumental and intrinsic values. There is a rapidly growing literature in philosophy on the “rights” and “interests” of animals, but space precludes any discussion of it (58). Suffice it to say that a growing number of people now wish to argue that wild animals have intrinsic value; that is, that conservation for the benefit of humans alone is not enough.

opposition to further forest destruction.

The federal government has passed the Protection of Wildlife Act (1972) and the Environmental Quality Act (1974), introduced regulations under the latter to deal, for example, with effluent discharged from rubber factories and palm oil mills, created the Department of the Environment (1975) within the Ministry of Science, Technology and the Environment, devoted a chapter of the *Third Malaysia Plan 1976-1980* (TMP) to environmental issues, called for the creation of a large number of parks and reserves during the TMP period and proclaimed a National Parks Act (1980) (61).

In addition to listing a large number of protected birds and mammals, the Protection of Wildlife Act provides for the establishment of wildlife reserves and sanctuaries, while the National Parks Act establishes a formal legislative framework for the creation and management of national parks in Peninsular Malaysia (62). The reserves proposed in the TMP, however, have not advanced beyond the paper planning stage.

At this point it is important to note that under the Malaysian constitution, the federal government has very limited powers over matters pertaining to agriculture, forestry, land and water, all of which are state responsibilities (63). In short, a new park or reserve must have state approval. State authorities, however, tend to view conservation and development as antithetical goals, and they have in the past de-gazetted several sanctuaries and reserves. As far as parks are concerned, then, conservation in Peninsular Malaysia faces a double problem, namely, the creation of new reserves and the security of tenure of those that exist.

During the early years of the TMP period (1976-1980), the federal government clearly revealed an interest in balancing the goals of economic development and conservation. Since the mid-1970s, however, the government's commitment to environmental issues has waned perceptibly (64). This is evident, for example, in the *Fourth Malaysia Plan 1981-1985* (FMP), which includes only three short paragraphs on the environment (65). Paragraph 1131, the only one that is of interest in the context of this article, reads as follows:

*1131. Zoo and Wildlife protection. A sum of Malaysian \$13 million is provided for wildlife management and conservation activities. Two new national parks, the Endau-Rompin National Park and the Kuala Koh National Park, will be developed. In addition, a sum of [M] \$2 million is allocated to Zoo Negara for improving its facilities.*

There are two things to note about this statement: first, the two national parks have not yet been created; and secondly, a sum of [M] \$13 million spread over a five-year period is altogether inadequate for the job at hand.

Some attention, however, is being given to the conservation of species, albeit on an *ad hoc* basis. Among the projects that have been established to enhance the chances of survival of certain species are

the following, the first four of which are based on Khan *et al* (66).

1. New methods of elephant control have been introduced, including the use of electric fences and perimeter ditches (as already noted) and the trapping of animals in the vicinity of agricultural areas, the captured animals subsequently being released in more appropriate habitats or donated to zoos.

2. Suitable pastures for the seladang (*Bos gaurus hubbaki*), whose numbers are increasing, are being created in Taman Negara National Park and in the Krau Wildlife Reserve.

3. Two deer farms have been established—one in the Sungkai Game Reserve, Perak, and the other in the Krau Game Reserve, Pahang—and attempts are also being made to breed lowland pheasants in the Sungkai Game Reserve.

4. Three river terrapin (*Batagur baska*) hatcheries have been started in the states of Kedah, Perak and Trengganu. Some 20000 one-year-old terrapins have been returned to the wild since 1967.

5. In an effort to conserve the leathery turtle (*Dermochelys olivacea*), a hatchery was opened at Rantau Abang in Trengganu in 1961, and several thousand turtles have been added to the population in the intervening years (67).

6. A marine park, Peninsular Malaysia's first, has been created around Pulau Redang off the coast of Trengganu. Ironically, the publicity surrounding the campaign to establish the park caused an influx of skin-divers, anglers and other holiday-makers who caused extensive damage to the reefs and their environment. Now that the reefs are protected, it is hoped they will be better managed (68).

The projects outlined above, though praiseworthy in themselves, are piecemeal, not nearly as satisfactory as the conservation of ecosystems, and have played only a very minor role in regional and national planning policies. Nor is there much public support for conservation at present, probably for two closely related reasons. First, the many people who are still poor have other things to worry about; and secondly, little effort has been made to state clearly and to demonstrate convincingly that conservation and development are mutually dependent.

On the other hand, more Malaysians are now aware of environmental issues than ever before, and several citizens' groups are now active in environmental affairs, among them the Consumers' Association of Penang, the Environmental Protection Society of Malaysia and the Friends of the Earth Malaysia. In 1977, several societies and citizens' groups campaigned against the logging of the core area of the proposed Endau-Rompin national park (69), thereby contributing significantly to saving one of the last refuges in the peninsula of the Sumatran rhinoceros (Figure 6). Again, in 1982, a similar movement was instrumental in reversing a government decision to build a dam on the Tembeling River. Had the dam been built, it would have flooded a large portion of the fauna-rich lowlands of Taman Negara National Park (70). The extent to which public pressure groups will be permitted to oper-

ate freely, however, remains to be seen. It is to be hoped that they will grow in strength and maturity.

Loss of habitat is the major threat to the animal life of Peninsular Malaysia. Selective logging, hunting and collecting, and pollution also endanger a variety of species. The processes of environmental change are often interrelated and cumulative in their effects, while the resources in money and personnel that are assigned to conservation are entirely inadequate. A major problem is lack of co-operation between federal and state authorities. The present absence of political will is itself a threat to species.

Chemical pollution of rivers and streams is a relatively new environmental problem, and the rapid expansion of selective logging is primarily a post-colonial phenomenon. Much older are hunting and collecting and the expansion of the settlement frontier. No doubt at one time the resources of the peninsula must have seemed inexhaustible. Writing in the early years of this century, Warnford-Lock commented approvingly on the "vermin" destroyed for bounties in 1901 by Malay trappers, "the bag including 45 tigers, 20 leopards, and 13 panthers, besides 989 snakes, 1130 crocodiles, and 1732 crocodile eggs" (71). More than any other factor, however, the rapid expansion of the area devoted to plantation crops has posed the greatest threat to both plant and animal species.

Extinction, the usual fate of most species, is being greatly speeded up throughout the humid tropics, especially by the rapid conversion of tropical forests. Peninsular Malaysia is a treasure-house of plants and animals, a renewable cornucopia of importance to mankind. But wealth is now threatened with impoverishment.

Where once great green forests held sway are now serried rows of plantation crops, murky mining pools and gray expanses of tin tailings, padi fields of brilliant green or dun, new towns and villages and roads and railways and suburbs whose geometry is that of the plantation—straight and orderly. Peninsular Malaysia is largely a new place, its landscapes carved out of a jungle fastness. Though there is poverty still to be eradicated, it is a prosperous Third World region—prosper-



Figure 3. Sumatran rhinoceros: Symbol of the "Save Endau-Rompin National Park" campaign.

ous and wise enough perhaps to do something about the new kind of impoverishment that looms ahead.

Few countries or regions in the humid tropics can boast a better educated or more environmentally conscious public than can Peninsular Malaysia. The pace of deforestation, however, is so very rapid that it now seems doubtful whether more than a tiny fraction of the region's outstanding natural heritage can be saved. Perhaps somewhat more might be conserved if, for example, the international community could be persuaded to lend greater support to the non-governmental organizations that are now struggling to protect the region's natural riches (72).

## References and Notes

- N Myers, *Conversion of Tropical Moist Forest; A Report Prepared for the Committee on Research Priorities in Tropical Biology of the National Research Council* (National Academy of Sciences, Washington, DC, 1980) pp 25-26; and J-P Lanly, *Tropical Forest Resources*; FAO Forestry Paper 30 (Food and Agricultural Organization of the United Nations, Rome, 1982) p 100.
- N Myers and E S Ayensu, "Reduction of Biological Diversity and Species Loss" *Ambio* 12, 2, 72 (1983).
- A G Marshall, "Conservation in West Malaysia: The Potential for International Cooperation" *Biological Conservation* 5, 2, 136 (1973).
- G Maxwell, *In Malay Forests* (William Blackwell and sons, Edinburgh and London, 1907) p 2.
- S R Aiken *et al*, *Development and Environment in Peninsular Malaysia* (McGraw-Hill International Book Company, Singapore, 1982) pp 120-122.
- Wild Life Commission of Malaya, *Report of the Wild Life Commission*, 3 Vols. (Government Printer, Singapore, 1932).
- S Majid and A Majid, "Public Sector Land Settlement: Rural Development in West Malaysia" in *Rural Development and the State: Contradictions and Dilemmas in Developing Countries*, D A M Lea and D P Chaudhri Eds (Methuen, London and New York, 1983) pp 66-99.
- M Khan b. Momin Khan, Sivananthan T Elagupillay, Zolkifli b. Zainal, "Species Conservation Priorities in the Tropical Rain Forests of Peninsular Malaysia" *Malayan Naturalist* p 2 (May, 1983).
- Government of Malaysia, *Second Malaysia Plan 1971-1975* (Government Press, Kuala Lumpur, 1971) p 131.
- "Forest Resource Base, Policy and Legislation of Peninsular Malaysia" *Malaysian Forester* 42, 4, 333 (1979).
- FAO, *Forest Resources of Tropical Asia* (Food and Agricultural Organization of the United Nations, Rome, 1981) p 289.
- R A Sebire, "Top Exporting Nation Faces Changes" *Australian Forest Industries Journal* 46, 8, 47 (1980).
- M E D Poore, "Studies in Malaysian Rain Forest. I. The Forest on Triassic Sediments in Jengka Forest Reserve" *Journal of Ecology* 56, 1, 187 (1968).
- Lord Medway, "Fauna" in *Malaysia: A Survey*, Wang Gungwu Ed (F A Praeger, Publishers, New York, 1964) p 55.
- D Lee, *The Sinking Ark: Environmental Problems in Malaysia and Southeast Asia* (Heinemann Educational Books (Asia) Ltd., Kuala Lumpur, 1980) p 55.
- P W Richards, "The Tropical Rain Forest" *Scientific American* 229, 6, 59-60 (1973).
- F Bourlière, "Animal Species Diversity in Tropical Forests" in *Tropical Rain Forest Ecosystems: Structure and Function*, F B Golley Ed (Elsevier Scientific Publishing Company, Amsterdam, 1983) pp 80-87.
- T C Whitmore, *Tropical Rain Forests of the Far East* (Clarendon Press, Oxford, 1975) pp 166-168, 212-213.
- P Ehrlich, A Ehrlich, *Extinction: The Causes and Consequences of the Disappearance of Species* (Ballantine Books, New York, 1983) pp 155-212.
- W E Stevens, *The Conservation of Wildlife in West Malaysia* (Office of the Chief Game Warden, Ministry of Lands and Mines, Seremban, Negri Sembilan, 1968) p 99.
- M Khan b. Momin Khan, "Man's Impact on the Primates of Peninsular Malaysia" in *Recent Advances in Primatology: Vol. 2: Conservation*, D J Chivers and W Lane-Petter Eds. (Academic Press, London, 1978) p 43.
- Kiew Bong Heang, "Conservation Status of the Malaysian Fauna. I. Mammalia" *Malayan Naturalist* pp 13-14 (May, 1982).
- J E Duckett, "Plantations as a Habitat for Wild Life in Peninsular Malaysia with Particular Reference to Oil Palm (*Elaeis Guineensis*)" *Malayan Nature Journal* 29, 3, 180 (1976).
- New Straits Times* (Kuala Lumpur), January 13, 1982.
- S R Aiken *et al*, *op cit* 5, p 125 and calculations based on Government of Malaysia, *Mid-Term Review of the Third Malaysia Plan 1976-1980* (Government Press, Kuala Lumpur, 1979) p 128 and Government of Malaysia, *Fourth Malaysia Plan 1981-1985* (National Printing Department, Kuala Lumpur, 1981) p 277.
- M Khan b. Momin Khan, "Reproduction, Productivity and Mortality of the Malayan Elephant" *Malayan Nature Journal* 30, 1, 28-29 (1977).
- New Straits Times* (Kuala Lumpur), October 21, 1981.
- J E Duckett, *op cit* 23, p 180.
- M Khan b. Momin Khan, "Problems of Wildlife Management in South-east Asia" in *Wildlife Management in the '80s*, Thane Riney Ed (Proceedings of Conference Organized by Field and Game Federation of Australia and Graduate School of Environmental Science, Monash University, November 27-29, 1981) p 68.
- C C Wilson, W L Wilson, "The Influence of Selective Logging on Primates and Some Other Animals in East Kalimantan" *Folia Primatologica* 23, 4, 245-274 (1975); and A Johns, "Wildlife Can Live with Logging" *New Scientist* 99, 1367, 206-211 (1983).
- A Johns, *ibid*, p 207.
- M Khan b. Momin Khan, "The Value of Fauna Conservation" in *Proceedings of the Symposium on Biological Resources and National Development*, E Soepadmo, K G Singh Eds (Malayan Nature Society, Kuala Lumpur, 1973) p 141; and *New Straits Times* (Kuala Lumpur), May 28 and June 10, 1983.
- A T Rambo, "Bows, Blowpipes and Blunderbuses: Ecological Implications of Weapons Change among the Malaysian Negritos" *Malayan Nature Journal* 32, 2, 209-216 (1978).
- C H Southwick, F C Cadigan, "Population Studies of Malaysian Primates" *Primates* 13, 1, 15 (1972).
- New Straits Times* (Kuala Lumpur), January 18, 1982.
- M Khan b. Momin Khan, Sivananthan T Elagupillay, Zolkifli b. Zainal, *op cit* 8, p 4.
- R B Lulofs, "Endangered Freshwater and Marine Environments and Conservation of Coral Reefs" in *Proceedings of the Seminar on Modernisation and the Environment*, Lim Wah Ching, Ravinder Singh Eds (Consumers' Association of Penang and the Penang Branch of the Malayan Nature Society, Penang, 1974) p 35.
- Kiew Bong Heang, *op cit* 22, p 16.
- C E Southwick, F C Cadigan, *op cit* 34, pp 15-16; M Khan b. Momin Khan, *op cit* 21, p 42.
- The Age* (Melbourne), February 17, 1984.
- op cit* 37, p 34; and E O Moll, "West Malaysian Turtles: Utilization and Conservation" *Herpetological Review* 7, 4, 163-166 (1976).
- S Aiken, M R Moss, "Man's Impact on the Natural Environment of Peninsular Malaysia: Some Problems and Human Consequences" *Environmental Conservation* 3, 4, 276 (1976).
- Abdu Aziz b. Ahmad, *Palm Oil Effluent Processing. Volume 1: Foreseeable Technological Problems* (Department of Factories and Machinery, Kuala Lumpur, 1974) p 6.
- M Khan b. Momin Khan, *op cit* 26, p 29; and M Khan b. Momin Khan, "On the Population and Distribution of the Malayan Elephant" *Malayan Nature Journal* 30, 1, 4 (1977).
- Kiew Bong Heang, *op cit* 22 pp 3-19; and Kiew Bong Heang, G Davison, "Conservation Status of the Malaysian Fauna. II. Birds" *Malayan Naturalist* pp 2-34 (November, 1982).
- A Locke, *The Tigers of Trengganu* (Museum Press Limited, London, 1954) pp 7-8; Malayan Nature Society, "The Tiger" *Malayan Naturalist* 2, 2, 6 (1975); *op cit* 8, p 3.
- Op cit* 8, M Khan b. Momin Khan, Sivananthan T Elagupillay, Zolkifli b. Zainal, p 3.
- M Collins, S Wells, "Invertebrates—Who Needs Them?" *New Scientist* 98, 1358, 444 (1983).
- E P Eckholm, *Down to Earth: Environment and Human Needs* (Pluto Press, London, 1982) p 8.
- K Endicott, *Batek Negrito Religion: The World-View and Rituals of a Hunting and Gathering People of Peninsular Malaysia* (Clarendon Press, Oxford, 1979) pp 12-13, 62-67.
- S Mills, "Shades of Reasons for Protecting Wildlife" *New Scientist* 98, 1361, 685 (1983).
- T Inskipp, S Wells, *International Trade in Wildlife* (International Institute for Environment and Development and the Fauna Preservation Society, Earthscan Publication, London, 1979) pp 32-34.
- R Allen, *How to Save the World: Strategy for World Conservation* (Littlefield, Adams & Company, Totowa, New Jersey, 1981) pp 108-109.
- R Prescott-Allen, C Prescott-Allen, "Park Your Genes" *Ambio* 12, 1, 37-39 (1983).
- M Collins, S Wells, *op cit* 48, pp 441-444; P Ehrlich, A Ehrlich, *op cit* 19, pp 91-120.
- See, for example, *Biological Diversity in the Tropics* G T Prance Ed, (Columbia University Press, 1982); F C Golley, *op cit* 17.
- S R Aiken, C H Leigh, "Ending the Threat to Taman Negara: A Malaysian Gordon-Franklin Won" *Habitat* [Australia] 11, 2, 12-13 (1983).
- See, for example, *Environmental Philosophy* D S Mannison, M A McRobbie, R Routley Eds; Monograph Series No. 2 (Department of Philosophy, Research School of Social Sciences, Australian National University, Canberra, 1980).
- S R Aiken *et al*, *op cit* 5; and T Sharp, "Malaysia's Environment in Danger" *Ambio* 12, 5, 275-276 (1983).
- Malayan Nature Society, "The Grounds for Conservation" *Malayan Nature Journal* 24, 3-4, 193-194 (1971); and Malayan Nature Society, "A Blueprint for Conservation in Peninsular Malaysia" *Malayan Nature Journal* 27, 1-2, 1-16 (1974).
- Laws of Malaysia Act No. 76. Protection of Wildlife Act, 1972; Laws of Malaysia Act No. 127. Environmental Quality Act, 1974; Government of Malaysia, *Third Malaysia Plan 1976-1980* (Government Press, Kuala Lumpur, 1976) pp 218-227; and Laws of Malaysia Act 226. National Parks Act, 1980.
- The Act does not apply to Sabah and Sarawak (East Malaysia), nor to Taman Negara National Park, Peninsular Malaysia.
- M Suffian b. Hashim, *An Introduction to the Constitution of Malaysia* (Government Printer, Kuala Lumpur, 1976) pp 143-180.
- "The Fourth Malaysia Plan—So Disappointing on the Environment" *Alam Sekitar* 6, 2, 7-8 (1981); and K B Heang, "Fourth Malaysia Plan" *Malayan Naturalist* pp 3-6 (January, 1982).
- op cit* 25, paras 1079, 1081 and 1131.
- M Khan b. Momin Khan, Sivananthan T Elagupillay, Zolkifli b. Zainal, *op cit* 8, p 5.
- S R Aiken *et al*, *op cit* 5, p 195.
- New Straits Times* (Kuala Lumpur), May 13, 1983.
- S R Aiken, C H Leigh, "A Second National Park for Peninsular Malaysia? The Endau-Rompin Controversy" *Biological Conservation* 29, 3, 253-276 (1984).
- S R Aiken, C H Leigh, *op cit* 57, p 12.
- C G Warnford-Lock, *Mining in Malaya for Gold and Tin* (Crowther & Goodman, 1907), p 3.
- On some of the strategies that might be adopted by the international community to protect certain resources of value to mankind, see N Myers, D Myers, "How the Global Community Can Respond to International Environmental Problems" *Ambio* 12, 1, 20-26 (1983).
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