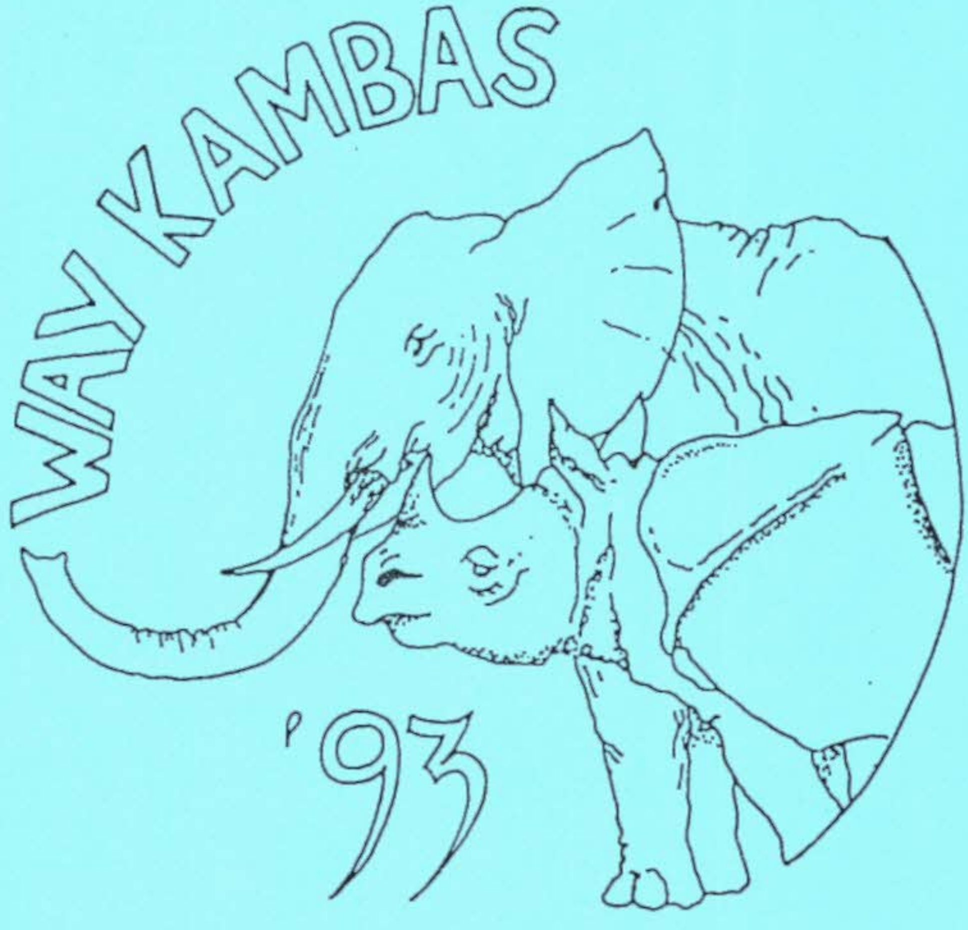
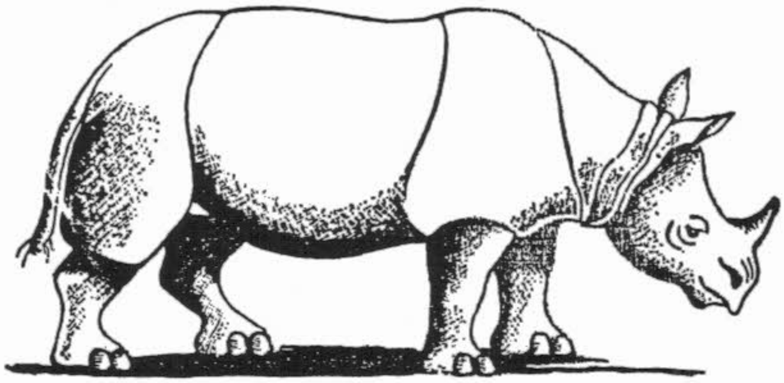
WAY KAMBAS '93



PATRON: PROFESSOR DAVID BELLAMY.

Proposal To Assess The Suitability Of The Way Kambas National Park For the Reintroduction Of The Javan Rhinoceros *Rhinoceros sondaicus*, Habitat Structure And Potential Impact Of The Existing Populations Of Large Herbivores.



To be carried out in collaboration with, the Universities of Lampung, Indonesia and Southampton, U.K.

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Summary

The population of fifty Javan rhinoceros in Ujung Kulon National Park, Java, remains vulnerable to extinction. If a breeding nucleus was taken to Way Kambas National Park survival probability would increase due to (a) increase in numbers (b) separation from threats in Ujung Kulon. Before such a move is possible, an ecological survey of Way Kambas is necessary to establish whether (a) requisite habitats and food plants are present, and (b) resident species threaten the rhino. The proposed expedition would undertake this survey, at the same time collecting data of use to the conservation strategies for these resident species themselves.

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SECTION.

SECTION 1 INTRODUCTION.

"....One of the most pressing species conservation priorities in the world"
(Khan, 1989, on the Javan rhino recovery program).

The Ujung Kulon National Park, in Java is the last stronghold of the Javan or lesser one horned rhinoceros *Rhinoceros sondaicus*, with a population estimated at 50. A few are to be found in South Vietnam and there are none currently held in zoos. Twenty five years ago, there were only 20 rhinos known worldwide; in an effort to save the rhinos from extinction, the World Wide Fund for Nature (WWF) established a conservation program and since then the population has more than doubled (see Fig 1.1).

Of the three Asian species, the future of the Javan rhino is perhaps the bleakest as its small population makes it vulnerable to sudden perturbations in its environment. At the beginning of 1982, five rhinos were found dead in a very restricted area of Ujung Kulon. It is thought that they died as a result of an epidemic disease, probably due to the anthrax virus. In a separate incident an outbreak of *Septicaemia epizootica* in November 1981 was believed to be responsible for the deaths of about 50 Buffaloes and 350 goats in the neighbourhood of Ujung Kulon; in such a case other large mammals could act as vectors for the disease which could affect the rhino population, although in this instance the epidemic had no effect on the rhinos.

The National Park of Ujung Kulon, lies in the vicinity of the active volcanic island of Krakatau. In 1883, the eruption of Krakatau and the resulting 20 metre high tidal waves, (tsunamis), destroyed 25-30% of Ujung Kulon. In an attempt to safeguard this rhino population against further epidemics and possible habitat destruction (for example, if Krakatau were to erupt again in the future), Schenkel & Schenkel (1982) recommended that a small breeding nucleus of rhinos be translocated from the Ujung Kulon National Park to another suitable reserve.

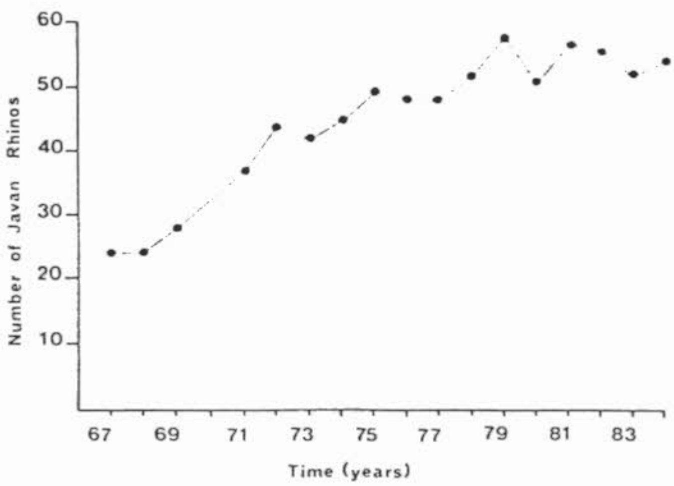


Fig. 1.1 The Changes in the Number of Javan Rhinoceroses in Ujung Kulon National Park.
(Taken From Santiapillai and Suprahman 1986)

During the translocation of some threatened rhinos from the borders of Meru National Park in Kenya, 8 animals out of the 42 that were translocated died shortly after (Martin & Martin 1982). Such high losses would be unacceptable in the case of the Javan rhino as their rarity alone does not permit any experimentation. Thus even greater caution is needed before attempting their removal. The translocation of the Indian rhinoceros *Rhinoceros unicornis* from the Kaziranga National Park in Assam to the Dudhwa National Park in 1984 was carefully carried out and the whole operation involved a feasibility study, and preparatory, release and follow up phases; as a result this translocation was a success.

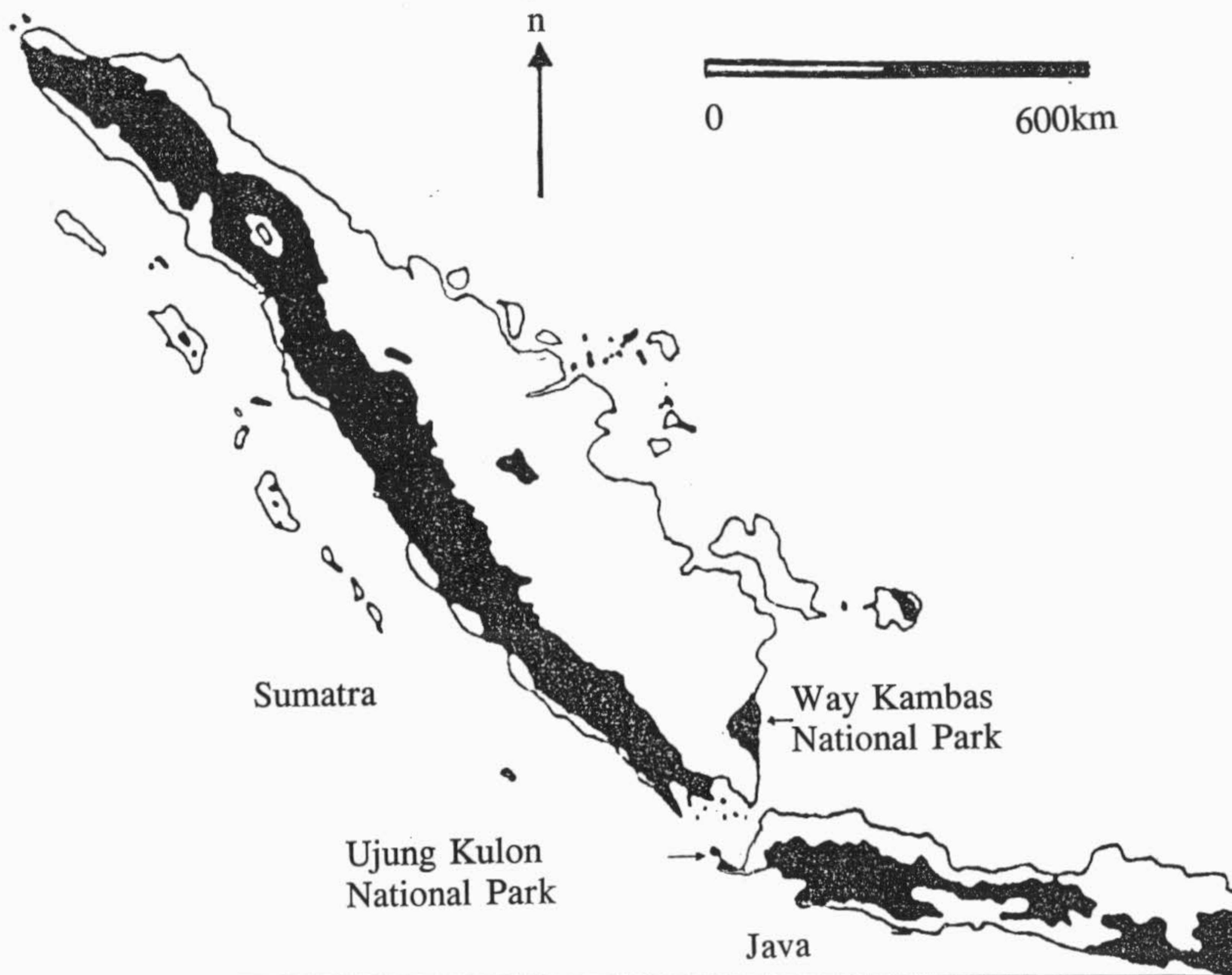
In 1991, Way Kambas National Park in Sumatra was finally chosen as the reserve for translocation (IUCN Management Plan). This area is particularly suitable, since a population is known to have existed here prior to its extinction in 1961. The IUCN states that 'where a wild species has become locally extinct and the reasons for its disappearance have been removed without any radical alteration in the condition of the habitat, it may be re-introduced with relative safety into its old range, because it will be once again interacting with the biotic and physical system in which it evolved. Way Kambas has appropriate habitats for rhinos, and many of their food plants in Ujung Kulon are also present in Way Kambas. Over the last few years there have been reports that a few rhinos may still exist here. (In 1987 Mr. Widido Sukohadi, the then Chief of Way Kambas NP, reported seeing rhino dung in the park; more recently, two park guards reported actually encountering a single horned rhino and plaster casts have been taken of an animal's footprint which could be that of a rhino (Santiapillai, 1991: pers. comms.)). However, since the 1960's the reserve has been drastically altered as a result of logging. Over 70% of the reserve has become degraded into scrubby bush and alang alang *Imperata cylindrica* grassland. Whether or not the rhinos could live in this logged forest will depend greatly on the extent of suitable habitat present and the degree of competition likely to be encountered from resident large herbivores.

Large mammal translocations are frequently controversial issues, and with these factors in mind it will be necessary to carry out a thorough feasibility study prior to moving any animals. Questions to be addressed by such a study would include whether there is a sufficient amount of food resourses available in Way Kambas to sustain a population of Javan rhinos, whether the logged forest is indeed a suitable habitat for the rhinos, and how great competition from existing large herbivore populations is likely to be. The most important of the herbivores is likely to be the population of Asian elephants *Elephas maximus*. Although in Ujung Kulon the Javan rhino co-occur with banteng cattle *Bibos sondaicus*, water buffalo *Babalus babalus* and rusa deer *Cervus timorensis* (Hedges, 1991), there are no elephants in the reserve; indeed there are no wild populations of Asian elephants in Java. Little is therefore known to what extent these two species will overlap in their habitat use and food plants. As Javan rhinos once lived in Way Kambas, they once coexisted with the elephants. However, with the drastic change in the habitat of Way Kambas over the past 20 years, it may be possible that the resources available may have been reduced to such an extent that it would not be possible for a population of Javan rhinos to co-exist with the elephants. There are also populations of tapir and sambar deer within the park which could interact with the rhinos in a significant way.

In the same context, however, we should note that the elephants represent a major conservation project in their own right. Although not as endangered as the rhino, the Asian elephant is far more threatened than its high profile African cousin. Current estimates of elephant populations in Sumatra range between 2,800 -5,000. There are at present a number of problems, both natural and manmade, threatening their tropical rainforest habitats in Sumatra (these including forest fires, human resettlement, logging, agricultural expansion, shifting cultivation and road-building). As a result, elephants and other mammals are becoming confined to shrinking habitats; in extreme cases becoming pocketed, which can lead to local extinction. Any work evaluating possible overlap between the elephant and the rhino would therefore necessarily be of value to the conservation efforts concerning the elephants themselves.

A further issue of particular sensitivity in Way Kambas itself, is that at dusk numbers of elephants leave the National Park, crossing its southern border and raiding the local villagers' crops. This is causing the significant damage to the subsistence agriculture, and to such an extent that people have been killed trying the frighten the elephants away from their crops. Whether this is symptomatic of an over-burdened environment within the park, or merely represents opportunistic taking of easy food, is unknown, but the answer to these questions may have implications on conservation strategies within the park, and warrants consideration in its own right.

Fig. 2.1 Map Showing the Location of Way Kambas and Ujung Kulon National Parks in Indonesia



SECTION 2. WAY KAMBAS

Way Kambas National Park covers a relatively large area - 1,235km^2, which is more than four times the size of the Ujung Kulon peninsula. It is situated at the south-west of Sumatra, in a lowland area, at an altitude range of 0 - 50m (figure 2.1). The Park can be roughly divided into three types of defined vegetation, comprising freshwater swamp (300km^2), lowland rainforest (500km^2) and mangrove (10km^2), (fig.2.2). It has recently been designated a World Heritage Site, so, together with six other protected areas in Sumatra, Way Kambas is given top priority status and offers the best example of non-peaty swamp. The Park is surrounded on three sides by cultivated areas and human settlements, whilst the eastern boundary is 60km of sea coast. Unfortunately the Park is situated in one of the most densely populated provinces in Sumatra, namely Lampung; nevertheless Way Kambas is one of only four protected areas rated as having average management standards (no areas have good management). Although poaching could still be a major problem -the Park is easily accessible and adequate anti-poaching methods would be necessary to ensure the rhinos' survival - it is encouraging that the last Javan rhino to be shot in Way Kambas was in 1931, whilst the animal only became extinct in 1961. Since then, however, the Park has been drastically altered as a consequence of indiscriminant logging and today over 70% of the Park has become converted to scrubby bush and alang alang grasslands (Caufield 1984). If rhinos can survive in logged forests (as Van Strien, 1985, suggests), then the present condition of Way Kambas should not be a powerful argument against their relocation. The Park has appropriate habitats for the rhino, viz. mudflats, sandy beaches, mangroves, freshwater (non-peat) swamp forests, lowland forests, patches of dipterocarp forest, rivers and estuaries. Plants such as *Glochidion sericeum, hibiscus tiliacum, Ardisia humilis, Leea indica, Rhizophora conjugata*, known to be eaten by the Javan rhino in Ujung Kulon are also present in Way Kambas (Santiapillai & Suprahman, 1986).

Previous surveys of Way Kambas have concentrated on very narrow aspects of the Park's ecology (e.g. Cousens, Hedges, & Webb, 1989). At present much of the information necessary to evaluate the rhinos' chances of survival if reintroduced is simply not available. There is, therefore, an acute need for an ecological survey which will collect more general information on the park.

What is obvious is that the status of Way Kambas National Park is one of extreme importance in relation to both the possible translocation of the Javan rhino and for the conservation of the Asian elephant and other large mammals.

SECTION 3. BIOLOGY AND ECOLOGY OF THE JAVAN RHINO.

(Rhinoceros sondaicus)

The Javan, or lesser one-horned rhinoceros (*Rhinoceros sondaicus*) stands around 6 feet tall at the shoulder, and weighs approximately 3,527lbs. Its head and body measure 11'6" long and its horn is just 10-10.25" long (Species Conservation Monitoring Unit, 1987). In the past, Javan rhinos could be found throughout Sumatra, Thailand and Vietnam, and areas of Burma, Java and the Malaysian Peninsula, but the species is now restricted to a population of approximately 50 in an area of 360km in Ujung Kulon, Java (see Fig 3.1). There is also believed to be a small but inviable population of 12-15 individuals along the Dong-Nai river in South Vietnam. It now has the dubious distinction of being the rarest species of large mammal in the world.

Its exact distribution in past times is still unclear, as *R. sondaicus* was only distinguished from *R. unicornis* (the great Indian one-horned rhinoceros) at the beginning of the nineteenth century. A direct comparison of the two species shows that *R. sondaicus* has a far less "knobbly" appearance and fewer neck folds, and the horn is smaller and restricted to the males (see Fig 3.2a and b). The first scientific distinction was made by Desmarest in 1822, by which time museum collections, culling and poaching had rendered it extinct in many of its former habitats. After examining 46 skulls of *R. sondaicus*, Groves in 1967, on account of skull and tooth measurements, recognised three different subspecies:- *R. sondaicus sondaicus* Desm. for Java, *R. sondaicus floweri* Gray. for Sumatra and *R. sondaicus inermis* Lesson for the Sunderbunds of the Ganges Delta. Rhinos were first reported in Ujung Kulon

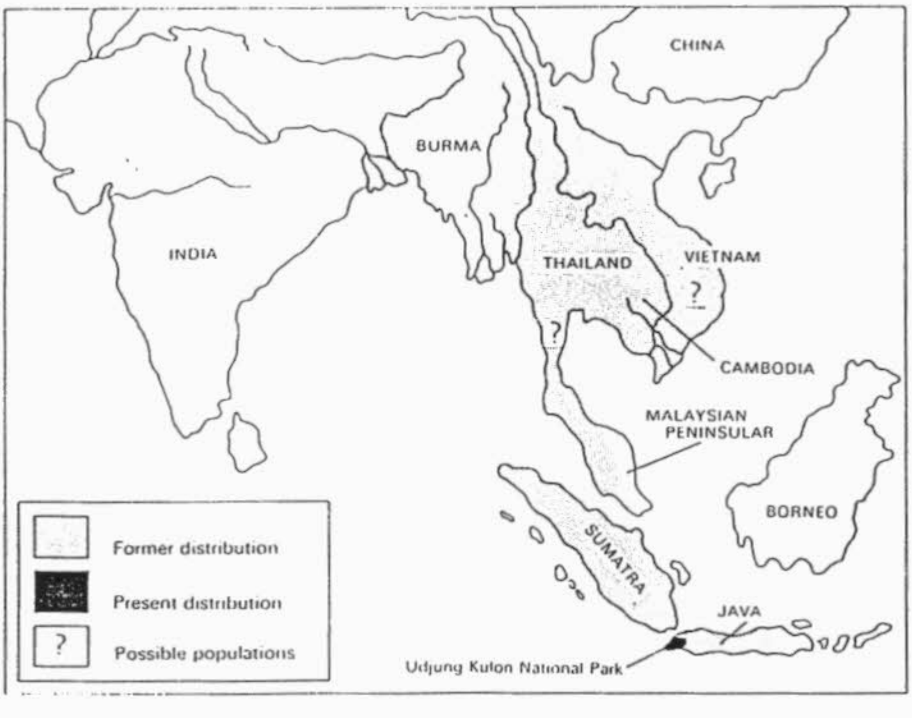


Fig 3.1 The Past and Present Distribution of the Javan Rhinoceros.
(Taken From Penny, 'Rhinos-Endangered Species', 1987)

in 1861, and in 1909 were declared a "protected species". Despite this, many poaching incidents were still documented until finally in 1937 Ujung Kulon was declared a Nature Reserve (it became a National Park in 1980). However, the remaining population has still remained vulnerable, with heavy poaching occurring after the Second World War and again between 1963-4. It was not until 1988 that it was declared "Endangered" by IUCN.

A large field study was carried out between 1967-8 by Schenkel and Schenkel-Hulliger (1969) which initiated several subsequent studies, particularly those of Hoogerwerf, WWF and Ammann. Thus, despite the rhino's wariness and somewhat elusive nature, we now have a substantial amount of information, particularly concerning its ecology.

Rhinos may occur singly or within groups. Calves have been observed with mothers, but beyond this little is known about interrelationships, since the existing population is so small. Although Hoogerwerf suggests that rhinos maintain a peaceful coexistence with other animals in Ujung Kulon, Hazewinkel (1933) documents clashes between bull rhinos and cattle and even horses in the past. Competition between the rhinos and the banteng cattle (which ironically is also one of the world's most endangered mammals) may be occurring to such an extent that it is restricting the number of rhinos that the park can support. The rhinos and banteng also share diseases, for example *Paramphistomiasis*, which is caused by nematode worms of the family *Paramphistomidae*. This causes pronounced effects of stress in the animals. Also a large amount of trampling around water holes can stir up micro-organisms, increasing the likelihood of an disease outbreak, for example the anthrax virus.

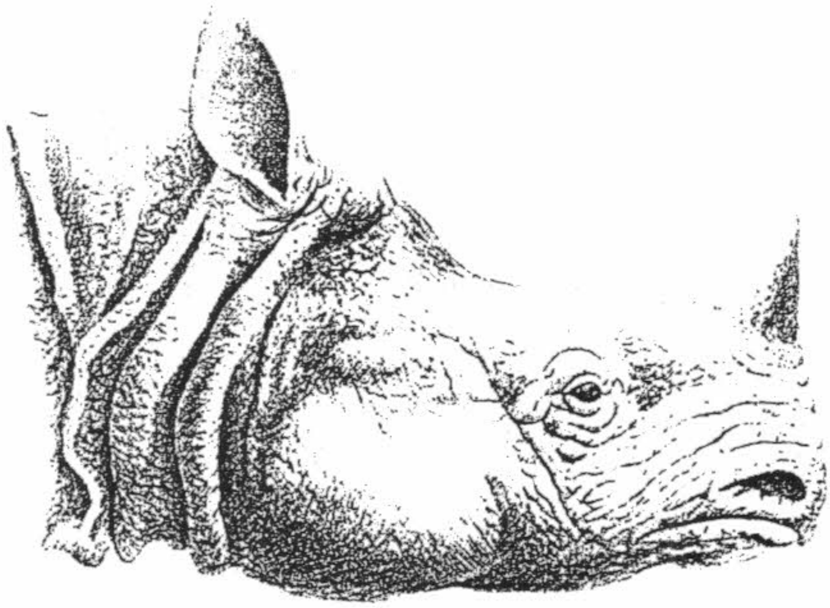
Since the demise of the rhino in Way Kambas changes will no doubt have occurred in the situations of the other large mammals, and so it is necessary to address the problem of whether a niche still exists for this animal in Way Kambas - if the elephants here prove to be stronger competitors than the banteng are in Ujung Kulon the rhino population may have difficulty in re-establishing itself.

The Javan rhino is largely a browsing forest inhabitant; reports from Ujung Kulon suggest that it tends to avoid the mountainous areas such as the Mount Pajung range, but will only penetrate ranges to a certain height. Reports from the early part of this century, when the Javan rhino and the Sumatran rhino were both widespread throughout Indo-China and occurred in sympatry in places, suggest that both animals were capable of occupying high or low ground; when they did occur together, however, the Sumatran rhino was invariably found on the high ground, while the Javan rhino held sway over the lower regions (Grzimek, 1990).

The dominant vegetation types in Ujung Kulon comprise of palm forest and dense rattan shrub, of which the second is particularly important for its abundance of suitable food plants and very low levels of human activity. Coastal regions, especially the boggy areas of the East, are known to be frequented and may be associated with the need both for wallows and salt-licks. The rhino browses on a variety of foliage, small branches and the green parts of climbers. It is able to reach to an estimated 2.5m, but also bends small saplings of diameter 2-10cm, to grasp growing shoots with its prehensile upper lip. Of 190 different food plants, Ammann (1985) found that 44% consisted of: *Spondias pinneta, Amomum, Leea sambucina* and *Dillenia excelsa;* a fifth preference is probably *Glochidian zeylanicum,* although this was not included in Ammann's study area. It is not, however, believed to take bamboo and palm.

Fig. 3.2 The similarity between the Javan Rhinoceros *Rhinoceros sondaicus* and the Greater Indian One-Horned Rhinoceros *Rhinoceros unicornis* led to confusion until the species were separated in 1822.

a) Javan Rhinoceros.



b) Greater Indian One-Horned Rhinoceros.

Taken from Penny,'Rhinos-Endangered Species'(1987).

Schenkel et al. (1969) documents a favourite food plant as tepus (*Nicolaia sp.*), whilst Lee Talbot (1959) also writes that twigs and fruit are consumed as well as leaves. A mixture of species probably enables this mammal to gain sufficient nutrients whilst avoiding toxin build-up, and allows regeneration of damaged shoots. Ammann also found that the majority of feeding areas were light, open spaces, which may assist in the regeneration process.

Study of the Javan rhino has provided a challenge for many years; its low numbers and nomadic life-style have led to relatively little direct observation, and the nature of the terrain has posed difficulties for research. Thus, the majority of studies have focused on indirect methods such as dung analysis, tracking and evidence of habitat use.

The footprints of individuals may be distinguished by measuring: 1) the difference between the width of hind and forefoot, 2) the shape and size of pugmarks (see Fig.3.3)
Hoogerwerf (1970) records a width of more than 25cm in adult prints, from the edge of the outer toe to the edge of the inner toe. Both forefeet and forehooves are larger than hindfeet and hooves as shown in the following data:

Average of	231 forefoot prints (adult)	= 28.05cm
	118 rearfoot prints	= 26.10cm
	161 forehooves	= 11.77cm
	68 hindhooves	= 11.04cm

"Gait" is measured as the distance between successive imprints of the forefoot on the same side, and averages between 150-180cm. It should be emphasized however that pugmark measurement may differ according to speed of pace, gradient of terrain and type of soil, and so it is not always a satisfactory method of population analysis, but is useful in establishing habitat preference.

Dung piles may consist either of solitary 'events' or vast heaps and there is little evidence for areas specific to this function, Hoogerwerf (1970) records an average dung heap as measuring 50-90cm long x 30-75cm wide and 14-30cm tall, consisting of "indigestible, large coarse fragments of plants".

Observations of its behaviour suggest that Javan rhinos possess poor eyesight, but very acute senses of smell and hearing; upon encountering humans, Schenkel noted that an individual appeared to respond after picking up a human scent with an associated 'pricking up' of the ears. The use of strong-smelling urine as a marker would seem to confirm the importance of the olfactory sense. Schenkel reports seeing males spraying bushes with orange-red urine, which had a characteristic pungent odour. This is also known to occur in wallows, possibly as a means of coating the skin with scent in order to mark trails after leaving the wallow. However, Schenkel does not report dung-marking as a means of communication, and indeed defecation seems to be a more random event than urination.

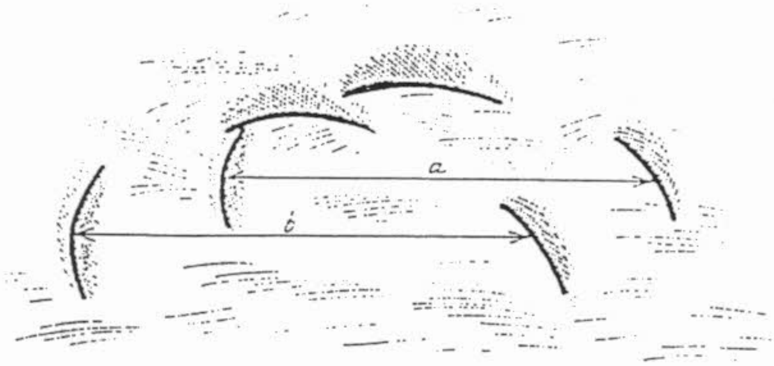
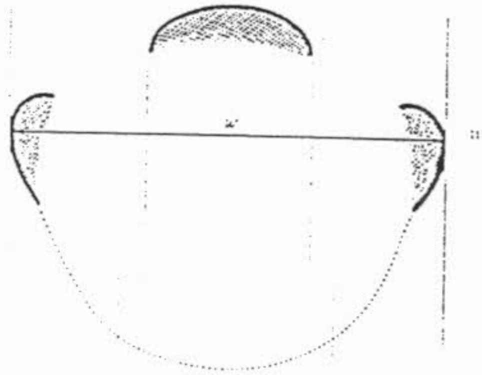


Fig. 3.3(a) Footprints of the Javan Rhinoceros. With the Hindfoot (a) on top of the fore foot.



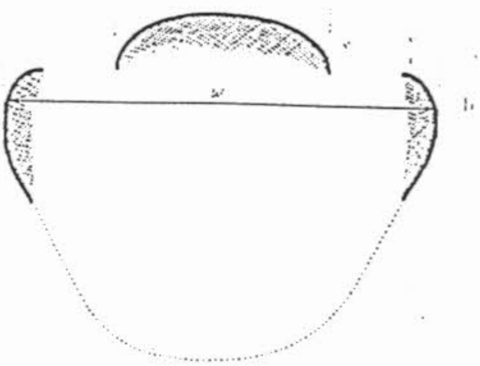


Fig 3.3(b) Footprints of the Javan (a) and the Greater One-Horned Rhinoceros. Width of the foot print (w).

Taken from Hoogerwerf (1970).

Bathing and wallowing are both activities which probably help keep the skin moist and regulate the body temperature, whilst providing protection against skin parasites. Bathing occurs in streams and pools, and tends to occur less frequently than wallowing, whereas wallows tend to be fairly small areas of water and provide the more specific purpose of scenting. Rhinos also use pools for drinking; in other rhino species, salt-licks are also an important feature, and although none could be found in Ujung Kulon, it is possible that the population uses coastal areas to satisfy its salt requirement.

Neither paths, wallows or feeding areas are visited regularly; rather, the animals move about their home ranges, remaining for longer periods in more plentiful areas. Solitary rhinos may cover some 1.4 to 3.8 km in a 24 hour stretch, often following well-established paths and tunnels. Hoogerwerf, however, states that "rhino travel not infrequently 15-20 km within one single day but often also hardly leave an area of less than half a square mile for several days".

No-one knows the life-span of *R. sondaicus*; one specimen (which had been incorrectly identified at the time as an Indian one-horned rhinoceros), was reported to have lived to 30 years of age in Adelaide Zoo; others however believe that it should have a similar life-span to that of an Asian elephant. Certainly, it is also a highly k-selected species, and any pressure on its population could therefore have a disastrous and long-term effect. The eruption of Krakatau in 1883 was probably a major cause of mortality, and destroyed much of the habitat in Ujung Kulon. This obviously still poses a threat. Also, as Ujung Kulon is such a small reserve, it is vulnerable to biotic catastrophes such as disease and competition; it is thus of vital importance that radical attempts are made to protect this species.

SECTION 4.

BIOLOGY AND ECOLOGY OF THE SUMATRAN ELEPHANT

(Elephas maximus sumatranus.)

The proboscidians were until recently a varied and widespread group, but have been in continual decline for some time now, and today only two species, referred to separate genera, remain: *Elephas maximus* - the Asian species, and *Loxodonta africanus* - the African species. Unfortunately the trend of decline continues in both species, and since 1977 the Asian elephant has been designated an "Endangered" species so that by law it can be neither hunted nor exported. It may be distinguished from its African cousins firstly by its size; it rarely exceeds a weight of 4 tonnes or a height of 3.5m, whereas the African elephant is considerably larger. It possesses smaller ears and has only a single finger at the tip of its trunk which it uses to manipulate vegetation. In addition, it has a rounded back, compared to the African's saddle-back, and a double-domed forehead.

The Asian elephant species is divided into three separate subspecies, of which the Sumatran elephant (*Elephas maximus sumatranus*) is the smallest. Its range originally extended into Sumatra while the island was still connected to the Asian mainland, but is now confined solely to this area.

Elephants reach sexual maturity between the ages of 6-15 years. They have a polygamous or promiscuous mating system and so the sex-ratio of females to males (P_f) is distorted in favour of females. Thus, there may be a higher production of young than would be possible in a monogamous species. These proboscideans represent an extreme example of a k-selected species, characterised by a high level of parental care, low reproduction rate and high survivorship until the end of the physiological life-span. It is probable that reproductive rate instead of calf mortality is the main regulatory factor, and a reduction in population density would cause an increase in survivorship of young and thus a younger age distribution. However, as Widodo (1991) points out, minor fluctuations in population density may occur around the carrying capacity, so estimates of the population dynamics based merely on an age-structure survey are not reliable; "the status of the population cannot be determined on the basis of age-structure alone". Disturbance to the population may also affect social structure and behaviour.

Elephants have two fundamental social units:-

1) the integrated family unit, a cohesive group (sic) of (usually) a matriarch, her daughters and their offspring, but excluding mature males. In Asia, these groups average 5-10 individuals.

2) bull-herds (sic), or loose temporary aggregations of often unrelated males. In Way Kambas

National Park, these were seen to average 2-7 individuals. [1]

On the whole, males tend to lead a mainly solitary life, joining herds mainly for breeding. It is probable that a high incidence of loners or all-male groups is indicative of a high level of human disturbance, Finally, herds may form part of larger, unrelated groupings, or "clans", which congregate from time to time.

Bull calves remain with female groupings for only a few years, after which time they lead a more solitary existence. Once sexual maturity is reached, they begin to show signs of "musth" between 15-20 years of age, and attain their full adult size at 20. During periods of musth, bulls show increased aggression which may function as a means of challenging the established dominance hierarchy. Although it does not represent "rutting" in the classic sense, musth is associated with significant fluctuations in androgenic hormone ratios and fluctuations in the concentrations of ancillary (and probably chemo-communicative) volatiles. It is therefore characterised both by secretions of the temporal glands and changes in behaviour. The process is under endocrine control, and is known to be synchronised and more obvious in the Asian than the African elephant. Musth bulls usually remain within the female groupings, and in Sri Lanka, 13 different bulls were observed to go into musth from 1 to 3 times in the period of one year. Each time, the phase lasted between 1 to 34 days, during which time, the musth bull was always successful in a highly ritualised contest with other non-musth bulls.

In the wild evidence suggests that only bulls in or nearing the period of musth are successful in mating. Courtship involves both chemical and tactile signals, often becoming more intense during the 4-5 month period of oestrus, before the female becomes fully receptive and allows the bull to mount. The mating procedure then lasts only 10-15 seconds, but may occur several times in a day.

An extensive study of the Asian elephant population in Ruhuna National Park in Sri Lanka has brought to light many different aspects of elephant activity, and although a different subspecies from the Sumatran elephant, it is likely that the population in Way Kambas would follow similar behaviour patterns. By repeated observations, it was found that solitary animals showed a bimodal pattern of diurnal activity (i.e. grazing or browsing), with peaks at 0800 and 1700 hours, while the herds' activity picked up from 1500 hours and increased up to 1800 hours when maximum activity was noted (Dissanayake, 1992). No account of home ranges has yet been found, but it is known that the Way Kambas populations can traverse the 30km of the National Park in a 24 hour period. It is likely however, that distances are dependent on the food and water available at that time of year. Population disturbances may, however, lead to some disruption of family units (Dissanayake et al., 1992) leading to increased mobility of individuals and thus larger ranges. This is particularly true where fragmentation of the habitat has occurred and resources are thus limited.

Elephants spend 2/3 of the day (about 16 hours) in feeding activities, and just three hours

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[1](Footnote: despite the adopted terminology used above, the generally accepted definitions of "groups" and "herds" follow Kurt's description, 1974, whereby a "group" refers to any temporary aggregation of animals, while a "herd" is a cohesive group seen repeatedly. A "bull herd" would thus more correctly be termed a group, and as such is a misnomer.)

(adults) or five hours (calves) resting. They feed by tearing branches down to the ground, which they may reach by standing on their hand legs, Wood, bark, leaves and fruit may be taken and often "cleaned" before eating. Grasses also undergo some preparation to remove the inedible roots. Apart from their tusks, elephants possess six pairs of molars in each jaw, which move forward in progression with age. Asian elephants consume an estimated 150kg per day (Mackay 1973 - Sri Lanka).

In Way Kambas, it is known that bull elephants regularly leave the Park at dusk to enter agricultural land to feed on crops. This activity will be particularly useful in attempting to observe individuals. Elephants generally remain near water-sources since they tend to drink at least once a day if water is available, so these areas can also provide appropriate observation points.

Asian elephants in the wild today total only 1/10 of African populations, numbering between 30,000 and 55,000. In Sumatra alone, there are believed to be only 2,800-4,800, and these 44 populations are increasingly vulnerable. In the much-publicised case of the African elephant, the problem is primarily ivory-poaching. However, only some adult Asian males possess tusks, and the females have small "tushes" which seldom show, and so poaching is not a major problem.[2]

The main threat lies in the changing pattern of land-use and increasing human settlement. Between the years 1961 and 1980, the population of Lampung alone increased by 177%, mainly through the Government's sponsored transmigration programme, and their practice of "shifting cultivation" led to the destruction of large areas of forest. Asian elephants prefer shady lowland forest and cannot utilise the coarse grass *Imperata cylindrica* (alang-alang) which arises in deforested areas, and as a consequence, the groups are pushed into small "pockets" of rainforest. Past observations have shown that sites such as wallows, bathing sites , salt licks and specific sleeping places are still important features of elephant habitat, and fragmentation could be disastrous for populations. Certain migratory routes have also been blocked and the remaining forest fragments surrounded by human settlements and agricultural plantations. As noted above, this ever-increasing pressure can lead to human-elephant conflicts, with some elephants moving out into the crops to feed and causing considerable damage.

Since 1982, PHPA has attempted to reduce the problem by means of translocation and capture of recurrent offenders. The first Elephant Training Centre was established in Way Kambas National Park in 1986, with the intention of re-training the captured individuals to prevent wild populations encroaching further on the crops, and also for use within multiple-use forestry reserves. However, this has been relatively ineffective as wild bulls tend to terrorize the domesticated elephants, and so the most recent recommended action is to enclose the area with electric fences. Andau & Payne (1992) have suggested that a more reliable alternative may be to use some sort of physical barrier, such as a strip of sharp stones, closely spaced and embedded in the ground. This has been found to be effective at dissuading elephants from crossing boundaries in zoos; however, unlike electrical fences, it would not prevent

[2]It has been suggested however, that poaching and shooting of the few tuskers in the population could have adverse genetic effects, and a low number of sightings may reflect the intensity of past hunting.

smaller animals, such as pigs, deer, and primates, from raiding the crops. Although the initial cost may be comparable to that of a fence if the stones have to be brought into the area from outside, the advantages of a stone barrier over an electrical fence are that it requires almost no maintenance, is not susceptible to tree falls and floods, and represents no danger to human activities.

At present, a limited amount of information has been collated on Way Kambas. This is due primarily to the nature of the habitat, particularly the impenetrability of the secondary forest. Between 1984-6, extensive surveys were undertaken throughout Sumatra in an attempt to identify the locations, size and numbers of elephants by extrapolating from populations in small areas and these suggest a decline in overall numbers. Some estimates suggest 12 populations in Lampung Province (550-900 individuals), of which a possible 200 exist in Way Kambas National Park (Santiapillai, 1991). The total area of the National Park is 1,235 km^2, which would imply a density of $0.16/km^2$. 2 herds (40-70 animals) were driven into the area to attempt to resolve human/elephant conflicts prior to it gaining National Park status, although 9 individuals were subsequently captured in 1989 for training.

Way Kambas is still considered a prime elephant reserve, containing one of the last remaining lowland habitats. Although much of it is now secondary forest, it is believed to support a greater density of elephants than primary forest, but Santiapillai (A.E.S.G. Summer 1991) points out that the "frequency with which elephants can utilise it depends on the amount of human disturbance." For long-term viability an effective population size of 500 has been suggested, more than twice that currently estimated a being in Way Kambas. However, a substantial increase in this area could have critical implications not only for local agriculture, but also the introduction of the Javan rhino.

In other areas in Sumatra the situation is even worse - between 1982 and 1985 the Kerumatan Baru Nature Reserve population seems to have disappeared. Furthermore, of the 44 elephant populations recorded in Sumatra, 17 occur in mountainous areas considered to be suboptimal for elephants. Those populations which do occur in the preferred lowland rainforest regions require continued protection and management if they are to survive. To achieve this information on population numbers, habitat requirements, resource use, and general behaviour is necessary. At present this data is minimal in Way Kambas, and further research is required.

SECTION 5. THE SAMBAR DEER

(Cervus unicolor equinus)

The Sambar Deer, subgenus *Rusa*, of the Asiatic mainland, may all be treated as races of the species *Cervus unicolor*. The typical and largest of the races of Sambar is the Indian Sambar, *C.u.unicolor*. The race native to Sumatra is the Eastern Sambar, *C.u.equinus*, whose populations are also distributed throughout the Malay Peninsula, Burma, Assam, Kachar and northeast into Kampuchea, Laos, Cochin-China, southern China, Hainan and Taiwan.
The antlers of the Sambar are three-pointed and the brow tine branches off from the rough, corrugated beam at a wide angle. The colouring of the coat is uniformly dark smoky brown, without ticking. The tail is relatively long and the hairs along the throat form a type of inverted mane. They are large animals (almost as large as the Indian type which it closely resembles) with the males reaching a height 160 cms at the withers and a weight of 200kg. Though widespread, these animals seldom reach high densities, and the typical group size is small (most commonly 1-3 individuals, though this will vary with habitat type) (Mathur, 1991). As with other species ephemeral concentrations may occur at waterholes. The Sambar is predominantly a forest animal, coming out into the open occasionally at dusk and during the night but seeking the cover of trees within an hour after dawn. They are considered to be generalist feeders (they are less specialised in their food requirements than most other ungulates); some authors regard them more as browsers than grazers, whilst others maintain that young green grasses constitute the preferred forage of sambar, and when available, particularly from June to October, the bulk of their diet undoubtedly consists of this. Browse becomes an important component of their diet whenever green grass is scarce. The readiness with which the sambar either grazes or browses has undoubtedly been a major reason for the wide distribution of the species.

In a study of habitat use by ungulates in India, Mathur (1991) found that the three major species (Sambar, chital *Axis axis*, and Nilgai *Boselaphus tragocamelus*) were well separated in terms of their use of different habitat types. In this case the Sambar utilised areas of forest where tree cover ranged between 4-8m in height, usually in hilly areas, and near natural water sources; sambar are seldom found far from water and drink every night at forest springs and streams throughout the year. Furthermore, the sambar was found to avoid areas near human settlement, bare and eroded ground, weeds, litter and where shrub cover was between 1-2m. This preference for forest has been recorded in Sambar in Burma and Sri Lanka (Santiapillai et al., 1981).

With respect to predator response, the sambar exhibit a number of signals which serve to alert other members of the herd, as well as other ungulate species, to possible danger. Visual and auditory cues appear to dominate, but olfactory ones probably contribute importantly as well. The animal may thump a foreleg on the ground with a hollow thud, the noise carrying at least 300 feet at night. This stamping of the feet appears to be an auditory signal, communicating danger, but also the position of flight. The alarm bark of the sambar is a loud, ringing call, termed "pooking" or "belling" because of its resonance, which is audible for at least a half mile in the forest.

SECTION 6. THE MALAY TAPIR

(Tapir indicus)

The Malay Tapir is the only species showing a colour pattern; the American species are uniformly slate-coloured. The Malay Tapir, by contrast, is coloured dirty white over the whole of the back, behind the shoulders and on the sides, while the head, shoulders, forelimbs and hindlimbs from the thighs to the toes are blackish, as are the chest and belly. This high-contrast, black-and-white colouration provides it with excellent camouflage in its shadowy forest habitat. This camouflage is especially important at night, when the tapir must remain concealed from the searching eyes of its natural enemies, the tiger and leopard. The height at the shoulder is about 3.5 feet; the weight may reach 520 pounds. The young at birth have a spotted and striped pattern of yellow-brown mixed with blackish brown, but they change to a mature colouring in the first year. One or two are born at a time.

Except in the case of mothers accompanied by their young tapirs are rather solitary animals. They have large, overlapping territories and are primarily, but not exclusively, nocturnal. They cover large distances as they forage for food and make frequent stops to graze on grass, leaves and twigs. The Malay tapir can be found in all types of lowland and highland forests. It is a good climber and is unimpeded by steep slopes and rocky declivities. Like the other species of tapir, the Malay tapir marks its territory and daily paths with urine, which it sprays to the rear, on small bushes and other plants. It moves slowly with its head down; this probably makes it easier for the animal to pick up scents that can provide it with information about other tapirs roaming around in the same area. Their range includes the Malay Peninsula as far north as Tenasserim, encompassing Sumatra.

Although Malay tapirs are seldom seen in the wild, they may be quite numerous, and may thus play an important role in the ecology of the Park. However as is the case with most large, forest-dwelling mammals, their population density is low. Threats include hunting in non-Moslem regions. However, destruction of their forest habitat is by far the greatest danger faced by these threatened animals.

SECTION 7. PROJECT PROPOSAL

The two broad aims of the project are to; (a) assess the suitability of the Way Kambas National Park for the re-introduction of the Javan rhino (*Rhinoceros sondaicus*), and (b) collate information of use to the conservation of the population of Sumatran elephant (*Elephas maximus sumatranus*) resident in Way Kambas. These two issues are closely related, and there will be much overlap in addressing them; this is seen as an advantage for the proposal.

To realise these aims, specific questions must be asked. With respect to the suitability of the Park for the rhino, these will be;

- What are the major habitat types present in Way Kambas, and what is the extent of each type?

- To what extent are food plants known to be eaten by the rhino in Ujung Kulon, present in Way Kambas, and how abundant are they?

- How much competition is the rhino likely to face from resident large herbivores (namely the Asian elephant *Elephas maximus*, the Sambar *Cervus unicolor*, and the Malay tapir *Tapir indicus*)? Possible competition could be direct (exclusion competition; are these animals eating any of the rhino's likely food plants?) or indirect (interference competition; to what extent are they likely to impinge on the rhino's habitat requirements?). To answer these questions information will be required on the dietary components of the resident large herbivores, together with their abundance and distribution.

- Are there any Javan rhino still present in Way Kambas, as certain reports might indicate (see Section 1 above)?

The issue of elephant conservation requires information on the following;

- What is the size and age/sex structure of the Way Kambas population of Asian elephant?

- What is the distribution of this population with respect to habitat, and what are their dietary requirements?

- What is the extent of the conflict between the elephants and the local farmers; how much damage is being done? Which individuals are responsible? Why are the elephants doing it? Finally, what measures can be taken to prevent or reduce crop raiding in this area?

In addition to the above, if time and facilities permit, we will also opportunistically collect additional records on other matters of interest concerning the National Park; for example, extending the species list for the Park, recording any sightings and behavioural activities of the white-winged wood duck *Cairina scutulata* (which is one of the world's most endangered birds), recording and photographing any nesting colonies of stork in the Park (as a few of the species are endangered, namely the milky stork *Mycteria cinerea* and the Storm's stork *Ciconia stormi*).

SECTION 8. METHODOLOGY

Any field work undertaken by workers unfamiliar with the area will necessitate a flexible approach to methodology, as the methods used will depend to a large extent on the conditions found in the field. This in mind, however, there are a number of techniques which have been used by other workers in answering the questions asked above. The methodologies are presented below, with respect to the question it is hoped they will answer.

Suitability of Way Kambas for the re-introduction of the Javan rhino.

(1) Nature and extent of habitat types; to get some idea of the habitats present in the Park, and the abundance of each habitat type, we shall characterise and map the major physiognomic types of vegetation. This will require defining a number of gross vegetation types which appear characteristic of the area studied, followed by an attempt to map the distribution of these major types with respect to some parameter (see below). A higher number of categories will increase the detail which can be achieved by this approach, but will also increase the demands on the workers undertaking this survey; a compromise will be reached depending on time and resources available (probably no more than 10 major types will be defined). Several plots (say of 100 x 10 metres) representative of each major type (as defined by us) will be surveyed in detail; the most complex type encountered is likely to be the lowland rainforest, and measurements taken for such an example would include;

- stand density
- dbh (diameter at breast height) of each stand
- basal density (to be calculated from the previous two measurements)
- percentage canopy closure (can be worked out from photographs)
- no.s of large woody climbers
- no.s of epiphytes
- leaf size classes
- primary or secondary forest? (difficult to do, but a guess can be made on the basis of the "impenetrability" - secondary forest is often more impenetrable)
- identification of dominant species (dipterocarp forest is often dominated by a small no. of species)

The swamp and mangrove forests of the area are likely to be less complex, dominated by a few or even a single species, and thus easier to characterise; much mangrove forest in the Oriental realm is characterised by *Rhizophora*, for example, with the salt-water palm *Nypa* characterising the vegetation often found fringing brackish-water creeks (Whitmore, 1984).

Using a portable satellite location finder the exact position of each surveyed plot can be recorded. After each vegetation type has been surveyed in detail, we will record the crude habitat type at any one position as much as possible, together with the exact location of each recording. By the end of the project this data, easily collated, should provide an accurate map of the major physiognomic types in Way Kambas; *these methods will describe the habitat on a scale likely to be important to the rhino and other animals in the Park.* It should be stressed that the work outlined is realistic in terms of likelihood of completion; it is not a conventional surveying operation which will take many months to complete, but a potentially quick system of relating gross habitat type to an exact position which can be determined using the location finder. This piece of equipment will significantly increase the scope of work possible in the time available.

Food plant availability and abundance: the known and likely food plants of the Javan rhino will be specifically searched for, both during the detailed survey of the physiognomic type samples (as outlined above) and during the routine activities of the project in general. Likely species will be keyed to at least generic level, using the expertise of local botanists. Abundance will be estimated on the basis on their occurrence in the plots surveyed in detail.

Potential competition from large herbivores: this is best considered as comprising of two parts, namely quantifying (a) the extent to which the large herbivores are using habitat likely to be used by the rhino, and (b) the degree of predation on plant species likely to be important to the rhino.

(a) The former question is best answered simply by measuring habitat use by the resident animals, i.e. their distribution and abundance.

The line transect methodology devised by Burnham et al. (1980) measures the density of animals in a given area. It makes no assumptions about limits of delectability, and as such has proved to be a robust technique in many different situations (e.g. Brockelman & Ali, 1987). It can be used to sample animals directly or indirectly (e.g. via faecal deposits); Dekker et al. (1991) have evaluated the line transect method as a means of censuring Asian elephant populations via dung traces and have come out in favour of this method. They have in addition written a manual for the Asian Elephant Specialist Group on the details of using the line transect method for this purpose; we will, however, take account of the criticisms of this technique levelled by Jachmann & Bell (1984). The transects will be patrolled on foot and by whatever suitable transport we have available (probably mountain bikes), and all details of each sighting will be recorded as standard. Distance of the sighting from the transect line is easily measured when surveying dung; with the animals themselves the distance from the observer will be measured by using a calibrated pair of binoculars or camera lens, and the angle between the observer-animal line and the observer-transect line will be estimated. The information on the dung deposition and decay rates required to infer population density from dung density must be relevent to the season and the area in which the sampling is taking place. The faecal deposition rates and decomposition rates necessary for interpretation of elephant dung found in the wild can be precisely measured by study of the animals in the Lampung elephant training centre; for the Sambar and tapir it may be necessary to rely on information from zoos or the literature. Transects will of course be repeated throughout the study to measure changes in local population density through time.

To gain an idea of the minimum population size of each of the three species in the Park it may be possible to use individual recognition. It has proved possible to recognise individual large mammals in a population in a number of studies; whales and deer are two well known examples. Workers in East Africa have reportedly been able to recognise by sight every individual in a herd of 250 elephants in the space of a few months (The Independent, 13.2.92). We will, where possible, photograph every large herbivore seen, recording in full details of the encounter; by the end of the project it should be possible to build up a comprehensive library of pictures from which individuals can be recognised. This data should give an idea of the minimum population of each species in the park, and may also allow us to understand the movements of individual animals.

Such work will not be limited to close ranges. Elephants in particular can be observed/photographed from large distances using binoculars and telephoto camera lenses, and these visual methods are usable for some time before sunrise and after sunset, when the elephants are most active (Dissanayake et al., 1992). If possible observation posts will be established in tall trees on forest edges, to allow maximum observation over large distances, and near water holes. Ordinary optical equipment (binoculars, cameras) will be used in preference to enhanced optical equipment (image intensifiers, thermo-imagers) for two reasons; firstly, the latter are usable only in total darkness, whilst the elephants' diurnal activity peaks are at times of partial light, and the latter are extremely expensive (unit price of several thousand pounds each), heavy, and drain batteries (our supplies of which will be limited).

Yet more visual records can be amassed by using trip-wire cameras. Alan Compost has successfully used still 35mm cameras positioned at various places along forest trails, with remote triggers, to record a number of animals using the trails in Ujung Kulon (Nardelli 1987). We will obtain a large number of suitable cameras for use along similar lines, and these will be able to record any large animal using the trails; in addition to augmenting the photographic libraries of the three large herbivore species, this method will probably be the best opportunity to detect the less-often seen animals such as the tapir, large cats (and any rhinos?). We propose to modify the technique used by Compost in two ways; the remote trigger will be a focused light beam (the shutter will be triggered upon disruption of the beam) instead of the pressure pad used by Compost, and we will minimise the disturbance to nocturnal users of the path by using infra-red (IR) flashes with IR sensitive film. This can be done cheaply and easily, but cameras set up for this will be of limited use during the day, so a separate camera with no flash and normal film will be used to record daylight uses of the trail. Unit price of camera with trigger mechanism will be £50 or less.

As has been stated, these direct visual methods will allow us to estimate a minimum population size for each of the large herbivore species on the basis of recognised individuals. They will also permit measurement of habitat use (by recording the location of each encounter and matching this to the habitat type at each location), and will allow an estimate to be made of a population's density at any one place at a given moment in time.

In addition to visual recognition , Payne et al. (1986) have found that it is possible to recognise individual elephants by using their infrasonic calls. The nature of the calls varies depending on the behavioural context of the animal making them, but it is possible to identify individual idiosyncrasies in the call, and when speeded up to ten times recorded speed the differences between individuals is easily recognisable to the ear. We will therefore use recording equipment with infrasonic-sensitive microphones to obtain recordings of the Way Kambas elephants, again building up a library of individual calls as far as is possible. Recordings of known individuals from the Lampung elephant training centre will be made to gain an idea of the range of calls made by one individual. This technique will have the advantage of not being limited by distance or habitat (such as dense vegetation which makes visual observation impossible). The immediate analysis of the data possible in the field will be supplemented by a detailed analysis using sound-analysing equipment upon return to Southampton. We therefore have another method by which the population size of the elephants at least can be estimated.

As well as being seen or heard, animals also leave traces which can be used to gain information about a population. A large mammal will leave footprints, defecate, and damage vegetation, and how one interprets this information depends on the exact circumstances of the study. For example analysis of footprints has yielded much information on the population size, age structure, and sex structure of the Javan rhinos in Ujung Kulon (Schenkel & Schenkel-Hulliger 1969, Santiapillai et al. 1990). Thus it may prove to be a valuable means of gaining data about tapir, sambar, and possible rhinos in Way Kambas, unfortunately this technique is useful only when the populations are at relatively low density, and may therefore not necessarily be of use in censuring the elephant population in Way Kambas, which is likely to be high. However, given that there is a direct correlation between footprint circumference and shoulder height in Asian elephants we will evaluate the usefulness of this technique, as applied to elephants, in the field. In particular it may prove useful in assessing the extent of elephant raids of neighbouring agricultural land (see below). Tying in with the use of dung to estimate population densities within an area, the presence of dung is obviously evidence of an animal making use of an area, and the age of the dung will indicate the time since the animal was present.

All these methods, then, will permit the abundance and distribution of the large herbivore species to be calculated with respect to habitat type. From this it will be possible to estimate the degree to which the resident animals are using habitat types likely to be necessary to the rhino.

(b) Whether or not the resident herbivores are actually eating rhino food plant species is best answered using dung analysis techniques. Samples of dung will thus be saved for later analysis (this is best done at an institution - preferably the University of Lampung, or failing that at the University of Southampton upon our return to the U.K.). Standard techniques of analysis will be employed throughout (Putman, 1984), and for all samples taken the location of the find and the best estimate of the age of the dung will be recorded, as well as the species the sample is thought to have come from. Examples of each plant species thought to be possible food plant for the rhino will also be saved so that their cuticles can be compared with any in the dung samples. This technique should allow us to quantify the likely extent of dietary overlap between the resident herbivores and the rhino. It will be supported by recording any plants seen to be taken by the animals in the course of observing them.

- Are there any Javan rhinos still present in Way Kambas N.P.; as detailed in the Introduction (Section 1) above there have been a number of reports of one horned rhinoceroses still being present in the area of the Park north of the Way Kanan River. The methods detailed above, in the context of detecting the presence of tapir, Sambar, and elephant, may similarly be used to record the presence of any rhinos, either directly or indirectly. The method most likely to detect this elusive animal directly (if it is there) is the trip-wire camera technique. Otherwise there are a number of techniques commonly used when working with the Ujung Kulon population, such as footprint analysis, the detection of plants spayed with urine, the presence of dung, and evidence for the recent use of a likely looking wallow, all of which are detailed in Schenkel & Schenkal-Hulliger (1969). Throughout this part of the investigation we will bear in mind the possibility of confusing the elusive Malay tapir for a small rhino, as the footprints of the two species apparently bear much resemblance to each other (Santiapillai, pers. comm.).

Conservation of the Asian elephant.

Turning to the specific problem of the Asian elephant as a conservation issue, we shall be studying the elephant population of Way Kambas in some detail. It should be obvious that the methodologies described above will all be suitable for this task, as the elephant is a major component of the first of the project's objectives; again, this overlap is seen as a definite advantage of the project.

- **Population size and age/sex structure:** specific information required of the elephant population is not only its size and distribution through the Park, which will be estimated when addressing the above aims, but the age and sex structure of the population. This will be assessed by refining some of the methodologies described above whenever they are being applied to the elephants.

Thus, when using visual methods for observing the elephant population we shall, where possible, be dividing the population into 9 age-classes (as described by McKay 1973). A description of the population with respect to age class will then be possible. So that the data obtained, can be translated into an estimate of not only the number of elephants in the Park but their total biomass as well, the average weight for each age class will be determined by referring to the elephants in the Lampung training centre; we can then obtain a figure for the total elephant biomass in Way Kambas N.P. Furthermore, we shall as a matter of course note the sex of every animal observed where possible (this applies not only to the elephants but the Sambar and tapir as well); thus we shall obtain an idea of the sex structure of the population as a whole as well as the sex structure of each age class.

Some of the indirect methods described above may also shed light on the age/sex structure of the elephant population. As mentioned above, there is a direct correlation between footprint circumference and shoulder height in elephants; thus it may be possible to interpret any footprints found in terms of the age structure of the population. It should be remembered, though, that any technique relying solely on footprints will be difficult to perform at high densities of the animals, and this may be a constraint on the success of using such a method in this context. It is also possible, that the size of any dung deposits may permit an estimation to be made of the size of the animal responsible, but its reliability is unknown.

-**Habitat use and dietary requirements;** ascertaining this aspect of the elephants' ecology will be covered by using the methods described above, namely by mapping the habitat types and relating the observed distribution of the animals in each habitat type. Again, dietary requirements will be measured by analysis of dung samples and by recording and plants seen to be eaten by the animals.

-What is the extent of the conflict between the local farmers and the elephants: again, it may be possible to answer this question by using the above methods adapted as circumstances demand. If feasible, we shall observe the elephants as they raid the crops, particularly if their attentions are restricted to a relatively small area; indeed, it may be possible to identify the individuals responsible for the damage. In addition footprints and dung traces may provide clues to any illicit activity; the dung in particular can be sampled to detect for the presence of any crop species it the animal's diet. It must also be remembered that damage to crop plants by large herbivores may look much worse than it is. Studies of depredation of crop species by deer in the U.K. have shown that the animals have little effect on the eventual yield of the crop, despite a high amount of apparent damage, and in some cases such depredation can even increase the yield. Thus we shall try to quantify the actual loss in yield in addition to the perceived extent of damage to the crop by the elephants.

As for possible solutions to this conflict, Way Kambas has been recommended for the installation of electrical fences between the Park and the affected farmland (Santiapillai et al., 1989). Andau & Payne (1992) have suggested areas of sharp stones in the ground as a cheaper alternative to this expensive solution, and it may prove possible to assess the effectiveness of this approach during the course of the study.

Other methods - carcasses & skulls: though not central to the work performed, the details of any carcasses or skulls found will be recorded in full. For mammalian herbivores one of the most informative pieces of anatomy are the teeth, which give an indication of the animals age and state of health, and they will be examined in detail at each find. Stomach analysis will be performed where possible. Carcasses will be examined for parasites, pathogens, and the area around each carcass will be checked for signs of predator activity.

Not to be used - as discussed above we have considered other methods and equipment types, which are sometimes used when studying large mammal populations, and decided against their use. The most obvious of these are radio tracking methods, and these would seem to be inappropriate for this study because (a) they are expensive when used in any study, and (b) fitting any animal with a radio-collar necessarily involves subduing them for a time; to do this with elephants is a difficult enterprise involving a team of experienced vets, tame elephants and riders, and runs a risk of injury for those involved (Sale et al., 1986). In addition tracking a collared animal is difficult, and the information gained is only ever of any value when used in conjunction with other techniques. We therefore feel that in this circumstance it offers little prospect of return on a high investment of time and effort, which would be better maximised by pursuing other methodologies. Ariel surveying is an oft employed method of censuring populations of elephant; however it is only of real value in the relatively open habitat of the African plains, and is unsatisfactory when dealing with forest species such as the Asian elephant (Santiapillai, 1991) (this of course neglects difficulty and expense of hiring a plane from which to do the work!).

Lastly, in addition to all the above, the climate during the project will be monitored; rainfall, temperature ranges, and relative humidity will be recorded as a matter of course using standard techniques.

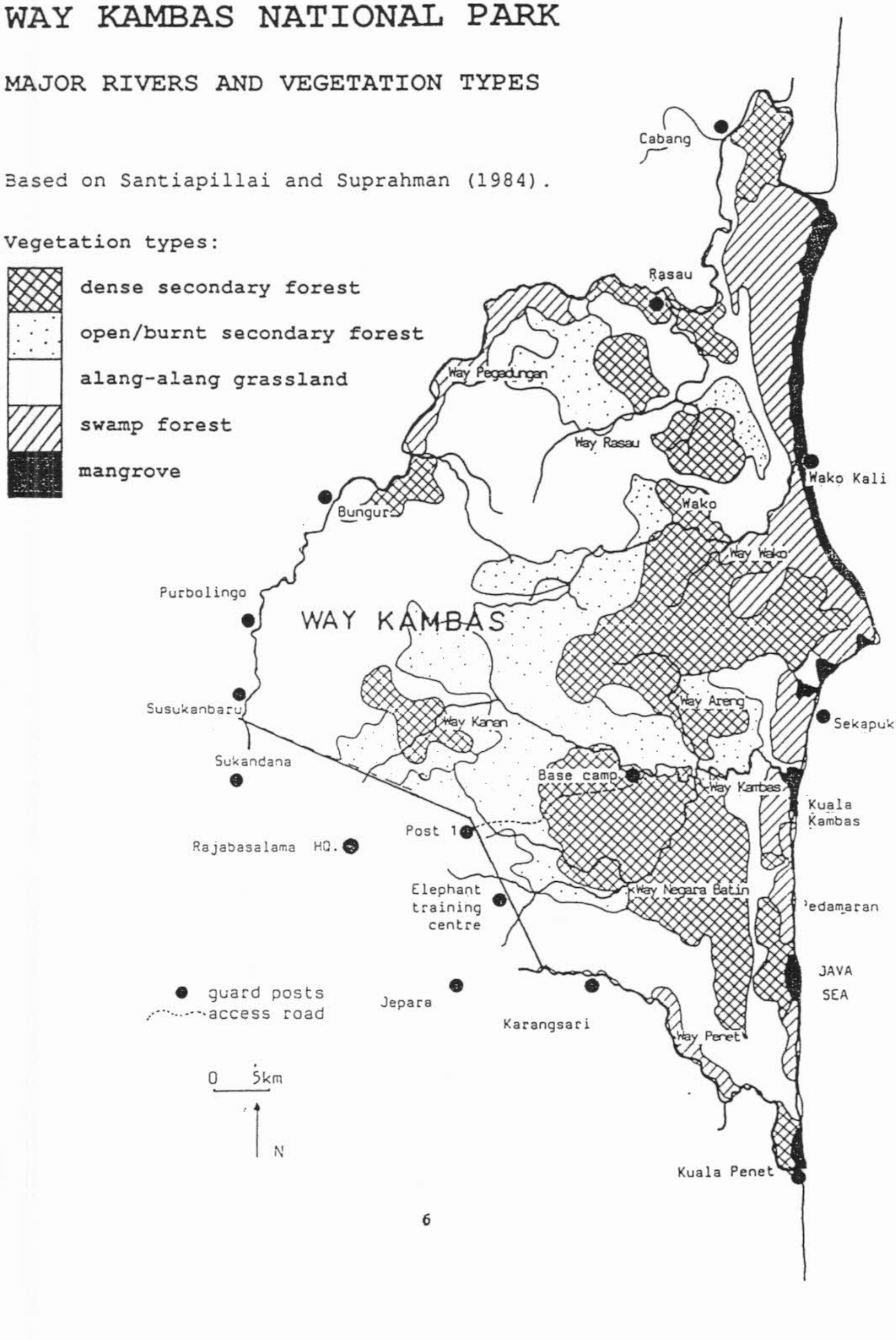
The methodologies described, which will comprise the main body of this project, have been

Fig. 2.2

WAY KAMBAS NATIONAL PARK

MAJOR RIVERS AND VEGETATION TYPES

Based on Santiapillai and Suprahman (1984).



tailored specifically to answering the questions asked in Section 7. There is no reason, though, why any local students who wish to cooperate with us, but who wish to pursue more their own interests, cannot use our work as a basis for further study. In particular it seems obvious that the proposed work on surveying the type and extent of the habitats in Way Kambas could be extended to answer more fundamental questions about the Park which we will unfortunately not have time to address. For example, one may wish to know the reasons why the habitat is distributed in the way we find it. One could thus relate the observed habitat pattern to the ecological factors most likely to determine the distribution of these physiognomic types: in Way Kambas these are likely to be;

- drainage
- relief
- human interference
- soil type

Transects (not detailed; merely noting the change from one physiognomic type to another along a rough line) can thus be taken along any gradient of these factors. Drainage is perhaps the most important of these; if so then transects across a number of drainage basins would give some idea of how this factor determines the patterns of physiognomic types present, for example. If any information is already available on the distribution of e.g. drainage basins in the park this can be used to build up a map of probable habitat distribution in relation to this factor.

If one was then to go on to make a complete vegetation map of the area, as and when remote sensing data of the park becomes available it will be necessary to cross-reference the spectral map with data 'from the ground'. This involves making a detailed survey of sample sites in the Park so that a distribution map of spectra corresponding with these samples can be made. For this data to be of value the exact location of the sampled area must be known; this information will be available to anyone conducting this work due to the work we will have performed.

We offer these examples as illustrations of the way that the proposed project could not only answer the questions asked above, but also fit in with additional work on the area that others may wish to pursue. We will be delighted to cooperate with anyone who wishes to work in Way Kambas, whether it be on our project directly or on other work which may tie into ours to some degree.

<u>SECTION 9.</u> <u>COOPERATION</u>

The success of the expedition as proposed will inevitably depend on cooperation with the authorities and educational institutions in Indonesia. The University of Lampung has already given a generous offer of assistance, and it is envisaged that government authorities will organise counterparts who will play an active role in the refinement of the methodologies and the collection of data. It thus seems appropriate to describe the proposal as a joint venture between the Universities of Lampung and Southampton and the Indonesian Parks Authority (P.H.P.A). The opportunity will exist for the involvement of any local students who are interested in the work. In addition Dr. Charles Santiapillai (formally of W.W.F. Indonesia) and Simon Hedges (of the Javan Large Mammal Project) have been helpful in providing background information, and have both promised us their personal support. It is hoped that this expedition will serve to strengthen ties between the two universities, and will be the start of a long term exchange of students between them.

The Indonesian counterparts will be involved in all aspects of the work. We will be drawing on the local expertise of the staff at the University of Lampung, especially in connection with questions of botany and habitat assessment.

The results will be published, and it is envisaged that they will be used in decisions concerning rhino translocation (the Rhino Rescue organisation has already expressed an interest), management of the elephant population (both for conservation and with respect to the agricultural problem), and the project will add to the existing data about the large herbivores, augment present faunal lists, and improve the vegetation maps of the area.

SECTION 10. EXPEDITION MEMBERS.

Team leader :Colin McHenry, (22), dual Irish-British nationality. He has a special interest in photography, and is a keen naturalist, specialising in reptiles. He has also travelled widely.

Treasurer :Julia Howard, (21), British nationality. She was awarded a prize for academic excellence at school and the second year prize for achievement whilst at university. She has a specific interest in entomology, and has carried out an individual project this year in conjunction with Rothamsted Experimental Research Station.

Secretary :Guy Hills Spedding, (22), British nationality. He is a keen ornithologist and naturalist, and was social secretary for the Biology Society during his second year at university. He has also travelled widely, and has experience working on a conservation project in the tropics.

Equipment officer :Kate Wilson, (22), British nationality. She has experience in conservation work in England, and an interest in entomology. This culminated in a project, for which she received an award from the Wellcome Trust, and a three-month post working in agrochemical evaluation. She has organised many fund-raising events for the University's Biology Society.

All team members have recently completed honours degrees in Biology at Southampton University.

SECTION 11. BUDGET.

Pre-Expedition Expenses:

Printing:	headed paper	10
	glossy brochure	16
	detailed prospectus	30
Postage:		20
Telephone:	(inc. fax)	10
Insurance:	(4 x 300)	1200
Flight:	London-Jakarta (4 x 700)	2800
	Jakarta-Sumatra (4 x 100)	400
Equipment:	microscopes	2000
	binoculars	1000
	location finder	1000
	general base camp equipment	200
	field equipment (including tents etc.)	400
	medical	100
	personal (4 x 300)	1200
	photographic; cameras	3000
	; film (inc. development)	1000
	mountain bikes & parts (4 x 300)	1200
	audio recording	250
	documents/maps	1000
Customs and Duties:		800
	Sub Total	17,626

Field Expenses:

Living costs: (inc. fuel allowances)	576
Wages for local counterparts:	726
Sub Total	1,302

Post Expedition Expenses:

Reports:	50
Reception for Sponsors:	150
Sub Total	200

Contingency: 10% 1,917

GRAND TOTAL: 21,052

SECTION 12. TIMETABLE.

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1992

JOBS            JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC

PROSPECTUS       <------------------------>

LAUNCH                *

PATRONS          <----->

APPROVAL:

  UNIVERSITY                                 *

  R.G.S                                      *

  INDONESIAN GOV'T                    <------->

GRANTS & SPONSORS     <----------------------------------------->

FUND RAISING           <---------------------------------------->

TRAINING & COURSES                <----------------------------->

AIRLINE TICKETS                                       <-------->

INSURANCE                                             <-------->

MEDICAL                                              <-------->
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1993

JOBS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
DEPART U.K.				*								
ACCLIMATIZATION IN JAKARTA				<--	-->							
ARRIVE IN SUMATRA					*							
PROJECT PERIOD					<----	----	----	----	---->			
DEPART INDONESIA										*		
WRITE UP										<----	----	---->
MEET WITH SPONSORS										<----	----	---->

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