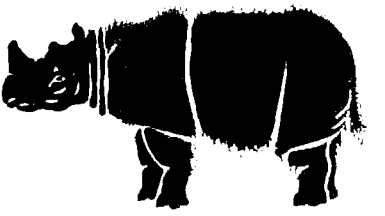
# NEDERLANDSCHE COMMISSIE VOOR INTERNATIONALE NATUURBESCHERMING



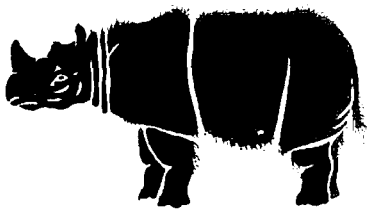
MEDEDELINGEN No. 22

NEDERLANDSCHE COMMISSIE VOOR
INTERNATIONALE NATUURBESCHERMING
(Netherlands Commission for International Nature Protection)

# *DICERORHINUS SUMATRENSIS* (FISCHER)

# THE SUMATRAN OR TWO-HORNED ASIATIC RHINOCEROS

## A study of literature



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# I. INTRODUCTION

The aim of this paper has been to collect and to arrange all publications in literature about the distribution and the ecology of *Dicerorhinus sumatrensis*. Other subjects are also dealt with as long as they can be considered to be useful or of general interest to anyone studying this species. In case a subject is not extensively treated references are made to articles containing more detailed information.

*Dicerorhinus sumatrensis*, Rhinocerotidae, Perissodactyla, is one of the three species of rhinoceros living in Asia. The other two are the Javan or smaller one-horned rhinoceros (*Rhinoceros sondaicus* DESMAREST) and the Indian or great one-horned rhinoceros (*Rhinoceros unicornis* L.). These two *Rhinoceros* species are characterised by the presence of several folds in the skin, giving the animal an armoured appearance, and the possession of only one horn on the nose. In *Dicerorhinus* the skin folds are far less marked and there are two horns on the nose. *Dicerorhinus* is by far the smallest of the three.

Although, from the number of horns, one might expect the contrary, *Dicerorhinus sumatrensis* is much more related to the Asiatic rhinoceroses than to African species, *Diceros bicornis* or black rhinoceros and *Ceratotherium simum*, or white rhinoceros.

*Dicerorhinus sumatrensis* (FISCHER) in the Copenhagen Zoo. This animal was captured August 1959 in Riau, Central Sumatra, and died February 1972. (Photo Erna Mohr)

For classification into subfamilies, see GROVES (1967a).

*Dicerorhinus sumatrensis* is largely sympatric with *Rhinoceros sondaicus*. Since these species are not always easily distinguishable in the field, errors can be made. A number of authors only speak about rhinos and it is not always clear which species they have in mind. It is therefore possible that a few citations in this paper refer actually to *Rhinoceros sondaicus* (eg HAZEWINKEL 1932, 1933) and that other references are wrongly omitted.

## 2. THE SCIENTIFIC NAME

BELL (1793) was the first to describe an Asiatic two-horned rhinoceros (from Sumatra); and FISCHER (1814) gave it the name *Rhinoceros sumatrensis*. Later, when more material had become available, four more species of Asiatic two-horned rhinoceros were described: *Rhinoceros crossi* GRAY, 1854; *Rhinoceros lasiotis* BUCKLAND, 1872 (SCLATER, 1872a); *Ceratorhinus niger* GRAY, 1873; and *Ceratorhinus blythii* GRAY, 1873. Already FLOWER (1876) made it clear that these species were based on insufficient material, or the variability was merely due to age, development, or individual variation, and that there was only one species of Asiatic two-horned rhinoceros. The distinct northern form *Rhinoceros lasiotis*, or hairy-eared rhinoceros, was maintained by many authors. In 1901, however, THOMAS stated that the animal on which this species was described, after a stay of more than 30 years in the London Zoo, did not show any more of the characteristics so clearly distinct when young. The only difference is that the northern specimens are larger, but this is not sufficient to distinguish a separate species (HOOIJER, 1946).

At first all species were grouped in one genus, *Rhinoceros* LINNAEUS, 1758. Later it became evident that the Asiatic two-horned species was so distinct that it should be classed under a different genus. For this genus the names *Didermocerus* BROOKES, 1828, *Dicerorhinus* GLOGER, 1841, and *Ceratorhinus* GRAY, 1867, are used.

Although it is antedated by *Didermocerus*, *Dicerorhinus* is commonly used. There is also doubt about the validity of the publication of the name *Didermocerus* (GROVES, 1967a). BOYLAN (1967) asked the International Commission on Zoological Nomenclature to decide in this matter. In a comment on this proposal, HOOIJER (1967) rejects the name *Didermocerus*, and advised to consider *Dicerorhinus* the correct name. A decision has not yet been taken.

More detailed information on this matter can be found in PRATER (1939).

Because of the confusing descriptions of new genera, species and subspecies, there are many synonyms for *Dicerorhinus sumatrensis*. A full account is given by HOOIJER (1946). The most commonly used synonyms are:

*Rhinoceros sumatrensis* (or *sumatranus*)
*Ceratorhinus sumatrensis* (or *sumatranus*)
*Didermocerus sumatrensis* (or *sumatranus*)

*Ceratorhinus crossii*
*Rhinoceros crossii*
*Ceratorhinus lasiotis*
*Rhinoceros lasiotis*
*Ceratorhinus niger*
*Ceratorhinus blythii*

In the following chapters, *Dicerorhinus sumatrensis* will be abbreviated to *D. sumatrensis*.

## 3. SUBSPECIFIC CLASSIFICATION

In the course of history a number of subspecies were described, but there was little unanimity on this matter. The most constantly maintained subspecies is *lasiotis* (BUCKLAND), identical to the species *Rhinoceros lasiotis* (SCLATER).

In recent years GROVES re-examined most of the skulls preserved in the European museums and the United States. By comparison of skull measurements he concluded that there are three distinct subspecies (GROVES, 1967a):

1. *Dicerorhinus sumatrensis sumatrensis* – FISCHER 1814
Distribution: Sumatra and Malaya.
Diagnosis: Size large; teeth medium to small; occiput narrow, low.

The Malaccan deme differs from the Sumatran in its slightly broader zygomata, and in the comparatively broader teeth.

2. *Dicerorhinus sumatrensis harrissoni* – GROVES 1965
Distribution; Borneo.
Diagnosis: Size small, teeth small; occiput narrow but proportionately high, and forwardly inclined.

3. *Dicerorhinus sumatrensis lasiotis* – BUCKLAND 1872
Distribution: northern Burma, into Assam and East Pakistan.
Diagnosis: size large; teeth very large; occiput broad and high.

One must bear in mind that these subspecies are only based on skulls and that nothing is known (maybe except size) about the differences in the appearance of the living animals.

## 4. PHYLOGENY OF DICERORHINUS SUMATRENSIS

Concerning the phylogeny of *Dicerorhinus* the following citations are of interest.

PRATER (1939) citing OSBORNE (1900)

In Tertiary times a number of species allied to the Sumatran rhinoceros inhabited the forest of Central and Western Europe. Their remains are abundant in the Miocene and lower Pliocene deposits of France and Germany. No fossil species allied to the Sumatran rhinoceros has ever been obtained from the Tertiary deposits of India. From which it is concluded that the *Dicerorhinus suma-*

*trensis* is a comparatively recent immigrant into Southern Asia, the type having probably originated in Western Europe.

The earliest representative of the group in Southern Asia is the flat-nosed *Rhinoceros platyrhinus* of the lower Pleistocene beds of India. They were quite abundant in the Siwalik Hills in the late Pliocene or early Pleistocene times. The upper Pliocene is indicated as a geological period when these animals, favoured by a genial climate lived in a broad forest belt which extended from the east coast of England and southwards and eastwards across southern France and northern Italy into India. Like their descendants of today, the primitive two-horned forms probably lived in the deepest recesses of the forest. The survival of the type through long epochs of time is traced to the protected environment in which they habitually lived – an environment which, while i. does not favour rapid evolution, tends on the other hand to persistence of typet

ZEUNER (1934)

He concluded after studying large numbers of recent and fossil skulls that the primitive *Dicerorhinus* were little differentiated wooded-steppe forms. At least three branches developed from this stem. The first, already distinct in the Pliocene, ended in the glacial-steppe form *Tichorhinus antiquitatis*† (woolly rhinoceros), a second line developed also in grass steppe-adapted animals (*D.hemitoechus*†), and a third line adapted to the tropical rain forest and is now represented by *Dicerorhinus sumatrensis.*

HOOIJER (1946)

From the cave teeth it is now evident that in Sumatra the rhinoceros has undergone a diminution in size during the Holocene period. The comparative large skulls from Chittagong and Tipperah show that in some parts of the Asiatic continent there still are living individuals which possess these greater prehistoric dimensions.

HOOIJER (1967)

*Dicerorhinus sumatrensis* may truly be said to represent a Miocene stage in the evolution of the Dicerorhine rhinoceros and is definitely not the most advanced among the cluster of species in the genus *Dicerorhinus* as understood by palaeontologists.

## 5. GENERAL APPEARANCE

*Dicerorhinus sumatrensis* is the smallest and the most primitive species of the living rhinoceros. The appearance is rather plump and roundish, the skin is smooth and more or less hairy. The most striking features are the two major skin folds: one encircling the trunk just behind the fore-legs and the second over belly and flanks, but not on the back, just before the hind-legs, and the two horns. The front or anterior horn on the tip of the muzzle is by far the largest of the two; the posterior horn, situated above the eyes is often not more than a lump.

## 6. DIMENSIONS

A few animals have been measured. Most of these had been shot before they were measured between uprights. The most important dimensions are listed below.

*Height at shoulder*

♂ 137 cm Malaya (HUBBACK, 1939)
♂ 133 cm Burma (EVANS, 1905)
♂ 132 cm Burma (PEACOCK, 1931)
♂ 121 cm Malaya (HUBBACK, 1939)
♀ 144 cm (height from shoulder to tip of longest toe) Burma (WROUGHTON, 1915)
♀ 138 cm Burma (Live animal in the London Zoo) (Chittagong) (SCLATER, 1872c)
♀ 135 cm Burma (EVANS, 1904)
♀ 128 cm Malaya (HUBBACK, 1939)
♀ 121 cm Malaya (HUBBACK, 1939)
– 135 cm Sumatra (MÜLLER and SCHLEGEL, 1844)
– 141 cm Burma (PEACOCK, 1933)
– 130 cm (Anon., 1895, KRUMBIEGEL, 1960)

*Length from muzzle to root of tail*

♂ 283 cm (including tail) Burma (PEACOCK, 1931)
♂ 249 cm Burma (EVANS, 1905)
♀ 252 cm Burma (WROUGHTON, 1915)
♀ 245 cm Malaya (GARROD, 1873)
♀ 233 cm Burma (EVANS, 1904)
– 248 cm Sumatra (MÜLLER and SCHLEGEL, 1844)
– 220 cm (Anon., 1895, KRUMBIEGEL, 1960)

*Girth behind shoulder*

♂ 216 cm Burma (EVANS, 1905)
♀ 197 cm Burma (EVANS, 1904)
– 210 cm Sumatra (MÜLLER and SCHLEGEL, 1844)

*Length of head*

♂ 81 cm Burma (EVANS, 1905)
♀ 68 cm Burma (WROUGHTON, 1915)
♀ 81 cm Burma (EVANS, 1904)
– 70 cm Sumatra (MÜLLER and SCHLEGEL, 1844)

Note: the main skull lengths for Borneo are 465.6±17.2 mm and for Malaya and Pegu 528.3±20.9 mm (GROVES, 1967).

*Length of tail*

♂ 34 cm (docked) Burma (EVANS, 1905)
♀ 66.5 cm Burma (WROUGHTON, 1915)

♀ 56 cm Malaya (GARROD, 1873)
♀ 50 cm Burma (EVANS, 1904)
– 32 cm Sumatra (MÜLLER and SCHLEGEL, 1844)

*Ear*
♂ 19 cm Burma (EVANS, 1905)
♀ 17.5 cm Burma (WROUGHTON, 1915)

Although it is not always clear how these measurements were taken, it can be concluded that the height does not generally exceed 135 cm; the length of the head and the trunk are about 250 cm; length of the head between 70 and 80 cm; and the tail seems rather variable in length.

A marked difference in dimensions between males and females does not appear from these figures.

Weights of the animal were not found, but estimates are given as between 1000 (ANDERSON, 1872) and 2000 kg (WRAY, 1906; ULLRICH, 1955).

## 7. THE SKIN

The skin is described as smooth or granular but is sometimes called very rough (GRAY, 1873; METCALFE, 1961). On closer examination the skin is cracked in small polygonal scales (NEUVILLE, 1927). The skin is rather soft and thin, compared with the other Asiatic rhinos and its maximum thickness is 16 mm (EVANS, 1904). WRAY (1906) measured 38 mm in places.

In the field the colour of the skin is largely the colour of the mud in which it took its last bath. The colour of shot animals or animals in captivity is described as brownish gray (MÜLLER and SCHLEGEL, 1844), dark grey (HUBBACK, 1939), slate back (WROUGHTON, 1915), dirty grey (METCALFE, 1961), dark slate (GARROD, 1873), light buff (PEACOCK, 1933).

Around the lips, inside of the ears, under the throat, under the belly, inside of the legs, in the groin, and in the skin folds, the colour shades are flesh, dirty flesh or pink (MÜLLER and SCHLEGEL, 1944; PEACOCK, 1933; HUBBACK, 1939; WROUGHTON, 1915).

Apart from the two major skin folds already mentioned under the heading 'general appearance', there are a number of less distinctive folds on the neck and the upper parts of fore- and hind-legs.

Note: In the field the skin folds form the most important distinctive character between *Dicerorhinus sumatrensis* and *Rhinoceros sondaicus*. The presence of one or two horns is difficult to establish, because of the smallness of the posterior horn in *D.sumatrensis*. *Rhinoceros sondaicus* has a third very distinctive fold around the neck, extending on the back and thus forming a saddle-like structure on the neck.

## 8. THE HAIR-COVER

The presence of a more or less dense hair-cover is one of the major differences with other rhinos, although in the field this hair in general will not be seen owing to the mud-cover. The extent and density of the hair-cover is very variable and is largest in the young animals. The face and the skin inside the folds is hairless. Hairs are especially numerous inside the ears, on the middle line of the back, the belly, the lower side of the flanks and on the outside of the legs (ANDERSON, 1872; MÜLLER and SCHLEGEL, 1844). At the tip of the tail there is a tuft of longer hair. The ears are fringed with a distinctive line of hairs of variable lengths. The variability of the hair-cover of the ears led to the description of *Rhinocerus lasiotis* or 'Hairy-eared rhinoceros'. The upper lip has strong bristles set widely apart (ANDERSON, 1872). Eyelashes are present on upper and under lid of the eye (CAVE and WINGSTRAND, 1972).

The colour of the hair is very variable and ranges from almost white to black; the darker shades seem to be more common.

In the course of life, the hair-cover is much reduced. This is partly due to friction imposed by the dense thorny-jungle terrain (HUBBACK,1939) but seems to be also a natural age change. The animal (*lasiotis*) that lived for more than 30 years in the London Zoo showed at the time of its death no more of the original hairy coat (THOMAS, 1901); the same holds for both animals living in the Schönbrunn Zoo which lost their original hair-cover (ANTONIUS, 1937). In the last case it has been suggested that this loss was unnatural and caused by the absence of a basin in their enclosement.

## 9. THE HORNS

The horns are derivates from the skin, and have no connection with the skull, although a supporting boss of bone on the skull may serve as its foundation. The horns grow throughout life and if lost are reproduced (Anon., 1934). The horns are a formation of a closely matted mass of horny fibres or filaments, often described as coaglutinated hairs. RYDER (1962) studied the microscopical structure of a rhinoceros horn (*Rhinoceros indicus*) and concluded: 'Although I have avoided the view that horn filaments are homologons to hairs, one cannot escape their similarity. This is partly due to the similarity of the dermal papillae of the epidermis with those of hair follicles and there is no doubt an evolutionary association between them'.

The horns are the same colour as the body: dark grey or even black, darker on the stem than on the base; darker in adults than in juveniles (GROVES, 1971).

The record anterior horn is in the British Museum and measures 81 cm but this is exceptionally long. BLYTH (1861) says that he knows of two more horns of that dimension. The average horn does not exceed 50 cm (GROVES, 1971). In nature the shape of the horn is very pointed, with a rather abrupt transition to the wide base. On pictures of animals living for some years in captivity (AN-

TONIUS, 1937; DANDO, 1902; BREHM, 1920) the horns are much thicker and blunter. The sharp-pointed from of horns of wild living animals will be caused by wear. If the horn grows to any length at all, the nasal horn curves back noticeably.

The posterior horn is much less developed than the front horn, and is often not more than a small knob. Measurements of the posterior horn are seldom taken, the largest recorded was 8.8 cm (EVANS, 1905). BLYTH (1862) figures a skull with a posterior horn that will measure at least 15 cm. There seems to be little parallelism in development between the two horns. The front horn of the animal with the largest recorded posterior horn was only twice as large (EVANS, 1905) whereas the posterior horn was not more than a knob of an animal with a 48 cm front horn (fig. 15 in GROVES, 1971).

The horns of females are said to be smaller and less rugged than in males (HUBBACK, 1939; BLYTH, 1862). The horns of males have also a larger basal girth, correlated as a rule with a greater width of the horn-area of the nasal bones (POCOCK, 1946; GROVES, 1967). The greater horns and the correlated greater nasal width are the only secondary sexual differences.

A common feature is the hyperkeratinisation of the skin around the horn bases, particularly on the front of the snout. The muzzle itself conspicuously lacks the mobility seen in other rhinos, having only a single transverse grove which runs between the nostrils across the anterior surface while the upper border of the nostrils itself is immoveable, convex and supported by a strong cartilage (BEDDARD, 1889; GROVES, 1971).

## 10. OTHER EXTERNAL FEATURES

The feet are wide and flat and bear three round nails each. The skin under the foot seems to be rather soft; the feet of the animal living in the Copenhagen Zoo were hurt by sharp gravel (ANDERSON, 1961). The colour of the nails is blackish (MÜLLER and SCHLEGEL, 1844).

The penis points backwards and the result is that when the male urinates he does so behind. There is no scrotum. The glans penis is provided with two large oblong-oval lobes only attached to the glans at their bases (FORBES, 1881). More details about structure and function of the male generative organs are found in FORBES (1881), KUIPER and SCHNEIDER (1940), CAVE (1964). In the field this structure is difficult to see as it is situated deep between the hindlegs (see photographs – HUBBACK, 1939).

The udder, two inguinal mammae, has two fairly large teats, each of which has eleven largish openings (EVANS, 1907).

The iris is brown (MÜLLER and SCHLEGEL, 1844; WROUGHTON, 1915).

## 11. INTERNAL ANATOMY

Except on the development of the teeth (Chapter 12), only references are given:

| | | |
|---|---|---|
| Visceral anatomy | – | GARROD (1873) |
| Visceral histology | – | CAVE and AUMONIER (1963) |
| Lymph node structure | – | CAVE and AUMONIER (1962) |
| Musculature | – | BEDDARD [anc TREVES] (1889) |
| Brain | – | GARROD (1878) |
| Skull | – | BLYTH (1862) |

Differences in skull and teeth between *Dicerorhinus sumatrensis* and *Rhinoceros sondaicus*: GRAY (1873), FLOWER (1876), POCOCK (1945), HOOIJER (1946).

## 12. TEETH

In full grown state *D. sumatrensis* have on every jaw-side one incisor and a row of 3 praemolars and 3 molars. (There are 7 deciduous molars but the first is not replaced).

The incisors in the upper jaw have a large flattened crown. In the young animal these teeth are absent. A young animal reared in the Calcutta Zoo still did not have these teeth at the age of 2 years and 7 months (SANYAL, 1892). Another animal taken to the London Zoo also did not have the upper incisors either, although it was at least 6 years old (SCLATER, 1872d). They are already present when $pm^4$ of the milk dentation is still in use and the top of $m^3$ hardly visible in the bone (POCOCK, 1944). The incisors in the lower jaw are larger, acute and procumbent. The lower tusks (incisors) are sometimes lost in old animals (FLOWER, 1876).

The premolars and molars are much alike, rather low crowned and marked with transverse ridges of enamel (WALKER, 1968). The replacing of the milk teeth is reflected in the following growth stages distinguished by GROVES (1967a).

1. First permanent molar not visible.
2. First permanent molar erupting; no trace of 2nd molar.
3. 2nd molar erupting; 2nd and 3rd premolar in process of replacement.
4. 2nd molar in wear; 4th premolar in process of replacement.
5. 3rd molar in evidence; all milk teeth replaced.
6. 3rd molar fully erupted.

The deciduous first molar, with no permanent replacement is very reduced in size and shed in stages 3 or 4 (GROVES, 1967a).

Ages corresponding with these growth stages cannot be given. From what is written above about the development of the upper incisors one can expect that stage 4 will not set in before the animal is at least 6 years old.

On the upper jaw a pair of alveoli of shed and functionless incisors can be found lateral of the upper tusks (POCOCK, 1944).

In the other asiatic-rhinos (the dentation is much alike in the 3 species) the

upper tusks replace two rudimentary teeth but this could not be established for *D. sumatrensis* due to insufficient material on young animals. The same applies to the lower tusks (GRAY, 1873).

## 13. THE YOUNG

In three instances it is known that a young was born in captivity: the first on board the steamer Orchis on its way to London (BARTLETT, 1873), the second in Calcutta in 1889 (SANYAL, 1892) and the third also in Calcutta in 1895 (REYNOLDS, 1960). Several times very young or immature animals were captured and kept alive for some time. In 1886 a ten month old calf arrived in Hamburg (ULLRICH, 1955; REYNOLDS 1960), and in 1900 and 1902 two calves arrived in the Zoo in Vienna and survived for several years (ANTONIUS, 1937). In 1928 and 1930 two very young calves were captured in Sumatra and kept alive for some months (COENRAAD-UHLIG, 1933 and ULLRICH, 1955). HUBBACK (1939) mentions a calf captured and kept alive for 7 years by the 'To Raja Kiah of Jelebu' (Malaya).

The newborn calf is pictured and described by BARTLETT (1873): 'It reminds me of a young ass viewing its long legs and general mode of moving its large long head and meagre-looking body'. It was about 90 cm long and 60 cm high at shoulder, and its weight, judged by lifting, was something over 23 kg. The front horn is about 2 cm high; the posterior horn is not developed but a smooth spot indicates its position. It was almost black and covered with short crisp black hair, it ears were very hairy, inside as well as outside, the tail quite like a bush at the tip. It was thin and bony, looking much like a starved pig. The hooves were long and pointed and turned under the feet so that the points met almost in the middle of the sole. The extreme points of the hooves were quite soft. The proper form of the hoof is produced when these points are worn off.

SANYAL (1892) says about the young born in Calcutta in 1889: 'The body of the young animal at birth was covered with soft woolly hair, the skin was soft and of a pinkish brown colour, which gradually becomes darker as the animal grows but still retains its pinkish suffusion'.

The calf captured in 1928 in Sumatra would have been about four months old when it was described and pictured. It was 66 cm high at shoulder and 113 cm long from the upperlip to the end of its tail. The tail was 35 cm, the ears 12 cm, the front horn about 5 cm, and the posterior horn about 2 cm long. This animal had lost its hair cover because of a skin disease (COENRAAD-UHLIG, 1933).

A calf, about the same age as the one above, was captured in 1930 in Sumatra. It was about 60–70 cm high and weighed 40–50 kg. The front horn was about 5 cm long, the posterior horn not more than a small knob. The face, from the cheeks to the under parts of the lower jaw, are hairless as well as the two skin-folds. The rest of the animal was thickly covered with hair, especially on the legs, the belly and inside the ears. The distribution of hair on the sides seems

a little striped, judging from the photograph (ULLRICH, 1955).

The calf which arrived in 1886 in Hamburg was said to be 10 months old and was 72 cm high (NOACK, 1886).

MÜLLER and SCHLEGEL (1844), describe the hair cover of the new born calf as follows: 'It is covered with short coarse hair, which is a little curly and woolly. The colour is dirty white, with partly brown or blackish points. Along the back they form a dark band. The hair on the ears, legs and tail is a little longer, more slack and coarse and is of a blackish brown colour'. The colour of the hair of the two calves sent to Vienna in 1900 and 1902 was red-brown (ANTONIUS, 1937), and the hair of a stuffed calf in the Museum of Natural History, London, was black (DOLLMAN, 1928). As with the mature animals, the colour of the hair of the calves is found to be very variable.

## 14. GROWTH OF THE YOUNG ANIMAL

The calf born in the Calcutta Zoo in 1889 and suckled by its mother, equalled the mother in size and bulk after two years and 7 months (SANYAL, 1892). This would mean that *D. sumatrensis* reach fullgrown size in about two and a half years. Looking at a picture of one of the animals in the Vienna Zoo taken when it was about 3 years old, one would believe it to be fullgrown (ANTONIUS, 1937).

The animal kept by the To Raya of Jeleba in semi-natural conditions was, after 7 years, obviously not fullgrown. It was a little over 90 cm in height (HUBBACK, 1939). This retarded development can be caused by the lack of adequate nourishment (mothermilk) when very young.

## 15. PHYSICAL CAPABILITY

The authors, mostly also rhino-hunters, with a lot of experience in following rhinos are very impressed by the slyness and endurance of *D. sumatrensis*. EVANS (1905): 'The steeper the gradient, the more it would appear to appeal to them. It is surprising how they ever manage to climb over some of the rocky places one encounters, yet they do. They are the most difficult animals I have ever attempted to follow'. THOM (1935) says that for such a clumsy looking animal, *D. sumatrensis* is an extremely active beast and a wonderful hill climber.

HUBBACK (1939) makes the following remarks: 'They invariably go through the thickest undergrowth they can find and deliberately leave a game path to go through, or under, or over some fallen tree which appeals to their sense of humour, I suppose'. 'When they are being followed they excel themselves in ingenuity'. 'Nothing is too difficult for them'. 'Their walking powers in bad country are phenomenal'.

TALBOT (1960): 'It was difficult to believe that an animal the size of a rhino could get through such rough and steep country. Undisturbed rhinos had

wandered through rivers, not only calm, gravel-bottomed rivers, but extremely swift ones, up to 1.5 meters deep, with slippery rounded rocks for a bottom'.

HAZEWINKEL (1933) has a more moderate opinion on the endurance of Asian rhinos. The endurance is great when walking at a moderate pace, but a fast walk cannot be maintained for long.

*D. sumatrensis* can reach a great speed in an unbelievably short time (HAZEWINKEL, 1933). It is quick as lightening and can stop and turn in a fraction of a second (SKAFTE, 1961).

They swim well, crossing rivers etc. when they desire to do so (EVANS, 1905). STRICKLAND (1967) reported a *D. sumatrensis* to cross a canal and U TUN YIN (1954) gives a report of a rhino crossing two rivers. In Tenasserim (Burma) *D. sumatrensis* had found their way to islands before the coast. In 1889 ANDERSON stated that they existed on Kissaraing, Campbell and Forbes Islands. A police officer saw a *D. sumatrensis* swimming near High Island which is a good 20 miles from the mainland although there are islands in sight all around (U TUN YIN 1964b). From time to time reports came in that rhinos exist on Rodgers Island (U TUN YIN, 1954b). All the above mentioned Islands belong to the Mergui Archipelago, lying before the Burmese coast near the Isthmus of Kra.

## 16. SENSES

The most acute sense is that of smell, that of sight is very poor; on this all authors agree. On the sharpness of hearing they are not unanimous.

EVANS (1905), says that they rely much more on smell than on sight or hearing. Making a certain amount of noise, walking through the jungle, will not always disturb them.

THOM (1935), even declares that the sense of hearing is very poor. On the other hand HAZEWINKEL (1933) and HUBBACK (1939) state that the sense of hearing is very acute.

When testing the wind *D. sumatrensis* has the habit of curling up its pointed upper lip (HUBBACK, 1939).

## 17. VOICE

When feeding and quite undisturbed a rhino will continually squeak and talk to himself making some of the noises through its mouth and some through its nose. These noises can be heard for some distance (HUBBACK, 1939).

*D. sumatrensis* make a peculiar rather subdued kind of humming, rumbling or buzzing sound when submerged in their wallow. The noise is very similar to that made by a species of large horn-bill when soaring through the air, or like the sounds made by a vulture's wing when swooping down to earth (THOM, 1943). HUBBACK (1939) describes the sound made by *D. sumatrensis* in its

wallow as low and rather plaintive, something like the low note of a white-handed gibbon, but also with a faint resemblance to a bird, a noise impossible to describe accurately.

In addition to noises which represent some sort of endeavour to express its feeling, there is a complete series of snorts and grunts and blowings which the rhinoceros sometimes gives vent to when wallowing, probably due to trying to get the mud out of its nose and eyes (HUBBACK, 1939).

When alarmed *D. sumatrensis* snorts violently and when thorougly alarmed makes a noise something between the bark of a dog and the quack of a duck (HUBBACK, 1939), utters a succession of loud whistling braying sounds, in different keys, not unlike the braying of a donkey or a terrific snort (THOM, 1943), makes a dull growling, changing into a fierce snorting and sneezing and ending in a short jolting and barking sound (HAZEWINKEL, 1933).

When about to expire after being fatally shot, it utters a piercing long drawn-out scream (THOM, 1943), not unlike the screaming of the sambhur deer (*Cervus unicolor*) under similar circumstances, but an even more distressing sound.

When hungry and food is not forth-coming, *D. sumatrensis* in the Calcutta Zoo called for it with a monotonous wailing whine. Compared with the size, their voice is weak (SANYAL, 1892).

The voice of the females in the Vienna Zoo was a high, shrieking whistle, which one would more easily ascribe to a kind of crow than to a rhinoceros (ANTONIUS, 1937).

## 18. TRACKS

Since visibility is very limited in the tropical rain forest the study of tracks, footprints and marks on the soil and vegetation is very important.

*D. sumatrensis* has three nails on each foot, one central and two lateral nails. When walking the print of the hindfoot mostly overlaps the forefoot print. The hindfoot is narrower than the forefoot and the toe nails generally slightly larger (HUBBACK, 1939).

The only track that can be mistaken for a rhinoceros track is the track of the Malayan tapir (*Tapirus indicus*). The tapir has three toes on the rear foot and four on the forefoot. The outer toe of the forefoot is a bit smaller and placed higher on the foot than the other three, so that only a very clear imprint of the foot on soft soil will reveal its existence. A tapir often leaves a three toed print and a rhinoceros, due to overlap of hind and forefeet, can leave a four toed print. Generally the tracks of tapir are smaller, but there is an overlap in size between large tapir and small rhinoceros tracks. The nails of the tapir are more pointed than in the rhinoceros (STRICKLAND, 1967). When following a track it will generally be possible to distinguish both tracks clearly.

Another difference is that the tapir never wallows. Mud smears on trees or saplings along the path of the animal indicates a rhinoceros (HUBBACK, 1939).

Since the sole is rather elastic the width of the print varies considerably de-

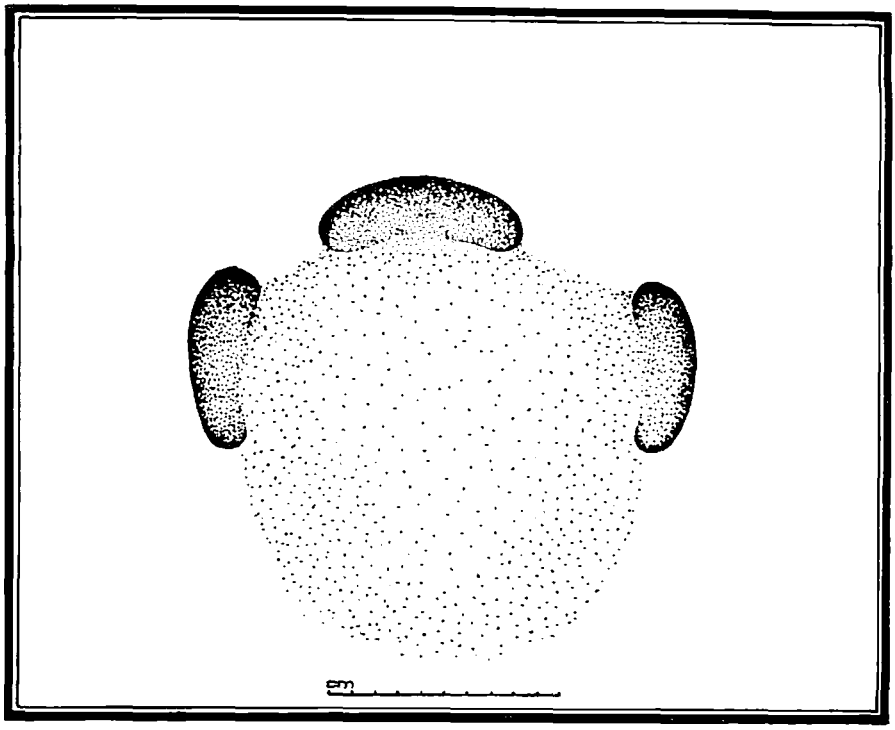



Fig. 2: Footprint of Dicerorhinus sumatrensis.

pendant on soil conditions. STRICKLAND (1967) found a difference of almost 2 cm between tracks in soft mud and those left in hard sand. KURT (1970) recorded a still larger variation, up to 6 cm but this can be caused by overlap of hind and front feet. BORNER (1973) found an average variation of 1.4 cm (maximum 2 cm) in tracks.

Most authors only give the maximum width of the track, from edge of inner toe to edge of outer toe. ANSELL (1947) reports a track of 17.8 cm (on solid ground) in the Shwe-U-Daung Sanctuary (Burma). HUBBACK (1939) measured in Burma prints of the forefoot of 21.5 cm and 21.1 cm. In Malaya FETHERSTONHAUGH (1951) reports a track of 20.5 cm and LOCH (1937) one of 24.8 cm (from an extraordinarily large animal killed in 1933). The prints of the three animals in the Sungei Dusun Reserve measured 16–18 cm, 19–21 cm and 21–23 cm (STRICKLAND, 1967). MILTON 1963 measured tracks of 14, 18, 19 and 22 cm.

In the Leuser area (North Sumatra) 11 tracks (hindfeet) were measured by KURT (1970). The smallest was on average 19.0 cm (17–22 cm) wide, the largest 29.5 cm (27–34 cm). It is suggested that these very large tracks belong to *Rhinoceros sondaicus*. (Formerly occurring on Sumatra but now thought to be extinct there). BORNER (1973) measured 8 tracks (hindfeet) in the same area, his smallest track was 17.5–19 cm, and the largest 23–24.5 cm.

HUBBACK (1939) reports two measurements of the central nails, 7.0 cm and 8.9 cm. MILTON (1963b) gives 5, 6.6 and 8 cm as the width of the central nails. Also KURT (1970) measured the width of the nails. There seems to be a very large variation in width of the nails, undoubtedly due to incomplete imprints. Only the largest figures given for each trail are considered here. In four tracks central and lateral nails are given and these are listed below (two other very large trails, possibly belonging to *R.sondaicus*, excluded).

| *Mean track diameter* (cm) | *central nail* (cm) | *lateral nail* (cm) |
|---|---|---|
| 21 | 6.5 | 7.5 |
| 23.5 | 8.5 | 7.5 |
| 20.5 | 5.5 | 9.0 |
| 23.5 | 7.0 | 6.5 |

It is striking that in two tracks the central nails and in the other two tracks the lateral nails are the largest.

The tracks of *Rhinoceros sondaicus* are not only larger. forefoot 25–32 cm hindfoot 23.5–28.5 cm (HOOGERWERF, 1970) but there seem to be also other differences. BERGER (1934) writes that VERNAY discovered characteristic differences in the pattern of the track and HOOGERWERF (1970) says that it must be very easy to distinguish both species by their footprints. Unfortunately both authors do not give any particulars on the nature of these differences. Comparing the pictures of prints made by STRICKLAND (1967) of *D.sumatrensis* and HOOGERWERF (1970) of *Rhinoceros sondaicus*, no characteristic differences could be seen. The impression of a short but wide toe nail indicates old age (HUBBACK, 1939).

Tracks of calves are very seldom found (HUBBACK, 1939; BORNER, 1973; THOM, 1943).

Males and females cannot be separated clearly on the tracks. HUBBACK (1939) thinks that the track of a larger splayed foot may be taken as an indication, but only an indication, that the animal is a female. Another indication of the sex of a *D.sumatrensis* seems to be the degree of damage done to the bark of small trees, through rubbing their horns against them. When much bark is taken off and the ground around the tree is much pawed up and the surrounding shrubs are sprinkled with urine, the doer will be a male. Female rhinos do rub their horns against trees in a similar fashion but it seems never to be accompanied by pawing (HUBBACK, 1939). THOM (1943) writes that he can easily distinguish between a male and female rhinoceros when following their tracks by noticing the way young saplings, creepers, or the branches of bushes have been twisted by the animals horns as it moves along when feeding. The more twisted the creepers. bamboos, and branches appear the better are the chances of coming upon a male with a good anterior horn. HUBBACK (1939) does not agree with this and states that this twisting of twigs etc., has nothing to do with the size of the horn (and correspondingly with the sex).

# 19. DISTRIBUTION

In this chapter all reports on specimens seen, captured or killed and other evidence on the occurrence of *D.sumatrensis* is listed chronologically. Geographical features not indicated on the maps of the Times Atlas of the World, comprehensive edition 1972, are, if possible, indicated with their co-ordinates derived from the Official Standard Names Gazetteer, United States Board on Geographic Names.

Note: For rivers the position of the mouth is given.

## 19.1 India and Bangladesh (Assam, Bengal, East Pakistan)

1864 One shot near Sankosh River, Jalpaiguri (Inglis c.s., 1919).

1868 One female captured 100 km south of Chittagong (Sclater, 1872a). This animal arrived February 1872 in the Menagerie of the Zoological Society, London, and lived there until August 1900.

1872 *D.sumatrensis* are found in the Cossyah Hills, south of Charyolah (?) (Anderson, 1872).

1875 One shot near Sankosh river, in the gorge where the river issues from the Bhutan Range (Sclater, 1875).

1876 One shot 20 miles south of Comilla, Tripura (Sclater, 1877).

1877 One recorded from Tripura. Probably the same animal as mentioned above (Blanford, 1888 – Shebbeare, 1953).

– In the valley of Nam-Tsai (27°30'N–97°00'E) plenty of spoor were found by Prince Henry d'Orleans (published 1895 – Hubback, 1939).

– One shot in Dalgaon Forest (26°34'N–92°12'E), Jalpaiguri (Inglis c.s., 1919).

1907 In Singpo country (?) an unidentified species of two-horned rhinoceros is found (Lydekker, 1907 – Hubback, 1937)

– Formerly common in the Lushai (Mizo) and Manipur hills and occasionally found in North Cachar, but by now hunted almost to vanishing point... – the record flood of July 1929 drove the rhino up into the hills and very few have been allowed by the Lushais to return (Milroy, 1934).

1930 A few still surviving a short time back in Burma, Assam (Lushai (Mizo) and Tripura Hills) and in the Chittagong Hill tracts in Bengal (Hobley, 1932).

1950 Tirap Frontier Trap National Park – A few animals may survive but this is very doubtfull (Gee, 1950).

1953 A two-horned rhinoceros was seen in North-East Assam. Reported in the Daily Telegraph, but no more details known (Shebbeare, 1953).

1960 Some possibility of isolated survivors in the Chittagong Hill tract, partially in the Indian Lushai (Mizo) Hills and partially in Bangladesh (Talbot, 1960).

## 19.2. Burma

1838 *D.sumatrensis* is common in Tenasserim and is to be found throughout the extent of the territories from 17° to 10° latitude (Helfer, 1838).

1842 Two skulls from Tenasserim presented to the Asiatic Society (Maddock, 1842).

1861 One shot at Bahpoon, Yunzalin river district (17°23'N–97°40'E), Upper Martaban (Blyth, 1862).

| | |
|---|---|
| – | Seen in Ya-ma-doung range (?) on the latitude of Ramree Island (BLYTH, 1862). |
| – | One shot near Sandoway (BLYTH, 1862). |
| – | One shot in Tavoy province, near the frontier of Thailand (BLYTH, 1862). |
| – | Three animals tracked in Southern Tenasserim Provinces (BLYTH, 1862). |
| approx. 1862 | Reported from southern portion of Arakan Hills (BLYTH, 1862). |
| – | *D. sumatrensis* are found in the Mogonny district (?) (ANDERSON, 1872). |
| 1884 | One male captured in the Bassein district. Sent to Regent's Park Zoo (REYNOLDS, 1960). |
| 1914 | One female shot near Bankachen, 17 miles inland from Victoria Point, Southern Tenasserim (WROUGHTON, 1915). |
| 1914/16 | Tracks reported from Pegu Yomas (WROUGHTON and DAVIDSON, 1918). |
| before 1917 | One shot in the range of hills bordering the Lemro river (20°25'N–93°20'E), Arakan (THOM, 1943). |
| – | One regularly seen on the banks of the Kaladan river, between Kyauktaw and Kaladan (THOM, 1935). |
| – | *D. sumatrensis* are still fairly plentiful in the hills which skirt the Ru(?), the Lemro (Lower Pen) and the Pen rivers in Arakan. Also fairly plentiful in the range of hills along either side of the watershed running between Arakan and the Thayetmyo District, inland from Kama and Mindon and in the Shwe-U-Daung range of hills (THOM, 1935). (THOM's information dates probably from before 1920). |
| 1922/26 | Four to six specimens reported somewhere west of Penwegon on the Rangoon Mandalay line (U TUN YIN, 1954). |
| 1927 | One shot in the Sadon area (?), Bhamo area (U TUN YIN, 1954a). |
| 1928 | Tracks reported in the Tenasserim range (LOCH, 1937). |
| 1929/30 | At least three reported from Kalihu sanctuary (17°30'N–19°15'E), (ANSELL, 1947). |
| 1931 | One shot within five miles of the railway line near Nansiaung in Katha division (ANSELL, 1947). |
| 1932 | Four estimated in the Kahilu sanctuary (17°30'N–19°15'E) (ANSELL, 1947). |
| 1932 | One reported in the Nami and Ledan valleys, as far south as the Indaw-Banmauk road (ANSELL, 1947). |
| 1933 | At least 6 in Kahilu sanctuary (ANSELL, 1947). |
| 1933 | Illicit hunting reported on the Arakan Yomas (ANSELL, 1947). |
| approx. 1933 | *D. sumatrensis* may still be located in parts of Myitkyna, in the angle between the Chindwin and the Uyu rivers in the Arakan hills as far south as Bassein, in parts of the Pegu Yomas, in parts of the Salween and Tenasserim drainages and in a few other remote hill tracts (PEACOCK, 1933). |
| 1934 | Still 6 specimens estimated for Kahilu sanctuary (ANSELL, 1947). |
| 1935 | Two rhinos were rumoured in the Pawn drainage in Karenni (Kayah State) (ANSELL, 1947). |
| approx. 1935 | One female killed near M.S. 70 Mawchi Road, south of Kwachi village (?). (ANSELL, 1947). |
| 1935 | Eight specimens estimated for Kahilu sanctuary (ANSELL, 1947). |
| 1935 | Tracks reported between Tawnaw (?) and Kora (?), north of the Uyu river (ANSELL, 1947). |
| 1936 | One seen on left bank of Uyu river, West Katha division (ANSELL, 1947). |
| 1936 | Two reported from the east bank of the Chindwin river, above Homalin (ANSELL, 1947). |
| 1936 | One seen in the Chaukni stream, west of Kyangin, Henzada division (ANSELL, 1947). |
| 1936 | One shot in the Nanyinh Ka reserve (25°03'N–96°10'E), Myitkyina area (ANSELL, 1947). |
| 1937 | One reported in the lower Uyu valley (ANSELL, 1947). |
| 1937 | Six estimated in Kahilu sanctuary (ANSELL, 1947). |
| 1937 | Reported in the Mulayit Sanctuary, (16°11'N–98°32'E) (ANSELL, 1947). |
| 1938 | Total number in the Kahilu sanctuary was given as seven; consisting of two male, |

four female and one bull calf (ANSELL, 1947).

1939 Tracks reported from Thani Chaung reserve (18°45'N–95°00'E), Thayetmyo division (ANSELL, 1947).

1939 One reported from Lower Uyu valley (U TUN YIN, 1954a).

1940 One seen and photographed in Kahilu sanctuary (ANSELL, 1947).

1940 Tracks reported in Manaung (15°07'N–97°59'E) and Yechaung (15°30'N–98°00'E) reserves, Amherst district, and also in the Tavoy division, the Henzada-Bassein division and on Sanwingan hill (?) in Tharrawaddy (ANSELL, 1947).

1943 Two shot west of Chaungson (25°04'N–95°05'E), Uyu area (U TUN YIN, 1954b).

1943 One shot in the Mansi Likun hills (?), Myitkyina area (U TUN YIN, 1954a).

1940/45 Reported west of Prome (TALBOT, 1960).

1943/45 During the campaign in Arakan British officers on patrol in the Arakan hills reported the presence of rhinoceroses to Lt. General Christison. In this period three animals were seen. Tracks, droppings and wallows were reported and local information gathered. Based on these data five areas inhabited by *D. sumatrensis* were mapped:

a. about 8 km NE of Paletwa;
b. about 40 km east of Paletwa and about 65 km NNE of Myohaung;
c. about 35 km NE of Myohaung;
d. about 80 km SSE of Myohaung and about 65 km NE of Myebon;
e. halfway between Sandoway and Prome (CHRISTISON, 1945).

1946 Rhinos are reported between Sandoway and Prome, the same area as area e of Christison (ANSELL, 1947).

1946 The forests of Mindon are said to contain a few rhinoceroses (ANSELL, 1947).

1946 One killed in the Ma-ubin tract, Bhamo district (ANSELL, 1947).

1946 Rhinos are supposed to exist west of Indawgyi Lake (ANSELL, 1947).

1946 About six are reported from the Salween area (ANSELL, 1947).

1946 Tracks from 2 specimens reported on the Kahilu sanctuary (ANSELL, 1947).

1946 Tracks of a female and calf reported in the Yomas, probably north-west of Pegu (ANSELL, 1947).

1947 Tracks reported in the Shwelaung reserve between Shwelaung and the Pegu river, about 6 km from Kadokchaung (17°38'N–96°41'E) (ANSELL, 1947).

1947 Tracks reported near source of Tagwin Chaung (?), Mogaung Range (U TUN YIN, 1954b).

1947 ANSELL (1947) estimated the total number in Burma between 21 and 45. See: Estimates of total population.

1947/48 One occasionally seen in Kahilu sanctuary (U TUN YIN, 1954a).

1948 Tracks reported in Pao Tan Bum, Pindung reserve (?), Myitkyina area (U TUN YIN, 1954b).

1948 Tracks of two animals reported in Maingseingyi (?). Myitkyina area (U TUN YIN, 1954b).

1949 One shot near Kungsai (?), Uyu drainage (U TUN YIN, 1954a).

1950/51 About five estimated in Nankasa (24°35'N–95°37'E) and Nan-Yoke-Chaungs (25°12'N–95°48'E), Uyu drainage (U TUN YIN, 1954a).

1951 Reported to exist in the Victorai Point Range, Tenasserim (U TUN YIN, 1954a).

1951 Three to four estimated in Laisai tract (26°00'N–95°45'E?), Uyu drainage (U TUN YIN, 1954a).

1951/52 Reported in Nataleik Yele Forest, Somra tract (25°22'N–94°41'E), Uyu drainage (U TUN YIN, 1954b).

1952 Two seen in Zamayi Reserve (18°08'N–96°04'E), upper reaches of Pegu river (U TUN YIN, 1954a).

1952 Three shot at Chindwin river near Bum Chyang Bum (?) (U TUN YIN, 1956).

1952/53 Five estimated in Nankasa, Nam-Yoke-Chaung and the Taungthonlon (24°58'N–95°48'E) area, Uyu drainage (U TUN YIN, 1954b).

1953 Seen in Bigon forests (?) between Matupi (?) and Paletwa, Arakan Yoma (U TUN YIN, 1954a).

1953 Tracks reported on Lontin Hill (?) between Matupi (?) and Kanpetlet (?), Arakan Yoma (U TUN YIN, 1954a).

1953 Tracks of two specimens reported near source of Thounze (17°36'N–95°44'E ?) Chaung, Pegu Yoma (U TUN YIN, 1954a).

1954 Numerous fresh tracks reported in the Laisai tract (26°00'N–95°45'E ?), Uyu drainage (U TUN YIN, 1956).

1954 One shot near source of Thounze Chaung (17°36'N–95°44'E ?), Uyu drainage (U TUN YIN, 1954a).

1954 Seven or eight estimated in Homalin Sub-Division (U TUN YIN, 1954b).

1954 Tracks reported on right bank of Chindwin river north of Nantalaik (?) (U TUN YIN, 1954b).

1954 REYNOLDS (1954) estimates the total population in Burma as 36. See: Estimates of total population.

1955 At least 30 estimated by local officer in Kan Taik Bum (?), Wantuk Bum (26°15'N–96°25'E), Bum Chyang Bum (24°09'N–97°26'E ?), Hpala nung Bum (25°41'N–96°02'E), and Bumdaw bum (25°55'N–96°05'E), in Kachin State (U TUN YIN, 1956).

1955 Fresh tracks reported between Laisai (26°00'N–95°45'E ?) and Haungpa (25°29'N–96°07'E) and the Chindwin River (U TUN YIN, 1956).

1955 Reported from Pa-aing Reserve (?), Mau West Reserve (?), Kyetmauktaung (24°55'N–95°41'E) area, and Ngape area, 50 miles SSE of Myohaung (U TUN YIN, 1955).

1960 Two reported in Kaletha sanctuary (17°10'N–97°00'E) (TALBOT, 1960).

1960 TALBOT (1960) estimates the total number between 35 and 46. See: Estimates of total population.

– Skulls are precent from High Island, Mogok, Putao and some of the places mentioned above (GROVES, 1967a).

1963 BURTON (1963) estimates the total population as 26. See: Estimates of total population.

*Shwe-U Daung Sanctuary* (between the Irrawaddy and Shweli river, 23°02'N–96°17'E).

before 1920 Still fairly plentiful (THOM, 1935).

1929/30 One seen, not plentiful (ANSELL, 1947).

1930/31 One male shot and ten other specimens estimated (PEACOCK, 1931).

1931 Three seen (ANSELL, 1947).

1933 Numbers estimated at not more than 12, the majority on the Mongmit side and in the Ye-nya-u drainage (ANSELL, 1947).

1934 Fresh tracks reported (ANSELL, 1947).

1935 One seen (ANSELL, 1947).

1936 Eight specimens, estimated (ANSELL, 1947).

1937 Doubt was expressed as to the presence of more than ten specimens. Local people estimate the numbers between 10 and 100 (ANSELL, 1947).

1938 Five and probably more, estimated (ANSELL, 1947).

1939 Between 12 and 15, estimated (ANSELL, 1947).

1940/45 Three shot (U TUN YIN, 1954b).

1946 Eight and 15 specimens, respectively estimated (ANSELL, 1947).

1948 One seen and 4–5 estimated in Mong Mit sector (U TUN YIN, 1954a).

1949/50 Tracks rarely seen in East Katha sector (U TUN YIN, 1954b).

1950/51 One male and one female and one calf reported from Mong Mit sector (U TUN YIN, 1954).

1950/52 Three shot in Mong Mit sector (U TUN YIN, 1954b).

1952/53 One male, one female and one calf reported in upper reaches of Shwe-Mnyar-U-Chaung (U TUN YIN, 1954b).

1959 Two, maybe more (MILTON, 1961).

1960 Two or 3 estimated in upper reaches of streams in remotest parts (ALI and SANTAPAU, 1960).

*Estimates of Total Population of Burma*

| Area | Ansell 1947 | Reynolds 1954 | Talbot 1960 |
|---|---|---|---|
| Shwe-U-Daung Sanctuary | 5–10 | 5 | 4– 5 |
| Arakan upper | 7–12 | 6 | 4– 6 |
| Arakan lower | | | 3– 5 |
| Pegu Yomas | 3– 5 | 5 | 6– 8 |
| Kahilu Sanctuary | 2– 6 | 3 | 2– 3 |
| Uyu upper | 4– 8 | 5 | 4– 6 |
| Uyu lower | | | 3– 5 |
| Tenasserim peninsula | 0– 4 | 5 | 2– 2 |
| Kachin State (Tirap border) | | | 4– 6 |
| Other areas | | 7 | |
| Total | 21–45 | 36 | 35–46 |

## 19.3. Thailand (Siam)

1914 Rhinos (both species) are only to be found in the most northern parts of Upper Siam, but there they seemed to be not uncommon according to a statement of Doctor Högborn, who observed several tracks in the jungles surrounding the towns of Chiang Kong (?), Chiang Saen and Muang Fang (Gyldenstolpe, 1914).

1915(?) Tracks seen near Rat buri and Petchanburi (Phet Buri) along the Huey Sat Yai (Gardner, 1915).

1919 *D. sumatrensis* sparingly found along the western frontier, but its distribution is still very uncertain. It seems, however, to be more common in the southern districts than in the north (Gyldenstolpe, 1919).

approx. 1930 A young rhino, probably *D. sumatrensis*, captured near Pattani, according to newspaper article (Loch, 1937).

1933 W. W. Fegan reports that *D. sumatrensis* is very scarce (Loch, 1937).

1958 Three killed near southern part of Thai-Burma border (Talbot, 1960).

1959 Two killed near the border north-west of Karnchanaburi province (Talbot, 1960). Note: From the 5 specimens killed in 1958 and 1959 one is definitely *D. sumatrensis*. The species of the others is unknown.

1960 A few may exist in the extreme southern part and along the Thai-Burma border (Talbot, 1960).

1963 The existence along the Tenasserim Range is certain but no estimate of numbers has been made (Burton, 1963).

1965 A few survive along the Tenasserim range (Lekagul, 1965).

1970 Three killed in the Chaiyaphum province (Borner, 1971).

1970 Three to ten estimated along the Tenasserim Range (Borner, 1971).

1970 Reported near the Istmus of Kra (Borner, 1971).

1971 *D. sumatrensis* are reported to be still found in the Khao Luang National Park (08° 55′N–99°40′E) and the Khao Salob National Park (14°30′N–99°00′E) (IUCN, 1971).

1972 A few survivors can be found in the Tenasserim range, near the Malayan border and in Chaiyaphum province (McNeely and Cronin, 1972).

1973 *D. sumatrensis* occur in the Phu Kheio Game sanctuary in Chaiyaphum province and probably also in the Khlong Nakha Game sanctuary (?) in Ramong (Ranong?) province (Anon., 1973).

## 19.4. Laos, Cambodia (Khmer), North and South Vietnam (former French Indochina)

before 1890 — *D. sumatrensis* were numerous in the western buttresses of the Annam mountain chain with a maximum frequency in the south, particularly Boloven Plateau and the slopes extending west to the Mekong on the boundary of Cambodia (Harper, 1945).

– — *D. sumatrensis* were hunted in Phan Rang, Cam Ranh and Phan Thiet districts (Harper, 1945).

1902 — A stuffed head, origin unknown, reported in Nha Trang (Millet, 1930).

1904 — One killed near Cam Ranh (Sauvaire, 1930).

approx. 1916 — *D. sumatrensis* are abundant in the whole Mekong Valley and are hunted not far from Saigon (Harper, 1945).

approx. 1925 — Abundant in the Mekong valley (Talbot, 1960).

– — Stuffed heads reported in the possession of Laotians hunting in South-west Cambodia (Millet, 1930).

1936 — Rhinos (both species) still exist in the Sonla Samnena (?) region and probably also in the Boloven massive and in the mountain buttresses separating the upper Se La Nong and Se Kong from Kontum (Harper, 1945).

1937 — M. de Villa reports from Hanoi that *D. sumatrensis* is unknown and Prof. Bourret, Hanoi, states that is is only known in the south of Indo-China and in Cambodia and on the Annamite Chain (Loch, 1937).

– — Pocock (1944) mentions one female skull from Cochin China.

1960 — *D. sumatrensis* still exist in Vietnam and they are reported to be in an old royal forest reserve near Da Lat, north and east of Saigon (Talbot, 1960).

– — Other areas where rhinos were reported are: East Cochin China (the Cambodia – Vietnam border area); the mountains above Nha Trang (Vietnam, east of Da Lat); south of Da Lat (Vietnam); mountains south and west of Hue (Vietnam); forested country of south-east Laos and adjoing Vietnam (near the juncture of the Laos–Cambodia – Vietnam borders) (Talbot, 1960).

– — There are practically no accounts of the existence of *D. sumatrensis* in Laos (Deuve and Deuve, 1962).

## 19.5. China

Rhinoceroses survived in Southern China in historical times, but probably had already disappeared in the second century A.D. (Bishop, 1933). There are indications that *D. sumatrensis* was known in China, based on some rather accurate pictures from early Chinese periods (Sowerby, 1934; Harrisson, 1956).

In a travel description, published in 1895 by Prince Henry d'Orleans, a stuffed head is reported in Mong-le (22°30'N–1°02'E) near the Chinese - Laos border. The rhino was stated to have been killed about 6 km away (Hubback, 1939).

## 19.6. Malaya

1872 — One female captured in the Sungei-Njong district (3°02'N–101°52'E) (Sclater, 1876). This animal lived from 21st August 1872 till 21st September 1872 in the Menagerie of the Zoological Society in London (Reynolds, 1960).

1898 — One female killed at Rantau Panjang (2°53'N–101°29'E), Selangor (Flower, 1900).

1901 — Three rhinos captured in the Dindings (4°20'N–100°38'E). Formerly they were very plentiful here but have now become scarce and difficult to trap (Wray, 1906).

approx. 1902 — One captured in Trengganu and sold to the Perth Zoo (Reynolds, 1960).

1905 One male rhinoceros captured in the Dinding area (O'HARA, 1907.

1932 Several specimens survive in Perak, Selangor and Pahang (HARPER, 1945).

approx. 1925 One seen on the top of the Gunung Jerai (5°47'N–100°26'E) (PAGDEN, 1965).

1933 One male shot in the Sungei Bugis area between the Bernam River and the coast (LOCH, 1937).

– One shot in the Kenas area in the region of Gunung Bubu (FOENANDER, 1944).

1937 A few survive in the Dinding district (4°20'N–100°38'E) (LOCH, 1937).

1937 It is believed that 2–3 specimens occur in South Perak (COMYN–PLATT, 1937).

1938 One female and one nearly fullgrown young recorded at Maxwell Hill Cottage near Taiping, Perak (FOENANDER, 1944).

1941 *D. sumatrensis* are reported from the Krau Game reserve (3°41'N–102°11'E), southern quarter, in Central Pahang (1), the western slopes of Gunung Benom and high up the Klau Kechil (3°47'N–102°00'E) (HISLOP, 1966).

1941 Tracks of an unknown number reported in the hilly bamboo forests in North Kedah (HISLOP, 1966).

1944 *D. sumatrensis* may be found on the west of the Central range in eastern Kedah, Upper Perak, the Bubu-Bintang Hijan range and the Bernam valley west of the railway. On the east, south-western and southern sections of Kelantan and Trengganu, hilly tracts of Kuala Lipis district, the Benom range, the upper Jengka valley (3°31'N–102°38'E) and around Gunung Lesong of South-eastern Pahang. Johor has a number of these animals and these are most likely to be found towards the Pahang border or other hill ranges (FOENANDER, 1944).

1947 One shot in Johor (HISLOP, 1966).

1949 Two adults and one juvenile reported in Sungei Dusun Reserve (3°37'N–101°17'E) (HISLOP, 1966).

1949 One seen on Gunung Bubu (HISLOP, 1966).

1950 Reported in Taman Negara National Park (King George V National Park) (Anon., 1952).

1952 Three reported in Trengganu (HISLOP, 1966).

1956 Two reported in Bintang Hijau Forest Reserve (?) (HISLOP, 1966).

1957 One specimen photographed in Bintang Hijau Forest Reserve (?) (HISLOP, 1966).

1957 One specimen photographed near the Slim river, Perak (ALI and SANTAPAU, 1958).

1961 One seen and tracks reported in the Kuala Chamir area (?). One or two estimated in the upper reaches of the Spia river (4°30'N–102°39'E) and near the sources of the Kenyam river (4°31'N–102°28'E) (HISLOP, 1961).

1961 The total number in Malaya is estimated as 50. See: Estimates of total population (METCALFE, 1961).

1964 One seen in Tembeling valley, Taman Negara National Park (HISLOP, 1966).

1964 Tracks reported in the upper reaches of the Perak river (HISLOP, 1966).

– Reported from time to time near the border of Perak and Kelantan (HISLOP, 1966).

1965 One seen in Tembeling valley, Taman Negara National Park (HISLOP, 1966).

1966 Total number in Malaya is estimated between 10 and 30. The localitites are indicated on a map. See: estimates of total population (HISLOP, 1966).

1966 Three reported in Sungei Dusun Reserve (STRICKLAND, 1967).

1968 Total number in Malaya is estimated as 20. See: Estimates of total population. The areas in which they are recorded are the National Park, the Sungei Emas region of Johor, Ulu Perak, the Sungei Dusun Reserve in Selangor, the Ulu Selama area of Perak, Gunung Chamah in Kelantan, the Kerau Reserve (3°41'N–102°11'E) and two other localities in Pahang, and the Johor coast south of Mersing (STEVENS, 1968).

1971 Three reported in the Sungei Dusun reserve (BORNER, 1971).

1971 *D. sumatrensis* survive in Taman Negara National Park (IUCN, 1971).

1973 Total numbers in Malaya estimated between 16 and 18 (NG POH TIP, 1973). See: Estimates of total population.

- Pocock (1944) mentions one male skull from Kian Putu, north of Mt.Ophir (=Gunung Ledang).
- Groves (1967a) mentions skulls from Tahan River, Bruas, and Kenas (04°40'N–100°56'E).

*Estimates of total population in Malaya*

| State | Metcalfe 1961 | Hislop 1966 | Stevens 1968 | Ng Poh Tip 1973 |
|---|---|---|---|---|
| Johor | 10 | 0– 2 | 5 | 8 |
| Kedah | 4 | 2– 4 | | |
| Kelantan | 5 | | 1 | |
| Perak/Kelantan border | | 0– 2 | | |
| Perak Kedah border | | 2– 4 | | |
| Perak | 10 | 1– 3 | 5 | 4– 6 |
| Perak/Selangor border | | 3– 4 | | |
| Selangor | 6 | 0– 1 | 3 | 3 |
| Trengganu | 5 | 0– 2 | | |
| Pahang | 10 | 0– 4 | 3 | |
| Taman Negara National Park | | 2– 4 | 3 | 3– 5 |
| Total | 50 | 10–30 | 20 | 18–22 |

## 19.7. Indonesia - Sumatra

approx. 1790 One killed near Fort Marlborough (?), Benkulen (13°48'S–102°15'E), South Sumatra. This is the specimen on which Bell (1793) based his description.

1835 Three killed east of Padang, Padang Besi (180–300 m) (Müller and Schlegel, 1844; Hooijer, 1946).

1878 *D.sumatrensis* is fairly common in the hill forests. Tracks found up to 1,800 metres (Rosenburg, 1878).

1883 One male killed near Tandjoeng Morawa (T.Merowa (?) 3°25'N–98°27'E) (Hooijer, 1946).

1885 *D.sumatrensis* is scarce nowadays in the Pane (1°24'N–99°40'E) and Bola (?) basin. They survive in the Gajo and Alas region (4°00'N–97°15'E), Langkat (4°10'N–97°30'E), near the salt water springs at the east coast, Indragiri in Riau, Djambi, NW Palembang (Benarat) and in the Barisan range. (Neumann, 1885).
*D.sumatrensis* were numerous on the Bukit Sepatuhu (?) (Rudin, 1935).

1890 One seen at Serbang (Serbangan ? 3°02'N–99°41'E) (Hagen, 1890).

approx. 1900 Still numerous between the Besitan (4°06'N–98°10'E) and Batang-Serangan (3°01'N–99°41'E) (Otto, 1903).

– Many tracks reported near the Lepan (4°04'N–98°22'E) river (Otto, 1903).

– One shot in Paya Atjeh (Paja ? 5°07'N–96°33'E) (Otto, 1903).

– Many disused pitfalls reported at the watershed above the Siulak Kunan river (?) (about 2,300 meters) (Bünnemeijer, 1921).

1905 Reported in Upper Langkat, jungle at Bohorok (3°30'N–98°32'E), Batu Bahra (?), Tandjung Laut (?), Indragiri, Orang-Mamma region near Pematang Ruba(?) and Pematang Djenako(?). (Schneider, 1905).

1912 Reported in the Karo Mountains and on the northern slopes of the 'Goudberg' (5°40'N–95°25'E) (Voltz, 1912).

1912 *D. sumatrensis* are hunted in the Simalambu range (Rokan) (0°34'N–100°24'E) (DAMMERMAN, 1932).

approx. 1915 Exterminated at Kerintji mountain (HEYNSIUS-VIRULY 1935).

approx. 1925 One shot south of Gunung Dempo, Benkulen, South Sumatra (about 900 m). (HAZEWINKEL, 1933).

approx. 1925 One shot west of the Bukit Lumut (3°58'S–102°48'E), Palembang (about 900 m) (HAZEWINKEL, 1933).

1927 A few survive in the southern part of the Niru-reserve (Ogan ulu and Lematang Ilir) (?) (COOMANS DE RUITER, 1928).

1928 According to the local inhabitants *D. sumatrensis* is abundant on the Kerintji (VAN WATERSCHOOT VAN DER GRACHT, 1928).

1927/33 In South Sumatra tracks are very seldom found, only in the most remote places (VOOGD, 1933).

1928 One female, accompanied by a young, killed about 40 km inland from Langsay. The young captured and kept alive for some time. It died from a cobra bite (ULLRICH, 1955).

1930 One female and one juvenile in Atjeh. The female was shot and the juvenile captured and kept alive for some time (COENRAAD-UHLIG, 1933).

1930 One reported south of Bukit Sepatuhu (?) (RUDIN, 1935).

– *D. sumatrensis* were once very numerous on the blang on the Blangbeke plateau (3° 50'N–97°23'E) (MILLER, 1942).

– Formerly occurring in Bulu Telang (?) (HARPER, 1945).

before 1932 Pitfalls reported in Sekintjau region, Benkulen, South Sumatra (VOOGD and HORA SICCAMA, 1939).

1933 A couple believed to be living on Lepan (4°04'N–98°22'E) (HARPER, 1945).

1934 Reported in Dolok Saut (1°50'N–99°10'E), Tapanuli; Simbolan forest reserve (Simelungan?); Indragiri and Surulangun (Djambi) (HOOGERWERF and VAN STEENIS, 1936).

1935 Tracks reported on southern slopes of G. Seminung (45°56'S–103°58'E) (RUDIN, 1935).

1935 Tracks reported in South Sumatra reserve (5°10'S–104°10'E) (RAPPARD, 1936).

1935 One shot at Kongké (3°54'N–97°26'E) (HOOGERWERF and VAN STEENIS, 1936).

1935 Reported in Lalang (2°24'S–104°39'E) region, Palembang (HOOGERWERF and VAN STEENIS, 1936).

1936 Rhinos are reported in the Hulubelu (5°21'S–104°36'E) plateau (HARTMAN, 1936).

1936 Rhinos are reported in Berbak (1°04'S–104°12'E), Djambi (ENDERT, 1936).

1936 The number in the South Sumatra game reserve is estimated to be 30 at most (HOOGERWERF, 1936).

1937 Reported in the high mountains west of Blangrakal (4°53'N–96°44'E); high mountains west of Takingeu toward Pameua (4°45'N–96°26'E); high mountains north east of Lamno (5°06'N–95°23'E) (CARPENTER, 1938).

1937 Tracks reported near Pulah - Munteh, some kilometers from Pendeng (4°08'N–97° 37'E) (600 m) and near Lösten, a day's walk from Pendeng (800 m) (HOOGERWERF, 1939).

1936/38 Reported south of Sekintjau range, South Sumatra. Maybe a few survive on Kerintji mountain (VOOGD and HORA SICCAMA, 1939).

1938 Wallows are reported in South Sumatra in the following places. Lais- between Air Merah (?) and Air Seblat Djernih (3°14'S–101°36'E); Lebang – on the slopes of the Bukit Runtjing (2°55'S–102°12'E), Reges (3°07'S–102°19'E), Bukit Pandan, Gunung Baroe (?), Ulu Air Sulup (?); Redjang – slopes of Bukit Kelam east of the road from Tjurup (3°28'S–102°31'E) to Muara Aman; Seluma – Bukit Tjampong (?), Gunung Dempo, Bukit Dingin; Krui – sources of the Way Ru (?) and the Way Baru (?), Bukit Barisan range at the altitude of the Way Pintau (5°35'S–104°10'E) and the Way Mendati (?) (GROENEVELDT, 1938).

1939 A few may remain in the Wilhelmina range (3°44'N–97°15'E) (MILLER, 1942).

1941 One killed in Pangkalan Kampar (?) (HOOIJER, 1946).

1957? Tracks reported at five places in the South Sumatra Nature Reserve (TALBOT, 1960).

1959 Nine female and one male captured near the Siak river east of Pakanbaru by RYHINER and SKAFTE; three were shipped to the Copenhagen, Basel and Bogor Zoos. (ANDERSON, 1961).

1959 Ryhiner estimates the number living near the Siak river between 40 and 60 (GRZIMEK, 1960).

1963 The total population in Northern Sumatra is estimated 20 (BURTON, 1963).

1963 No signs of rhinos could be found in the areas in which RYHINER and SKAFTE captured ten animals in 1959 (MILTON, 1963a).

1964 The total number in Atjeh is estimated between 30 and 50, living in 9 unspecified places (MILTON, 1964a).

1968 Three killed in the upper reaches of the Mamas river (3°34'N–97°47'E), 20–30 kms south of the Alas river (main course of Simpang-Kiri) (SCHENKEL and SCHENKEL, 1969).

1969 Some evidence of rhinos in the region of Udjung Baru (?) and Pasirpengarajan (?) (BORNER, 1970).

1969 Rhinos have completely disappeared near the Siak river, where RYHINER and SKAFTE captured 10 animals (SCHENKEL and SCHENKEL, 1969).

1970 The total number in and around the Gunung Leuser reserve in Atjeh are estimated between 27 and 68. Rhinos live in 24 locations; in 9 locations their existence is doubtful. The various locations are indicated on a map (KURT, 1970).

1971 No signs of rhinos could be found near Lau Djohar, one of the rhino areas registered by Kurt 1970 (MACKINNON, 1971a).

1971 One or two may survive on Gunung Kerintji (IUCN 1971).

1971 *D. sumatrensis* are reported in the following areas: Atjeh – Gn.Leuser; Riau – Bastam (?), Taluk, Kerumuntan (about 0°10'N–102°55'E), Bangkinang (?), Sungei Rangan; Lampung – Sumsel I (South Sumatra Reserve), Way Kambas (7°10'N–105°40'E); Djambi – Berbak; Langkat – Gn. Whilhelmina (Directorate General of Forestry, 1971).

1971/72 In the Leuser area (Atjeh) tracks are reported by H. D. RIJKSEN in the Kompas/Silukluk area (about 3°15'N–97°51'E), Ketambe (3°42'N–97°42'E) and the mountains west of Ketambe. Local informants reported *D. sumatrensis* at Seldok (3°38'N–97°44'E), Gunung Setan (3°41'N–97°41'E), Gumpang (3°51'N–97°33'E), Konké (3°54'N–97°26'E) and Rambung (3°52'N–97°30'E) (RIJKSEN, 1972).

1973 Tracks reported along the Kapi river and in the Kapi region (3°55'N–97°30'E) (RIJKSEN, 1973).

1973 *D. sumatrensis* disappeared in the Gunung Leuser area from all peripheral areas. In the central Leuser Reserve a fairly large population exists, at least 8–10 animals (BORNER, 1973).

Note: The modern Indonesian spelling of Atjeh is Aceh.

## 19.8. BORNEO–SARAWAK, BRUNEI, SABAH (FORMER BRITISH NORTH BORNEO), KALIMANTAN OR INDONESIAN BORNEO

1889 One shot at Kinabatangan river (HARRISSON, 1956), p. 366.

1891 Four heads and 3 horns from the Upper Rayah (1°59'N–111°56'E) river are in the Kuching Museum, Sarawak (BARTLETT, 1891), p. 659.

1893 *D. sumatrensis* are occasionally met with in the interior of Borneo, but it is rare in the low country (HOSE, 1893).

before 1900 *D. sumatrensis* are found on the plain of Bah (Bareo) (HARRISSON, 1956).

1907 A few survive at the Upper Simpang about Batu Dayeu (?), the lowlands at the base

of Mt.Palung (1°13'S–110°08'E) and in the neighbourhood of Mt.Kedio (2°21'S–110°18'E) (LYON, 1911).

1915 Common near the sources of the southern tributaries of the Upper Kapuas and the Melawi river (VAN BALEN, 1915).

1915 Tracks reported near the Punan cave on the western slope of the Liang Kubung (?) (VAN BALEN, 1915); volgens Büttikofer in Januari 1892.

1915/16 *D.sumatrensis* are common in British N.Borneo and are also found in the mountainous regions in the far interior of the island (SHELFORD, 1919). 1916 ?

- 1925 A few tracks reported in the mountains at the upper reaches of the Telen river (about 2000 meters) and in the upper reaches of the Atan (0°51'N–116°31'E), a tributary of the Klindjau (WITKAMP, 1932).

- 1925 Four specimens seen near the upper springs of the river Boh (MJÖBERG, 1930).

- approx. Reported in the hills (up to 350 meters) between the Kedong Rantau (?), the Telen

- 1925 river and Makassar Strait (WITKAMP, 1932).

- 1927 One killed near the Tinghayu, a river emptying in Darvel Bay (DAVIS, 1962).

- approx. One seen 30 km south of Samarinda, near the upper reaches of the Sungai Kembodja

- 1930 and the Sungai Nangka (KELLER, 1932).

- – *D.sumatrensis* survive in the mountainous regions of the Lawas interior, interior of the Baram and Rajang (?) rivers, occasionally as far down as the Ulus (drainage area) of Mukah and Oya. Not present on the left bank of the Rajang or down in Saribas and Sarawak (BANKS, 1931).

- – Places where *D.sumatrensis* are reported in East and South Borneo, are indicated on a map; 15 reports are in the central mountains, mostly near the Sarawak border; 3 reports are in the low country in the south west of Borneo, and another three in the mountain range west of Balikpapan (ZONDAG, 1931).

- 1932 *D.sumatrensis* occur at the upper Belayan, Klindjau (0°26'N–116°41'E), Telen and Wahau (1°02'N–116°51'E) rivers (WITKAMP, 1932).

- 1932 *D.sumatrensis* are relatively abundant in Kutai (the proposed Kutai Reserve) (WITKAMP, 1932).

1935 *D.sumatrensis* survive near the upper reaches of the Malinau and Tubu rivers, near the Saba-border in Buntok (?) and Apo-Kajan (Upper Kajan), north of the Mahakam river and are very scarce in West Kutai. In Martapura (?) they have disappeared (HEYNSIUS-VIRULY, 1935).

-1936/38 *D.sumatrensis* occur in the Palung range, near the upper Kapuas and upper Melawi, Malinau, upper Kajan, Sambaltung, west Kutai and upper Mahakam, Sampit and Kotawaringin (VOOGD and HORA SICCAMA, 1939).

1937 A few survive in Sabah (COMYN-PLATT, 1937).

-1939 A summary is published of the reports on *D.sumatrensis* received from the Dutch part of Borneo in the past few years. On two maps 28 records and 4 doubtful records are indicated. *D.sumatrensis* has still a rather wide distribution but is nowhere abundant. Records are in the Upper-Sekatak (3°14'N–117°17'E) area, between the Malinau and the Bahau river, Krajan district, Meutarang district, source areas of the Malinau and Tubu, Bulongan (around Gunung Balu), Niapa and Suwaran gebergte, Upper Kajan, source area of the Barito, the upper reaches of the Mendawai and possibly also in the lower Kotawaringin. Also the reports previously published by WITKAMP (1932) and KELLER (1932) are again included (Anon. J. H. WESTERMANN, 1939).

- 1945 One seen between the headwaters of the Bahau (Poedjoengan) and Upper Batang Kayan (Kajan ?) (1000 m) (HARRISSON, 1956).

- – One killed near the upper Rajang river (HARRISSON, 1956).

-1952 According to local informants, *D.sumatrensis* are plenty on Mt.Trus Madi and eastward into Kinabatangan. In 1956 no traces could be found in this area (HARRISSON, 1956).

-1956 Total number in Sarawak will be not more than 2 (HARRISSON, 1956).

- 1957 One seen by employee of Forest Department in Sabah (DE SILVA, 1968).

1958 Exterminated in the Barito region (P. PFEFFER). T. HARRISSON estimates 15 to 25 in-

1958.



Mededel. Landbouwhogeschool Wageningen 74-16 (1974)

dividuals on the whole island. 2 in Sarawak and 5 in Sabah (Anon., 1958).

- 1961 Total number in Sabah estimated between 20 and 30. In recent years *D. sumatrensis* are reported in Upper Kinabatangan, Darvel Bay forests, Dent Peninsula (5°16'N–119°15'E), near Ranau (one shot in 1958) and the interior Residency (in 1957 the Resident recorded an increase here) (BURGESS, 1961).
- 1962 *D. sumatrensis* are widely, but very thinly, distributed throughout Borneo (DAVIS, 1962).
- 1968 *D. sumatrensis* is virtually extinct in Sarawak (ANDERSON, 1968).
- 1968 *D. sumatrensis* will probably be extinct very soon in Sabah (CARSON, 1968).
- 1970 *D. sumatrensis* is very rare along the Sagama river (?) (Formerly common here). The total number in Sabah estimated to be less than 100 (MACKINNON, 1970).
- 1971 A few probably survive in the Kinabalu National Park (IUCN, 1971).
1971 *D. sumatrensis* are still found in Kutai (Directorate General of Forestry, 1971).
– GROVES (1971) mentions skulls from Kapan Mts. (2°30'N–115°24'E), Sandakan, Mt. Kinabalu.

## 20. ESTIMATES OF THE WORLD POPULATION

GRZIMEK (1958): The total world population will be not more than 10. In Sarawak 1–2, a handful in Kalimantan, and a few in Sumatra.

SKAFTE (1961): It is impossible to say whether there are two hundred or two thousand left. I would rather use the last figure if I was pressed for an opinion.

Anon. (1962) (Oryx 6): 100–170.

BURTON (1963): Burma 26, Northern Sumatra 20, North Borneo 20–30. The existence in Thailand along the Tenasserim Range on the Thai-Burmese border is certain but no estimate of numbers has been made. They probably exist in several areas in Malaya.

IUCN (1967) (Red Data Book):

| | |
|---|---|
| Thailand Tenasserim border | 6 |
| Cambodia | 10 |
| Borneo | 10 |
| Burma | 20–30 |
| Malaya | 30 |
| North Sumatra | 20 |
| Riau | 25 |
| Sumatra, Lampong | 15 |

SCHAURTE (1968): 150–170.

SCHENKEL and LANG (1969): 50–100.

BASJARUDIN (1971): 80–90 in Indonesia.

## 21. DISTRIBUTION MAPS

A. Maps covering the whole range can be found in:

TALBOT (1960) (copied in a different form by ZISWILER, 1967) – Former and present distribution.

KRUMBIEGEL (1960) – very sketchy. Former and present distribution.

BURTON (1963) – former and present distribution.

GROVES (1967) – based on collecting-localities on museum labels and data by LOCH (1939), SODY (1959) and TALBOT (1960).

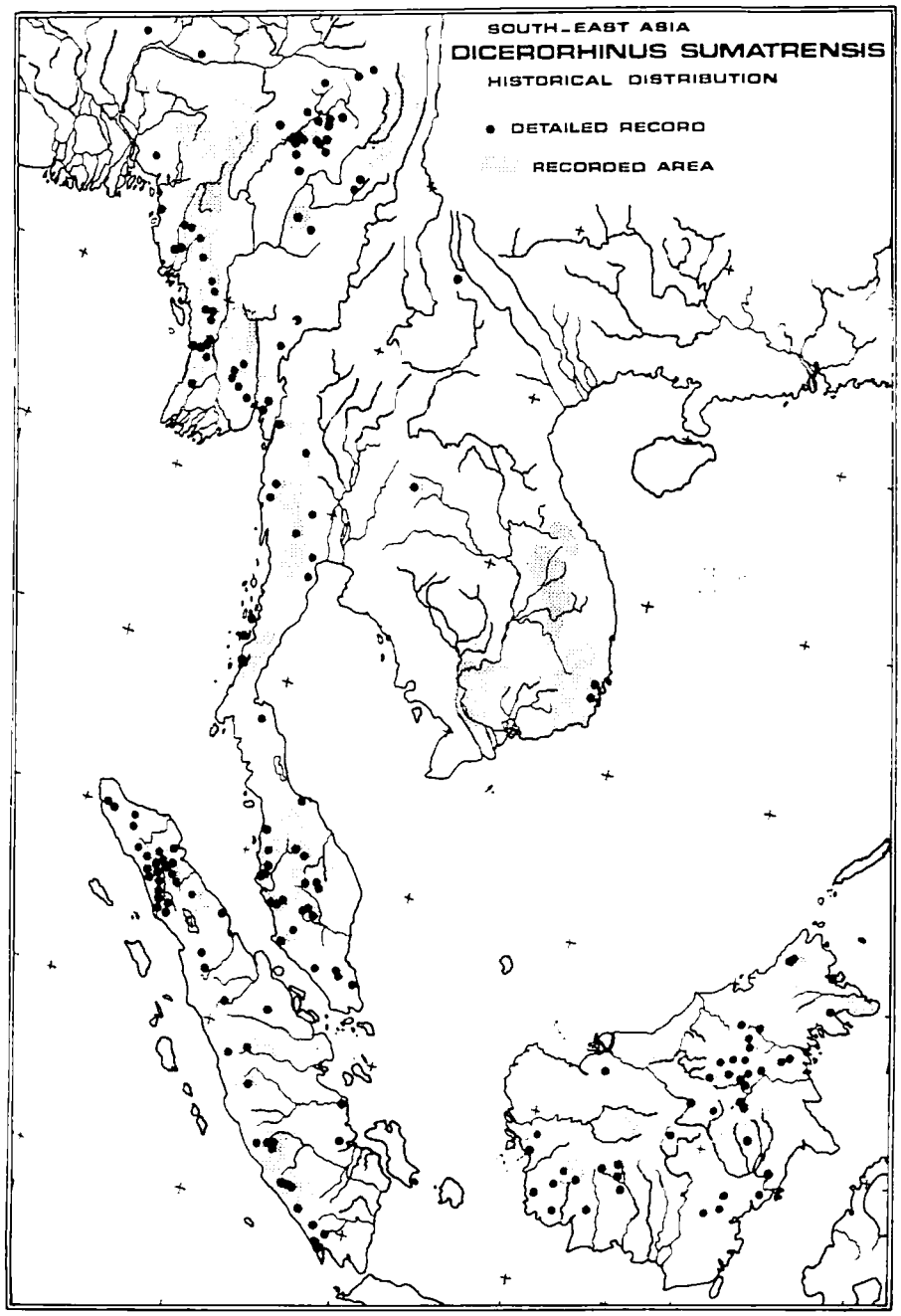
B. Maps covering a part of the range (present distribution) can be found in:

| | |
|---|---|
| Burma: | CHRISTISON (1945) – only the Arakan district. |
| | ANSELL (1947). |
| | BORNER (1971). |
| Thailand: | BORNER (1971). |
| Malaya: | HISLOP (1966). |
| | STEVENS (1968). |
| | BORNER (1971). |
| Sumatra: | KURT (1970) – North Sumatra – Atjeh. |
| | BORNER (1971). |
| Borneo: | ZONDAG (1931) – South and east Borneo. |
| | Anon. (1939) (J. H. WESTERMANN) – South and south-east Borneo. |
| | Anon. (1939) (J. H. WESTERMANN) – East Borneo. |

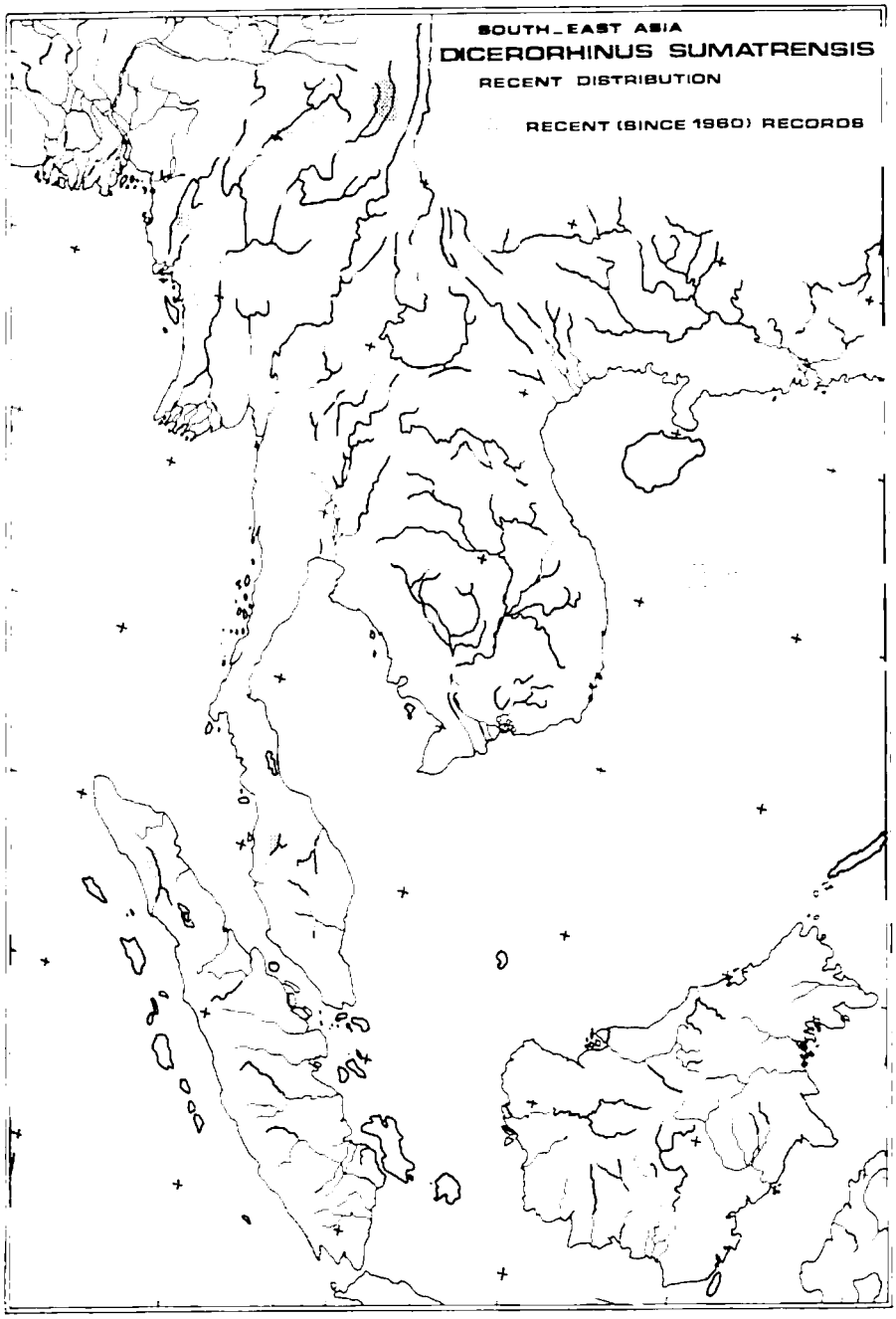
## 22. HISTORICAL AND RECENT DISTRIBUTION

The data written down in the chapters on distribution, estimates of world population and distribution maps are compiled on two maps. On the first map – historical distribution – all known records are figured, as well as the information on the various distribution maps mentioned in the last chapter. Records with a known position are indicated with a black dot (detailed record). When a particular area, a mountain chain, a drainage system etc., was mentioned to harbour *D.sumatrensis* this area is punctated (recorded area).

On the second map – recent distribution – the areas in which *D.sumatrensis* was recorded to survive after 1960 are punctated. This map has to be read with much reservation. From Burma the last records are from 1960 and 1963. It is well thinkable that *D.sumatrensis* is now extinct in most of these areas since there is much doubt about the status of nature conservation in this country. The same applies for Laos, Cambodia and Vietnam. In these formerly French territories only one area, the forests near Da Lat, is indicated. In 1960 *D.sumatrensis* was still supposed to occur there. For Cambodia the IUCN Red Data Book assumes the presence of 10 individuals, but since their residence is unknown and also hardly anything is known about the historical distribution, they are not indicated on the map. It is also very doubtful if any of these rare


SOUTH-EAST ASIA
DICERORHINUS SUMATRENSIS
HISTORICAL DISTRIBUTION
DETAILED RECORD
RECORDED AREA

Map 1


SOUTH-EAST ASIA
DICERORHINUS SUMATRENSIS
RECENT DISTRIBUTION
RECENT (SINCE 1960) RECORDS

Map 2

animals will remain after the past and present troubles in these countries.

The records for Thailand are fortunately of very recent date (1971–1973) and *D. sumatrensis* should still survive in 4 nature reserves. These records can be regarded as reasonably reliable.

In Malaya the presence in the Sungei Dusun Reserve and the Taman Negara National Park is confirmed and the records from Johor and Selangor are also trustworthy.

In Sumatra the occurrence in the Gunung Leuser Reserve is confirmed and the presence in a number of other reserves is very likely. At the moment the distribution in Sumatra is studied by a Swiss zoologist, MARKUS BORNER, and more details will soon be available.

In Borneo a few survive in Sabah and probably also in the Indonesian part (Kutai). The future of the few survivors in the Indonesian part is very dark, some of the area will soon be opened up for logging and the authorities in charge of the Nature Conservation have to solve many problems in this area.

## 23. THE HABITAT

In order to give as clear a picture as possible of the habitat, a number of opinions of people acquainted with the country and the rhinoceros are given below.

CANTOR (1849): A two-horned rhinoceros is stated by the Malayans to inhabit, but rarely to leave the densest jungle (Malaya).

EVANS (1905): They show a decided preference for hilly tracts and even mountainous country. In the hot season they are invariably found in hilly or mountainous country, by no means necessarily well wooded but where shade is sufficient. They rarely range far from the perennial streams in which there are usually numerous pools of cool water and abundant shade. Those streams with rocky and shingly beds are preferred. The feeder streams or gullies are also worth visiting. In the cool weather they may wander a good deal as also during the rains, ranging along the ridges and visiting the head waters of streams. During the rainy season *D. sumatrensis* certainly tour the lower lying country. They do not, I think, remain for any length of time, but come down only in search of particular kinds of fodder not obtainable at other times (Burma).

VOLTZ (1912): In essence an animal of the dense forest (Sumatra).

SHORTRIDGE (1915): They are said to visit the low grounds during the hot season when their drinking pools in the hills have dried up (Burma).

PEACOCK (1931): *D. sumatrensis* spend most of their time in the heaviest forest they can find and only occasionally emerge into the open grass-clad ridges and spurs which are a feature of the Sanctuary at elevations above 1,350 m (Shwe-U-Daung, Burma).

THOM (1935): I have found them on hills up to 1,350 metres. Although the hills are their proper habitat, *D. sumatrensis* occasionally descend to flat coun-

try especially towards the end of the rains, and remain there sometimes for long periods till January and February, when there is still plenty of cover and mud and water to be found everywhere. By March, as a rule, they are all back in high evergreen forest again. They are very rarely seen in the plains, so far as Arakan is concerned, during the hot weather months i.e. from March to June (Burma).

HUBBACK (1939): In the Malay Peninsula *D.sumatrensis* were to be found in many parts of the mountainous country and sometimes in the coast belts. It is now almost entirely a mountain animal due, I think, to having been driven back from the lower lands. They particularly favour the heads of narrow valleys where they generally have well used wallows, plenty of thick undergrowth and nice precipitous sides to the valley to give them plenty of exercise (Malaya).

WEATHERBY, D'ARCY (1940): In lower Burma until the *sondaicus* became extinct both they and the *sumatrensis* lived in the same country. In Malaya, in lower Perak and Northern Selangor, both species were found in the same country though, generally speaking, the *sumatrensis* are fond of the mountains.

MILLER (1942): Scattered about the blangs we saw many shallow clay-lined pools in which he (the pawang) said the rhinos used to wallow (Leuser area, Sumatra).

HARPER (1945) (A.S. VERNAY, in litt. 1933): *D.sumatrensis* live in the remotest and most inaccessible places, in hills that are practically impossible to man, and quite impossible to elephants (Malaya).

FETHERSTONHAUGH (1951): I have personally observed the latter (*D.sumatrensis*) from sea level to over 1.200 meters (Malaya).

SHEBBEARE (1953): Its grazing grounds straggle over a wide area, often following the ridges, for it is far more of a mountaineer and forest dweller than even the Javan rhinoceros. The ridge paths it uses are mostly below 1200 meters (Malaya).

METCALFE (1961): The present habitat of *D.sumatrensis*, namely the inaccessible densely forested mountain ranges is, the writer considers, one that has been forced upon it by insistent poaching in the past and by the natural advances of civilisation. There are various facts to support this belief and it would seem that those animals found in the Bernam Swamp area of Selangor and other similar areas in Johore maybe living in their true habitat. The ability of *D.sumatrensis* to adapt itself to almost any type of country has obviously already played an important role in its continued existence (Malaya).

SKAFTE (1961): Rain seems to influence the movements of the rhinos. When violent torrents flooded the lowlands, the rhinos stayed away from the swamps and remained in the hills where they had enough water for their daily bath. But the drier the forest was, the more traffic moved towards the bathing grounds in the swamps (Riau-Sumatra).

HARRISON (1964): Found tracks up to 3.000 meter (North-Borneo).

STRICKLAND (1967): The rhino's strong preference for characteristically sec-

ondary and fringe plants species give some support to the theory that the rhino is a marginal animal, although in fact the rhino does not appear to be as closely associated with these marginal areas as is the elephant (Malaya).

MACKINNON (1970): The rhinos favour hilly areas in eastern Sabah, and prefer the secondary forest where the upper canopy is broken and the smaller shrubs, canes and vines on which they feed are more numerous (North-Borneo).

KURT (1970): Rhino tracks only found in: the primary and secondary dense forest, the damp moss forest, clearings and young growth surrounded by or in the vicinity of primary forest.

Distribution of rhino areas according to local altitude (KURT 1970).

| Altitude (m) | 0–500 | 500–1.000 | 1,000–1,500 | 1,500–2,000 | above 2,000 |
|---|---|---|---|---|---|
| No. of areas | 7 | 6 | 13 | 5 | 2 |

BORNER (1973): The rhino habitat in the Gunung Leuser area is restricted to primary forest in an altitude of 1000 to 1900 m. In this area primary montane forest is changing to damp moss forest. Natural secondary growth along rivers and on erosion fields are not used by the rhinos.

From the citations mentioned above it is clear that *D. sumatrensis* can live in a wide range of habitats, from the swampy areas at sea-level to high in the mountains (which seldom reach higher than 2,000 meters). What is essential is enough fodder, water and shade. They prefer densely wooded areas but formerly could also be found on more open places. In the rainy season they like to descend to the flat lower-lying country but in the dry, hot season they are found in the evergreen forests on the hills, near the permanent streams. The preference to feed in secondary forest is not surprising in view of the fact that here the amount of fodder within reach is much larger than in primary forest.

The opinion that *D. sumatrensis* are driven by poaching from lower-lying areas in the densely wooded steep mountains is contradicted by the fact that even in the oldest publications, when rhinos were far more numerous, the hill tracts are reported as their true habitats. It is obvious that rhinos living in the more populated and cultivated lowlands will be exterminated faster.

The question whether there is a difference in habitat between *D. sumatrensis* and the largely sympatric *Rhinoceros sondaicus* has never been answered satisfactorily. It is generally accepted that closely related sympatric species will segregate in their habits and will show ecological differentation. For Burma EVANS (1905), SHORTRIDGE (1915), and PEACOCK (1933), state that they live in the same habitat, whereas THOM (1935) says that *R. sondaicus* invariably inhabit the planes and flat country. In Malaya *R. sondaicus* is unanimously said to inhabit the lower-lying country (HARPER, 1945; SHEBBEARE, 1953; METCALFE, 1961). SHORTRIDGE (1915), writes that he was always told in Indonesia that *R. sondaicus* was much more of a mountain animal than *D. sumatrensis*.

GROVES (1967a) makes some very interesting speculation on this subject, called ecological displacement, and makes an attempt to explain the differences in distribution (India-Burma and Indo-China) through differences in habitat.

## 24. HOME RANGE

Although *D. sumatrensis* is a great wanderer, it often seems to stay for some time, if undisturbed, in a particular area. The usual thing for a pair is evidently to frequent a district for a month or so, and then to move on to somewhere else (SHORTRIDGE, 1915). It lives for a week, a month or considerably longer in an area of say 8 to 10 square kilometers, then moves a considerable distance, returning often after three or four moves, to the original locality (WROUGHTON and DAVIDSON, 1918).

It changes feeding grounds generally once every ten or fifteen days. Sometimes, if the locality is a quiet one, and there are plenty of shrubs to browse upon, they remain in one place for nearly a month (THOM, 1935).

STRICKLAND (1967) studied the three rhinos in the Sungei Dusun reserve, Malaya, and mapped their ranges based on the tracks. The ranges of the two larger animals average about 10 square kilometers, and that of the smaller animal slightly less. The ranges overlap considerably. The area where all the ranges overlap appears to be the most favourable, that is, the animals spend the most time there, and it has obviously been used for many years by rhinos.

KURT (1970) found in the Leuser area, Sumatra, tracks of animals living in the same location in areas 3.5 km in diameter in Laudjohar and 2 km in the Mamas mountains. He supposes that the actual home range is larger.

It can be concluded that a *D. sumatrensis* inhabits an area of at least 10 square kilometers and repeatedly changes its feeding ground.

## 25. TRACKS AND WANDERING

HUBBACK (1939) writes on this subject: '*D. sumatrensis* will continually follow the same game trails, especially near wallows or near salt licks. They show an extraordinary obsession for keeping to and following almost the exact paths which generations of rhinos have used. When travelling through the jungle on their ordinary rounds, rhinos move slowly and steadily, covering a great deal of ground during the twenty-four hours. But occasionally finding some particular patch of jungle that it likes, a rhinoceros may hang about in the vicinity for some days'.

STRICKLAND (1967), after studying the three individuals in the Sungei Dusun reserve, Malaya, writes: 'The ranges of the three rhinos overlap considerably. The region where all three ranges overlap has obviously been used for many years by rhinos. The trails are very old and well worn, and the animals seldom deviate from them. The smallest animal often wandered off the main trails. Indeed, it spent much of its time in areas with few or no well-established trails, areas where other tracks were found only rarely. *D. sumatrensis* are capable of covering many miles a day (3 miles in 24 hours if undisturbed, but when disturbed it can cover considerably more). However, on more than one occasion signs at mud wallows, salt licks, feeding and resting areas indicated that less

than a half mile had been covered in a 24 hour period'.

STRICKLAND (1967) concluded that in many respects he did not find the rhino to be as methodical a beast as some authors have made it out to be. Still many of their trails were very well worn and had obviously been used for many years.

HAZEWINKEL (1933) distinguishes two types of paths. The permanent, mostly straight, paths that follow the curve of the terrain and irregular paths, which wind in loops criss-cross through the woods and are formed during the feeding. TALBOT (1960) found that stream beds were the most frequented rhino paths.

METCALFE (1961) found that a *D. sumatrensis* on its wanderings for food covers about three or four miles in a night although on occasions, especially during the season of *Garcinia forbesii*, a relative of the cultivated mangosteen, it will travel much further.

Most authors state that *D. sumatrensis* is a great wanderer. In Sumatra, KURT (1970), was told that bulls are much more nomadic than females with calves. In 1932, a *D. sumatrensis* came over the Uyu area (Burma) into the Nami and Ledan valleys during the cold weather and was seen as far south as the Indaw-Banmauk road. Later it was reported making for Meza Chaung, a distance of 100–150 km (ANSELL, 1947). In 1946, a rhino was first seen in the Kauk-Kwa valley, crossed the Irrawaddy River, Wilatha hills, the Taping River – a feeder of the Irrawaddy – and was shot in the Ma-ubin tract by the Shans (Burma), after covering a distance of about 100 km (U TUN YIN, 1954a).

## 26. SALT LICKS

Like most herbivores, *D. sumatrensis* visits salt licks regularly. The intake of salt water or saline mud is necessary to balance the ion-concentrations, especially Na and K, in the herbivore diet. When large amounts are swallowed it can be useful in cleaning the intestines of parasites. Most of the salt licks visited by rhinos are sulphur springs which are generally situated amongst rocks. They also visit mud-licks which show no exudation of sulphur but probably some trace of sulphur or possibly a saline which attracts them (HUBBACK, 1939). *D. sumatrensis* visits salt licks only once, or at the most twice, a month. They seem to come at the full moon, and at the appearance of the new moon (?). More visits are apparently paid to such licks between the months of December and June than at any other period (THOM, 1935).

STRICKLAND (1967) baited one of the wallows in the Sungei Dusun reserve, Malaya, with salt and was able to note increasing activity i.e. more frequent visits by the rhinos, but they still appeared sporadically. VERBEEK (1883) describes a spring with iron-stained water regularly visited by rhinos in Sumatra.

## 27. FOOD

*D. sumatrensis* is a typical browser, feeding on a large number of different

species, mostly shrubs and trees. Grasses are practically not fed on, except bamboo.

The menu, as far as is recorded, consists of a great number of species (102) of many plant families (44) (See APPENDIX B: List of food plants). It is remarkable that only very few species were recorded by more than one author. It is obvious that it will be possible to find many more food plants.

Of 82 species leaves and twigs were eaten, of 17 species the fruits, of 7 species bark and wood, and of 2 species the flowers. Of the food plants (33 species) reported in the Sungei Dusun Reserve (Malaya) more than half are characteristic of secondary forest or fringe areas (edge of clearings, land slopes, streams and river banks, wind falls etc.) (STRICKLAND, 1967). Also WYCHERLEY (1969) and KURT (1970) report on preference for feeding in secondary vegetation. THOM (1943) states that *D. sumatrensis* generally feeds along steep well wooded valleys and also along the steep banks of well wooded mountain streams. HUBBACK (1939) on the contrary states that *D. sumatrensis* invariably feeds only in virgin forest.

The contents of the stomach of a shot animal consisted of wild mangoes and other fruit, leaves and twigs of a tree not recognised and also twigs and leaves of a species of bamboo (*Melocanna bambusoides* EVANS, 1904). The stomach of another animal contained green vegetable matter and a number of large citrus fruits resembling oranges, merely bitten in half and swallowed (SHORTRIDGE, 1915).

The largest part of the diet consists of leaves, twigs, saplings, small branches of shrubs and trees (HUBBACK, 1939; STRICKLAND, 1967). Trees containing gum or getah are favoured by *D. sumatrensis* and they are very fond of the bitter leaves of the shrub manai (*Urophyllum spp.*), which grows in patches on hill sides (HUBBACK, 1939). The species most frequently fed upon in the Sungei Dusun Reserve were *Endospermum malaccense*, *Maccarenga triloba* and *Xylopia ferruginea* – all notably secondary species (STRICKLAND, 1967). The leaves of the nangka (*Artocarpus integra*) are also a favoured food (HEYNSIUS-VIRULY, 1935). HUBBACK (1939) reports a particular liking for the flowers of the tenglan (*Saraca sp.*).

Fruits fallen or growing within reach form another significant part of the diet. On account of the mostly seasonal occurrence, they from a varying share of the total diet. The principle jungle fruits that they are fond of belong to the genus *Mangifera* as well as the fruit of a tree called Mengelut or Salut (*Payena costata*) which has a thick creamy juice. Also the fruits of the lanjut, *Mangifera lagenifera* (STRICKLAND, 1967) and the bua Kuya, (maybe bua Kuyan – *Citrus medica*) (OTTO, 1903). *Garcinia forbesii* (METCALFE, 1961) are much appreciated.

Occasionally *D. sumatrensis* feed on native fields (ladangs) and they seem to be fond of chillies (ANSELL, 1947). Abandoned ladangs are rather attractive to rhinos (also a form of secondary vegetation) and they show a particular liking for the leaves of pineapples, maize and tjempedah – *Artocarpus integer* (HAZEWINKEL, 1933).

The animals in the Calcutta Zoo appeared to like the jack-fruit leaves (*Artocarpus integer*) best. The best substitutes are the leaves of the gulher (*Ficus glomerata*) and other species of figs (MITRA, 1893; SANYAL, 1892). Another captive animal showed special liking for the fleshy stems of the plantain (*Musa paradisiaca*) and for the small branches of the mango tree (*Mangifera indica*) (ANDERSON, 1873). A young in captivity in Sumatra, was fond of orange leaves (*Citrus aurantium sinensis*) which he liked to dip in a puddle (COENRAAD – UHLIG, 1932).

A surprising plant on the rhino's food list is *Melanorrhoea*. The latex of this plant causes a serious rash or blistering on the human skin and in cases of extreme exposure a high fever and even death may result (STRICKLAND, 1967).

About the eating habits HUBBACK (1939) writes the following. '*D. sumatrensis* obtains most of his food by breaking down small trees and pushing against them with his forehead or chest until the tree is sufficiently bent over to enable him to walk it down by pressing the tree under the belly. Sometimes when the tree is fairly large he puts his forefeet on it to bring more weight into play. He may even hold a tree down by standing on it with his fore-feet. I have often seen the marks of his toe nails on the trees that have been broken down. Having defeated the tree, the rhinoceros proceeds to eat the twigs and small branches. He will move round and round the end of the tree continually altering his position during the process of demolishing the leaves and ends of the branches. A favourite trick of the rhinoceros when feeding is to get a sapling behind his front horn and twist it round and round until it is thoroughly decorticated and covered with mud from the head' (METCALFE (1961) could find no evidence of this sapling twisting).

STRICKLAND (1967), describes the same as follows. 'Young saplings appear to provide the largest portion of their diet, and these are invariably damaged extensively during feeding. In some case the trees are merely bent over or partially broken, but more frequently they are completely snapped off at anywhere from a few centimeters to two meters from the ground. The smaller trees are probably broken by the rhino, but the larger ones are broken by first bending them over and then stepping on them. In some cases the trees are uprooted in the bending process and yet they are still stepped on and broken into smaller units. Many of the young trees that had been eaten had small bits of the bark scraped off about a meter from the ground. In a few cases I found trees that had been scraped in this manner but had not been eaten. I suspect this is one of the ways in which the rhino distinguishes the plant it prefers'.

It is rather generally accepted that *D. sumatrensis* usually feed during the night and the early morning and evening (EVANS, 1905; HAZEWINKEL, 1933; THOM, 1935; METCALFE, 1961). HUBBACK (1939) states that they seem to feed indiscriminately, that is to say, they do not appear to have any regular hours. Also SKAFTE (1961) writes that one of the animals captured in Sumatra and housed there in an enclosure for several weeks, ate both day and night.

## 28. DUNG AND URINE

The droppings consist of round balls, about 9 cm in greatest diameter (MEDWAY, 1969).

In literature it has always been a point of discussion whether *D. sumatrensis* deposit their dung regularly on the same spot, as does the Indian rhinoceros, or not. HUBBACK (1939) has only once on his extensive wanderings seen a place where a rhino had returned to a particular spot to defecate, and STRICKLAND (1967) never found such large dung heaps. According to THOM (1935) they seem to do so when they accidentally cut across their own tracks at a spot where they have previously defecated. EVANS (1905) found occasionally small heaps or mounds, perhaps the droppings of a week, and PEACOCK (1931) found also sometimes quite large dung-heaps in the Shwe-U-Daung sanctuary.

On the other hand there is the statement by METCALFE (1961): 'In normal circumstances the rhino deposits its dung in definite places, and on only one occasion has the writer come across rhino droppings other than at these "deposits".'

Captive animals seem to deposit their dung in a particular place (SKAFTE, 1961; ULLRICH, 1955).

From the foregoing it is clear that the making of large dung heaps is not a fixed habit of *D. sumatrensis*. Returning to the same spot will be largely influenced by the daily wanderings, migrations and disturbance.

On the places where dung is deposited EVANS (1905) writes: 'One habitually finds single droppings on their tracks on the sides of hills, ridges etc., and an abundance of them scattered about in the beds of streams.' TALBOT (1961) found most rhino droppings in the South Sumatra Reserve in the vicinity of wallows, though not in them, but they were also found rather indiscriminately throughout the forest floor. The dung heaps described by METCALFE (1961) were always found on regular routes and situated in shallow streams or on the edge of swamps. The animal in the Copenhagen Zoo invariably defecated in the pool inside the stable (ANDERSON, 1961).

Due to defective or much worn teeth the faeces of an old animal will contain coarse and only partly digested twigs (HUBBACK, 1939).

There is no difference in faeces between the male and the female (HUBBACK, 1939). According to THOM (1943) male and female can be distinguished by the position of the urine with regard to the faeces. In the case of the male the ordure and urine will usually be found on the ground exuded one behind the other, a foot or two apart, at least, whereas in the case of a cow they will be found more or less together scattered over the bushes in the immediate vicinity at heigths of three to four feet.

Both male and female have the habit of squirting the urine backwards. For the male this is the usual way of urinating, the result is that splashes and drops of urine can be seen on leaves of the bush he has passed through, even up to a height of six feet (HUBBACK, 1939). Also females (captive specimens in Calcutta, Basel and Copenhagen) squirt their urine to a great distance, sending it out

behind them nearly 6 meters (ANDERSON, 1872). When the female in the Copenhagen Zoo was on heat, she urinated in short squirts instead of in the usual steady stream (ANDERSON, 1961). The urine of a cow was of a pale pinkish colour (THOM, 1943). O'HARA (1907) writes that the urine is powerful enough to raise blisters on human skin.

The dung of a calf is hardly ever seen. According to a well-known local rhino hunter the mother covers up the dung of the calf with her own dung, and the only way to find the calf's droppings is by moving those of the cow very carefully to see if there are any small-sized faeces underneath (HUBBACK, 1939).

## 29. BATHING AND WALLOWING

One of the most important parts of the daily routine of any *D. sumatrensis* is the bath or wallow. They not only enjoy the cool mud during the heat of the day, or the defence a mud cover gives against flies, but a regular bath is indispensable for their health. When captive animals are not allowed to bath regularly the skin becomes cracked and inflamed. When the young raised by the Datok Rajah was not allowed to take a bath for a week, its skin was cracked in dozens of places and it died shortly afterwards (HUBBACK, 1939). Also the animals in the Copenhagen and Vienna Zoos got broken and inflamed skins due to insufficient bathing facilities. In the Vienna Zoo this probably caused the loss of the hair-cover (ANDERSON, 1961; ANTONIUS, 1937). COENRAAD-UHLIG (1933) nowhere writes about bathing facilities for their young *D. sumatrensis*: this animal got seriously ill, the skin broke and there developed suppurations and eruptions, the eyes were nearly closed, the nails were inflamed and all the hair was lost.

*D. sumatrensis* prefers to take its bath in streams with rocky and shingly beds, and also the feeder streams or gullies are often visited (EVANS, 1905). In the Arakan hills *D. sumatrensis* had their baths in natural pools at the foot of waterfalls (THOM, 1935).

In places where this is possible *D. sumatrensis* makes extensive use of mud baths or wallows. These wallows are very big in size (1.8 to 8 m in diameter) and are mostly surrounded by an open space, where the vegetation has been trampled on, from 10 to 35 m in diameter (KURT, 1970). Wallows are generally situated under a bank, sometimes in a swamp (HUBBACK, 1939). In South Sumatra, TALBOT (1960) found wallows usually on a hill side (2 to 3.5 m long and 0.6–1.5 m broad) and they appeared to be merely enlarged natural depressions.

The animals in the Calcutta Zoo were very active in digging. They loosen the earth with the anterior horn, scraping and throwing it back with the forefeet, sometimes beating the lumps down to convert them into a soft ooze which they so much enjoy (SANYAL, 1892).

Wallows are frequented at odd times but especially during the hot months (THOM, 1935) and once or twice in twenty-four hours, rather more in hot, dry weather (HUBBACK, 1939). During the hot afternoon hours they seem to enjoy

lying in a wallow (METCALFE, 1961). Even animals on the run from hunters frequently find time for a short wallow (HUBBACK, 1939).

## 30. RESTING AND SLEEPING

*D. sumatrensis* is a nocturnal animal, active during the night, early morning and evening. During the heat of the day they prefer to rest (ANDERSON, 1872; EVANS, 1905; HAZEWINKEL, 1933; HUBBACK, 1939; METCALFE, 1961; THOM, 1935). It may be found lying asleep during the day either in a mud wallow or at the foot of some shady tree or bamboo clump in fairly open jungle on top of some ridge, or hill, where it may catch any breeze that may be blowing (EVANS, 1905; THOM, 1935). When they rest, they lie on the side or half on the belly, half on the side (ANDERSON, 1872; HAZEWINKEL, 1933). They are very light sleepers and they are awake in a wink (HAZEWINKEL, 1933).

## 31. INTER-RELATIONS

As a rule *D. sumatrensis* wanders about singly. When two animals are recorded together it will be mother and child or a pair mating. Rather often *D. sumatrensis* is reported to be encountered in pairs. VOLTZ (1912), SHORTRIDGE (1915) and PEACOCK (1931) state that *D. sumatrensis* have generally been known to live in pairs, and SHORTRIDGE (1915) presumes that although they wander about singly, a pair will keep in touch and meet in the course of the night. On the other hand, HAGEN (1890), HAZEWINKEL (1933) and HUBACK (1939) write that it is unusual to find two of them together. HAGEN (1890) writes that a pair does not accept another pair within half an hour going, or even farther. HUBBACK (1939) writes: 'Although at times I have followed fresh tracks which crossed the fresh tracks of another animal I have seldom known them to join up'.

SCHNEIDER (1905) reports a male and a female in a wallow (the female was shot) and THOM (1943) reports also two animals (sex unknown) in a wallow.

In two cases a bull was reported to accompany a cow with a calf. In Burma a cow was shot which had given birth to a young (the udder was full of milk) and after the cow was wounded she charged immediately followed by a, till then unnoticed, bull (EVANS, 1904). When the mother of the calf captured by ULLRICH (1955) was killed, she was accompanied by a bull.

Although the evidence is very inconclusive, there are indications that the bond in a pair is tighter than is generally accepted. In Burma, MACKENZIE has found tracks of 4 *D. sumatrensis* together and a sahib told that he had seen 6 together (WROUGHTON and DAVIDSON, 1918). In Central Borneo, also 4 animals were seen together (MJÖBERG, 1930).

*D. sumatrensis* seem to fight among themselves. LOCH (1957) writes that both males and females have been killed scared all over. HUBBACK (1939) found traces of struggles between two rhinos while a third rhino was nearby. He thinks

that this was a fight between two bulls for the attentions of a cow.

The two females kept in the Vienna Zoo were intolerant for each other. When brought together they always started a furious fight (ANTONIUS, 1937). Concerning other captive animals (London, Calcutta) nothing is written about agression among fellow rhinos.

For the relation between cow and calf see the chapter on reproduction (35).

## 32. RELATIONS WITH OTHER ANIMALS

The only subject written about is the relation with the elephant (*Elephas maximus*). GYLDENSTOLPE (1916) writes that the Thais consider hunting rhinos on elephant-back to be impossible, because the rhino will at once attack the elephant as soon as it gets wind of it. Elephants are also said to be very afraid of the rhinoceros and will run away as soon as the rhino is going to attack. The animal captured near Chittagong in 1868 was dragged with elephants to the town. About the behaviour of these elephants SCLATER (1872a) writes that the elephants at the first sight of the rhinoceros were very much afraid and bolted one and all.

THOM (1935), however, reports the sight of a *D. sumatrensis* and an elephant in the same wallow, within 9 m of each other, and totally ignoring each other. Also EVANS (1905) and STRICKLAND (1967) report the use of the same wallow by elephant and rhino.

## 33. PARASITES AND DISEASES

The regular covering of the body with mud gives a protection to the bites of flies, ticks and leeches. HUBBACK (1939) writes that they are particularly troubled by a large fly (*Tabanus sp.*) and a special tick. In the wallows, HAZEWINKEL (1933), practically always found blood suckers, which certainly spoil much of the pleasures of the mud bath. Most captive animals died of diseases of the lungs (pneumonia), tuberculosis, bronchitis (MITRA, 1893; GARROD, 1878; COENRAAD-UHLIG, 1933). Other causes of death are tetanus (MITRA, 1893) and anaemia (ANDERSON, 1961).

## 34. RELATIONS WITH HUMANS

Although *D. sumatrensis* generally avoids the contact with humans there are several reports of animals that seemed not at all bothered by the presence of humans. HAGEN (1890) reports two cases of rhinos entering a tobacco plantation which showed no intention of leaving again. One animal only walked away after the coolies had put a noose around its neck and the other animal could only be chased away by shooting at it.

THOM (1943), citing the Burma Police Journal, writes the following. 'A *D.sumatrensis* walked into the middle of my camp in the Shwe-U-Daung sanctuary at two o'clock in the afternoon and stopped at a range of 3 meters... and showed no alarm at the sight or scent of human beings.' In the same paper another event in the Kahilu Forest Reserve (Burma) was published. 'It was only after much shouting on my part, at a range of less than ten meters that I was able to induce the rhinoceros to leave its wallow and within five minutes of driving it from the wallow it returned again and resumed its bath.'

About the animal pictured by BAZIN in Perak (1957). ALI and SANTAPAU (1958) write. 'It did not appear to be frightened but just got up from the wallow and slowly walked away regardless of the barking of dogs and chivying by Mr. Bazin's alsatian. The animal is said to have been followed for two hours along a forest road in a jeep at a distance of 10 meters behind. before it turned off into the jungle and disappeared.'

HAZEWINKEL (1933), writes that in forests seldom visited by humans. rhinos are easy to approach and they seem to care little about the presence of men. When captured. *D.sumatrensis* calms down quickly and seems to be comfortable in human company (SKAFTE, 1961; COENRAAD-UHLIG. 1933; ULLRICH. 1955; SCLATER, 1872a).

HUBBACK (1939) writes about a *D.sumatrensis* captured when young and kept for seven years by the Datok Rajah Kiah of Jelebu (Malaya). It foraged in the jungle during the days as it got older. had its own wallows. and returned to the To Raja's house in the evening for a feed of rice. When the rice was ready one of the household would call with a loud and shrill 'Hoh! Hoh!' and the rhino would answer from the jungle and come back at full speed for his evening meal. He slept under the house.

There are also a number of reports of *D.sumatrensis* charging on humans. especially when wounded. In the attack they use more the pointed sharp incisors than the horn (EVANS. 1904. 1905). SCHNEIDER (1905) was charged by a *D.sumatrensis* on Sumatra. The animal ran zigzag, moved its head up and down and rooted up the ground with its horn.

EVANS (1905) writes about a rhino that chased a hunter who managed to climb a tree. but had not got far enough up before the rhino overtook him and was able to give him a bite as well as afford him a hoist up. The Burmans state that in attacking these animals use their incisors freely. also the horn. and finish up by trampling on their adversary.

In Tenasserim. SHORTRIDGE (1915) was bothered twice in one night by a rhino. 'The animal began making a series of short rushes. crashing into trees and altering its direction so often that it was difficult to tell if it was gradually coming our way or not; between each rush it would become quite silent for several minutes, probably listening. and then start off in some new direction. It is astonishing how quietly even a rhino can move when it chooses. as at last without any warning, it suddenly crashed out of a bush almost on top of us. Several hours later when we had turned in for the second time we were awakened in exactly the same manner by a second rhino.'

HAZEWINKEL (1933) states that animals in rut and cows with calves generally are agressive and that among the solitary rhinos only the old males and females are agressive.

BLYTH (1862) writes about an attack on Prof. OLDHAM's camp in Burma. This animal seemed to be specially attracted by the camp-fire, thus giving support to the belief of fire-eating by rhinos. (See chapter on native tales: 39).

The above mentioned case of indifference or agression towards human beings are only exceptions. Generally *D. sumatrensis* avoid men and when disturbed tend to retreat over a great distance. When disturbed they set off at a smart gallop, making a great deal of noise by rushing through all minor obstructions. They usually travel a long distance, often in a straight line, and keep a sharp look-out (EVANS, 1905; THOM, 1935; HUBBACK, 1939). They are as anxious to preserve a whole hide as most other beasts. They are astonishingly agile (EVANS, 1905).

Very seldom *D. sumatrensis* is reported to cause damage to local crops. ANSELL (1947) reports of a little damage done on the fields near the Kahilu Reserve (Burma) in 1934. COENRAAD-UHLIG (1933) writes that a cow (killed) with young did much damage to the rice crop in Atjeh and THOM (1935) mentions an animal that descended from the hills and ravaged for several nights in succession a sugar cane plantation on the banks of the Kaladan river in Arakan (Burma).

The hunting of *D. sumatrensis* is dealt with in a separate chapter (37).

## 35. REPRODUCTION

The knowledge of the reproductive biology of D. sumatrensis is very incomplete. All authors agree that they are slow breeders and have only one calf at a time.

The only feature known to be connected with rut is the squirting of urine (see chapter 28). HUBBACK (1939) found indications of two males fighting for the favours of a female. BRASSER (1926) writes that August is in the middle of the rutting season. In July 1933, a forester reported that he had seen two rhinos mating in Burma (ANSELL, 1947). The supposed mating which resulted in the birth of a young aboard the steamship 'Orchis' in 1872 took place in May (BARTLETT, 1873). This is also the only indication concerning the gestation period. The mating, reported by the catchers of the cow, occurred about 7 months before the birth of the young. When correct a gestation period of 7 months is surprisingly short for a rhinoceros; the other species all have gestation periods of 14 to 19 months (WALKER, 1964). Probably based on the dimension of *D. sumatrensis* and compared with other rhinos, BURTON (1962) estimates the gestation period at 510–550 days, but he does not tell that it is only an estimate. In this connection it is useful to say that the gestation period of the *Hippopotamus* (not allied but also heavy-weighted) is also only 227–240 days (WALKER, 1964).

THOM (1943) writes that *D. sumatrensis* begins to breed at about 20 years of age.

There are a few indications that the sex-ratio is biased in favour of the females. RYTHNER and SKAFTE have caught in Central Sumatra 9 females and only one male (ANDERSON, 1961). Among the animals living in captivity there were 22 females and only 9 males (see chapter 36). Of the killed animals the sex is generally not known, there were only 4 females and 3 males (see chapter 19).

In 1889 a calf was born in the Calcutta Zoo. The evening before the mother refused to eat and was restless. Early next-morning, she was in acute labour pain, very restless, and after intense suffering of nearly an hour, she suddenly got up and the young one was born. The mother took no more notice of the young one. After about an hour and a half, and not until after several ineffective attempts to get up, the young animal at last got up and began to look for nourishment, but evidently did not know where to find it. It was weak and very unsteady in its movements, and could not walk three yards without tumbling. During the course of the night the young began sucking the mother, and henceforth there was no necessity for artificial nourishment (SANYAL, 1892).

Another calf was born in 1873 abroad the steamship 'Orchis' (7th December). After the young was born, the mother turned her head toward the young one and with her teeth bit or severed the connecting band. As soon as the young had sucked sufficiently it walked away from its mother and entered a dark corner in a box provided for it and lay down to sleep (BARTLETT, 1873). The last mentioned observation led BARTLETT (1873) to the thought that in a wild state the young would be left by the mother while she roamed about in search of food, returning to suckle the young at the proper time. This will probably only happen in the very first days of life (this young died after 2 weeks). There are three cases known of calves found in the immediate surrounding of a shot cow (COENRAAD-UHLIG, 1933; ULLRICH, 1955; HUBBACK, 1939). In one case the young could not be found but it is suggested that this calf was killed by a tiger as the cow was severily bitten in one hindleg (EVANS, 1904).

The milk is thin and watery, of a bluish colour, has a very pronounced saline taste, but no markedly distinct odour (EVANS, 1904).

About the period a calf follows its mother HUBBACK (1939) writes: 'Apparently the calf runs with the mother until nearly fullgrown. The evidence that I have on the latter point is not very convincing and taken cumulatively it does seem to point to slow maturity and long association with the parent. D'ARCY WEATHERBY (1940) writes that the greatest living expert on the subject (HUBBACK?) believes that the period of following the mother will be about six years.

The calf seems to follow the cow very closely (HUBBACK, 1939) and is said to be directed by the mother with the horn (COENRAAD-UHLIG, 1933). The calf of COENRAAD-UHLIG (1933) did not respond to calls but reacted very well on a small prod with a stick.

All authors stress the scarcity of tracks and other evidence of calves. People like HUBBACK and THOM, who spent years in the forest tracking rhinos, only very occasionally found spoor of calves. THOM (1943) found only once in about

50 years tracks of a young and HUBBACK (1939) was once very close to a mother with young and sometimes came across their tracks.

Also other authors like EVANS (1905), ANSELL (1947), U TUN YIN (1954, 1954b) and METCALFE (1961), only very sporadically found evidence of calves. This scarcity can partly be due to the obscurity of the tracks of young rhinos. HUBBACK (1939) writes that he has frequently seen tracks of a rhinoceros following a larger one and he suggests that they were mother and calf and that the calf was no longer extremely young.

Although propagation will be not such a rarity as would appear from the records of calves it is clear that *D. sumatrensis* is a slow-breeding animal. If the gravidation period is about one year and a half and the young follows its mother for a number of years, in which period no new calf is born, the propagation is very low. Together with a very low density and an ill-defined breeding season (at least nothing is known about this and about the rut) the chance for a fertile union is very small. It will be understood that this is extremely important for the survival of the species.

## 36. ANIMALS IN CAPTIVITY

In 1960, R. J. REYNOLDS published a summary of the animals held in captivity by zoos, circuses etc., in the International Zoo Yearbook II. There have been fifty-five individual animals in captivity, of which seven of the form *lasiotis*. Among the animals of which the sex is known, 22 were females and 9 males. The Zoological Society of London (London Zoo) holds the record for the number of specimens exhibited, having shown six *sumatrensis* and two *lasiotis*. Most *D. sumatrensis* were brought into captivity around the turn of the century.

Once a young was bred and born in captivity: Calcutta 1889. There have been two captive births of females, bred in the jungle, in 1872 aboard the steamer 'Orchis' and in 1895 in Calcutta.

The longevity record is held by a female (*lasiotis*) having lived in captivity a total of thirty-two years and some eight months. The second is a male (*lasiotis*) living for a total of twenty-five years and 7 months in captivity. The longevity of 19 captive specimens is known, ranging from less than a month to over thirty-two years and is on average a little more than 5 years.

A few additions can be made to the above-mentioned paper by REYNOLDS. The three animals in 1960 still on exhibition in Bogor (Java), Basel and Copenhagen, have died since. The animals in Bogor and Basel died in 1961 (ANDERSON, 1961) and the animal in Copenhagen died in February 1972 (CAVE and WINGSTRAND, 1972). At the moment there is no specimen in captivity.

SCLATER (1872b) writes about a female that arrived about 1868 in the zoological gardens of Hamburg. If correct this would be the first animal brought alive to Europe.

## 3. HUNTING

*D. sumatrensis* has never been intensively hunted by European 'sportsmen'. Only some very determined hunters made this species their main hunting object. They were too scarse and lived in too difficult a country to be obtainable for the average hunter. On the other hand the trophy was much esteemed and many chance encounters ended with a delivery to the taxidermist.

The serious reduction of the numbers or even the extermination in the largest part of the former area is caused by the ruthless persecution of indigenous hunters. This practice is caused by the widespread belief in the medical and magical powers of parts of these animals, especially the horn (see next chapter). Long before the arrival of Europeans, rhinos were exterminated in China and probably already much reduced in numbers in Indo-China. The opening up of large areas and the rapid population growth have certainly increased the native hunting pressure.

Most indigenous hunting is done with traps and not with fire-arms. The various ways of capture are described below. The most widely used trap is the pit fall. This method is reported form Malaya (O'HARA, 1902; HUBBACK, 1939; WRAY, 1906) and Sumatra (MÜLLER and SCHLEGEL, 1844; BÜNNEMEYER, 1921; BRASSER, 1926).

A pit fall is built on a track, preferably near a salt-lick. Often all paths leading to a lick are trapped in this way. HUBBACK (1939) once found 18 pits around one salt-lick. In general two types of pits are used. In places where the soil is firm enough it is so constructed that the sides slope slightly. When a rhinoceros falls into it he is wedged between the sides of the pit and thus kept from reaching the bottom with its feet (HUBBACK, 1939). In Atjeh (North Sumatra) such a pit is 2.5 by 1 meter and almost 2 meter deep (BRASSER, 1926). BÜNNEMEYER (1921) reports in central Sumatra pit falls about 160 cm long, 75 cm wide and about 2 meter deep. At the bottom the width is only 30 cm (maybe these are tapir falls; these dimensions are a little small for a rhinoceros). The other type has vertical walls lined with hard wood. In the Dindings (Malaya) such a pit measured 240 cm in length, 120 cm in width and 180 cm in depth (O'HARA, 1907). Another pit, also in the Dindings, was much larger, 315 cm long, 135 cm wide, and 255 cm deep (WRAY, 1906). The opening of the pit is covered with twigs and stems. On this cover a layer of loose earth is put and brought to the same level as the ground surface. The surplus earth is carried away for some distance, in order to remove the scent (HUBBACK, 1939; O'HARA, 1907).

At the construction of a pit in the Dindings (Malaya) a part of the excavated earth was used for building two small 'bunds' which ran parallel with one another for a distance of a couple of meters from the edge of the pit towards the direction from which the rhinoceros was expected (O'HARA, 1907). BRASSER (1926) writes that in Atjeh (N.Sumatra) firm sticks with fire-hardened points are placed on the bottom of a pit fall. Another widely used trap is a weighted spear hanging over a trail and released by a trigger mechanism over the path. This kind of trap is reported in Burma (BLYTH, 1862) and Sumatra (OTTO, 1907;

KREEMER, 1923; KURT, 1970). The spear is made of wood or iron and is weighted with earth, wrapped in a large bundle of leaves (OTTO, 1907) or a large log (KURT, 1970). The whole is attached to a horizontal pole fixed between two trees some 15 meters above the ground. The wooden spear is loosely attached to the lower end of this log. The trigger mechanism works as follows: when the animal touches a rotan wire stretched between two sticks and connected to a rotan ring, the ring is pulled down over the wooden stick holding the vertical spear-log in place. The log falls immediately so that the spear is driven into the back of the rhino (KURT, 1970). SCHENKEL and SCHENKEL (1969) report the use of poisoned spear falls in the Leuser area (Atjeh, Sumatra).

Pit falls and spear falls are only inspected with long intervals in order to disturb the area as little as possible. Since the main interest is the horn and the hooves the victim is often simply starved and left to rot (HOOGERWERF, 1939; HUBBACK, 1939). The use of this type of trap very soon exterminates all the animals from the area, since no animal escapes when every suitable place is provided with a pit or spear (HUBBACK, 1939).

Other hunting methods are used more locally. THOM (1935) writes that in the Arakan hills (Burma) *D. sumatrensis* are speared in their wallows during the heat of the day. HUBBACK (1939) mentions the use of shooting platforms in Malaya and once he has found a fence that covered each game trail into a lick and a spring bamboo spear placed so as to command a small opening left in each piece of fence.

P. VITRY (1936– in HARPER, 1945) writes that in South Vietnam (Southern Annam) hunters drove the animals down to the sea. The Battas (Bataks?) of Sumatra stalk the animal and shoot a finger long bullet between its ribs. If the animal is not killed at once, one hunter tries to come in front of the victim and to draw his attention while the other one creeps behind it and cuts with a sharp knife the Achilles sinew (v. BALEN, 1915).

MILLER (1942) writes that he was told by a native hunter (pawang) that years ago the forest on the south side of Gunung Leuser (Atjeh, Sumatra) was set on fire to drive the animals down the valley. In Riau (Sumatra) the native hunters are said to use a sling of steel wire which automatically laced the snout of the rhino just above its horn (SKAFTE, 1961). Another method used in Atjeh (Sumatra) is the placing of knives on rhino paths, preferably on steep slopes, with the purpose of ripping open the belly of the passing animal (KREEMER, 1923; COOMANS DE RUITER, 1948).

In Borneo the Punans and Ukits hunt *D. sumatrensis* with blow-pipes. They follow the trail without a sound and blow poisoned darts at the most vulnerable points of the animal. They may follow one and the same animal for weeks without giving up the pursuit, until they have secured a suitable opportunity to use their blow-pipe (MJÖBERG, 1930; BANKS, 1931). The Dajaks in Borneo hunt mostly with a spear. The persecution can last for weeks or even months (WITKAMP, 1932).

WRAY (1906) and O'HARA (1907) both describe a live capture of a *D. sumatrensis* in the Dindings (Malaya). The animals were caught in a pit fall and were

tamed by a little starvation. A stockage was built around the pit and the pit gradually filled up with earth so that the rhino could climb out. One animal was manoeuvered into a cage which was afterwards fixed on the back of the animal so that it carried its own cage. With six men this animal was directed to the river for further transport by boat. The other animal was guided to the river with ropes held by twenty men.

In the past, when rhinos were far more abundant, the hunting and the trade of rhino horns and other parts was economically rather important. Until 1928, there even was a special customs duty on rhinoceros horns in Thailand (LOCH, 1937).

About the native hunting in Burma, ALI (1927) writes that professional Siamese hunters, presumably having exterminated the rhinos in their own country, formed themselves into small roving bands and crossed over into British territory in the Mergui and Tavoy Districts of lower Burma, and carried on the slaughter.

The numbers reported to be illicitly killed in Burma are:

| | | |
|---|---|---|
| 1929/30 | – | 2 (ANSELL, 1947) |
| 1930/31 | – | 4 |
| 1931/32 | – | 2 |
| 1932/33 | – | 2 |
| 1935/36 | – | 1 |

Between 1940 and 1959 at least 17 animals were killed in the Shwe-U-Daung sanctuary, of which 10 were killed by one person (ALI and SANTAPAU, 1960; MILTON, 1961). TALBOT (1960) writes that in recent years several rhinos have been killed with official permits by high Burmese officials for medical purposes.

For Thailand no data on the extent of the hunting are known but LEKAGUL (1965) reports that during the past few years, Karen hunters have yearly offered horns and other parts of carcasses for sale on the market of Kanchanaburi. And even in 1972 MCNEELY and CRONIN found horns or parts thereof in every of the 25 Chinese druggists they visited.

WRAY 1906 writes that in the Dindings (Malaya) the capture and export of rhinos has been, in the past, quite a regular trade. It is said by the local Malayans that some fifty of these animals have been caught here altogether. Between 1945 and 1960 there are three recorded incidents of animals being killed or caught in Malaya (METCALFE, 1961).

Also in Sumatra and Borneo *D. sumatrensis* have been extensively hunted. DAMMERMAN (1929) gives an account of the amount (kgs) of horns exported from the former East Indies. The principal port of export was Tandjoengselor in East Borneo. They mostly went to Singapore and a small quantity directly to China.

| Year | Kg's exported from Sumatra and Borneo (DAMMERMAN, 1929). (in brackets the figures for Borneo - Anon., 1939) |
|---|---|
| 1918 | (27) |
| 1919 | 49 (39) |
| 1920 | 70 (67) |
| 1921 | 38 (38) |
| 1922 | 68 (66) |
| 1923 | 31 (–) |
| 1924 | 24 |
| 1925 | 16 |
| 1926 | 22 |
| 1927 | 26 |
| Total | 344 kg |

It is difficult to say how many animals had to lose their lives to produce such an amount of horn. Since this is only the amount registered to be exported and does not include the horns used for local 'consumption' and unregistered export it is clear that in these 10 years hundreds of animals were killed.

HOOGERWERF (1939) writes that formerly every year 5 to 8 rhino horns were brought to the market in Blangkedjeren and Kutatjane. MILTON (1964) states that between 1942 and 1959 at least twenty had been shot or trapped in Atjeh (Sumatra) and KURT (1970) was informed that since 1968 *D. sumatrensis* was hunted in 3 areas and since 1955 in 9 areas. Each year 2 or 3 animals were killed in the Leuser area.

The hunting in Borneo has been carried out mainly for the export, the local use was very restricted (HARRISSON, 1956). HARRISSON lists the numbers killed near Marudi (Baram, Sarawak). This was only one of the collecting stations in Sarawak, the others were Lawas, Limbang, Belaga, Sibu, Kapit, Kanowit and Brintulu.

| Year | Number killed near Marudi |
|---|---|
| 1925 | 18 |
| 1926 | 14 |
| 1927 | 8 |
| 1928 | 12 |
| 1929 | 11 |
| 1930 | 12 |
| 1931 | 4 |
| Total | 79 |

BANKS (1931) writes that not so long ago 36 horns were brought in Belanga in two years and that he has met men who have claimed to have shot over 30 in the course of their life time.

## 38. USE OF RHINO PRODUCTS

Since the supposed medical and magical powers of almost any part of the rhinoceros have caused the ruthless persecution to almost vanishing point of *D. sumatrensis* much attention will be paid to this subject.

As food the *D. sumatrensis* is of little importance, only the Battas (Bataks?), Gajos and Kubus on Sumatra are reported to eat the meat (HAGEN, 1898; COLLET, 1925; HOOGERWERF and VAN STEENIS, 1936). The meat has a very good taste, at least as good as beef, and is very soft, and also the liver is said to be very good (EVANS, 1905; THOM, 1935; SHORTRIDGE, 1915). The skin, roasted like pork cracknel, is considered a great delicacy (HUBBACK, 1939). The Chinese in Sumatra are reported to be very fond of the cooked green contents of the stomach (SCHNEIDER, 1905).

The main use of parts of *D. sumatrensis* is as medicine, against all kinds of ailments and for the detection of poison, as antidote and as aphrodisiacum. These uses are widespread in Asia but formerly also in Europ credence was given to the powers of rhinoceros horn. In South-east Asia almost every race or tribe, from Arabia to China, cherish the powers of the rhinoceros products. China and the Chinese elsewhere are the main consumers of this druggistry, with Singapore acting as the main collection point for horns (TALBOT, 1960).

The horn is the part to which the greatest power is attributed to. The horn of a *Rhinoceros sondicus* has a much greater value than one of *D. sumatrensis* on Sumatra (HAZEWINKEL, 1933). Imported horns from Africa are less valued than the Asiatic horns (TALBOT, 1960). In Malaya the best horn is from the freshly killed male animal. The steamed material used for cups is considered useless, and horns which have been shed (?) are considered inferior. There are two kinds: black and white, the black is superior. The top has most virtue, and horns from females, sick, twin (?) or dry-skinned (?) animals are not used (HARRISON, 1966). In Burma the Kachins believe the posterior horn alone to be efficacious: the anterior horn is only a protection to the posterior horn and is of no value to Kachins (U TUN YIN, 1954a). Indonesians recognise 3 kinds of horn, red, white and black. Black horns are the most common and the least valuable, white next and red most prized (TALBOT, 1960).

The horn is used in small pieces or powdered, mostly in combination with other products. Also knife handles, buttons, belt plaques and amulets are carved from rhinoceros horn, but mostly cups are made from it (TALBOT, 1960). Mainly in China, but also in other parts of Asia and even in Europe, small cups (libation cups) were cut from a horn. This custom seems to have died out some time ago, probably due to a shortage of horns (HARRISSON, 1956). The main purpose of a rhino cup was protection against poison. When a poisoned drink is poured into a rhino cup it will bubble, discolour or became harmless, or the cup will slowly disintegrate and shatter (TALBOT, 1960). This belief is found almost anywhere in Southern Asia and even in Europe. The belief in the virtues of rhinoceros horn persisted in Europe to the end of the 18th century and they were used by monarchs and popes (PRATER, 1939; TALBOT, 1960).

HUBBACK (1939) cites a certain THURNBERG who has experimented somewhere around 1800 with a number of cups and all kinds of poisons but could not find the slightest reaction.

In Burma it is believed that when shavings of rhino horn are put in a cup containing poison it will bubble and smoke, and in Sumatra mixtures containing horn-shavings are drunk as a purgative (TALBOT, 1960). Rhinoceros horn is said to be effective against snake-bites; a little piece is put on the wound (KREEMER, 1915; HEYNSIUS-VIRULY, 1935). A deep seated thorn can be extracted by rubbing the sore part with rhinoceros horn and a severe stomach ache or any other ache can be relieved immediately by the application of a rhino's horn to the affected place (HUBBACK, 1939).

The scraped or powdered horn, mixed with water, coconut oil or other solvents is considered a very potent afrodisiacum and a medicine against all kinds of diseases. The most widespread is the belief in the potency stimulating powers of rhinoceros horn and there seems to be a great demand for such products. A potion containing rhinoceros horn is effective against devils, evil spirits, miasmas, hallucinations, bewitching, nightmares, infantile convulsions, dysentery, tuberculosis, lepra, cancer, typhoid, headaches, infections, feverish colds, carbuncles, intermittent fevers with delirium, vomiting, food poisoning, arthritis, melancholia, loss of voice, heamathosis, epistaxis, rectal bleeding and smallpox. It has also powers to cool a fever-racked body, to expel fear and anxiety, calm the liver, clear the vision, remove a thorn, ease childbirth, shrink lumps, and close cuts. It is an antipyretic and dissolves phlegm, soothes irritations and causes broken bones to heal properly. Continuously administered it lightens the body and makes one very robust (HAZEWINKEL, 1933; MEDWAY and BALASINGAN, 1968; FOENANDER, 1944; TALBOT, 1960, HARRISON, 1966).

Apart from the horn almost any part, even urine and dung, are used as medicine. Fresh or dried blood is much valued and the first thing done after killing a rhinoceros is to plug any bullet hole in order to save as much blood as possible (EVANS, 1905). When killed the animal is turned on its back with its feet in the air. The viscera are carefully removed so as not to lose any of the precious fluids, and all the blood etc., which flow down into the body cavity are scooped out and collected in hollow bamboos, or in the guts of the animal in the form of sausages, and smoke-dried (ALI, 1927; EVANS, 1905) or soaked up in paper (HUBBACK, 1939). The blood is believed to possess tonic and aphrodisiac properties (ALI, 1927). In Nepal rhinoceros blood is efficacious to the dying as it is believed to ensure for the soul both a peaceful departure and a happy release on the other side (PRATER, 1939). THOM (1935) writes that blood is especially valuable if drawn straight from the heart.

In 1952 a rhino was shot in the Shwe-U-Daung sanctuary (Burma) under a special permit issued to the Maha Devi of Mong Mit for medical purposes. A physician prescribed the Maha Devi to take a rhino blood bath (U TUN YIN, 1954a).

Ground dried skin and molar teeth are effective against fevers (FOENANDER, 1944; HOBLEY, 1931), and the cutting teeth are valued as amulet (BRASSER,

1928). In Borneo a tail hung up in a room assures a woman of having no pain at delivery and the penis has a special place of respect among many Borneans (HARRISSON, 1956). Also flesh, bones and hairs and nails are valued, but no specific uses are mentioned for these parts.

The dried dung boiled and the brew drunk cools a fever-racked body (FOENANDER, 1944) and the urine is used against rheumatism, and taken by a bad dropsy patient it has an immediate effect and soon the bloated swellings will be reduced (FOENANDER, 1944; O'HARA, 1907). In Nepal the urine is considered antiseptic, and hung in a vessel at the principal door as a charm against ghosts, evil spirits and diseases (PRATER, 1939).

BLYTH (1867) writes that in that time in Bangkok the scraped horn and the coagulated blood of the animal are considered remedies in various diseases, but the effluvia are dangerous to the health and are almost sure to give cholera.

The belief in the powers of rhino products is already very old. PHILOSTRATUS, describing the travels to India of APOLLONIUS in the first century, mentions already the qualities of a rhinoceros cup (PRATER, 1939). HARRISSON (1956) writes that there is ample proof of intensive direct Borneo trade in rhinoceros horns with the mainland more than a thousand years ago.

The scarcity of these products has stimulated the production of forged rhinoceros horns, mostly made of buffalo horns (ALFRED, 1961; HOOGERWERF, 1970; HOOIJER, 1960; HUBBACK, 1939).

Even in the old days, when *D. sumatrensis* was far more numerous than now, rhinoceros products were hard to get and high priced. This scarcity must have stimulated the belief in the medical powers. EVANS (1905) writes about this: 'I expect their fictitious powers are derived from the fact that, like the milk of a tigress or the liver of a crocodile and such other materials, they are not easily get-at-able nor always at hand to include in prescriptions. The local doctor, in the event of his patient doing badly, can always save his reputation by claiming if he had some of these potent remedies he could effect a cure.'

The rhinoceros has inherited many of the vaunted virtues of the Unicorn. Among them its weakness in the presence of virgins and the efficacy of its horn against poison (PRATER, 1939). More details on this subject can be found in PRATER (1939) and KREEMER (1915).

The great demand and the scarcity have forced up the prices of rhinoceros products. Especially Chinese are said to pay almost any price for a horn and the hunters can be sure to be able to live for months or even years on the revenue of one rhinoceros.

In Burma 50 Rs (rupiah) or 5 pounds were paid for a good horn in 1862 (BLYTH, 1862). In 1918 as much as 400–1000 Rs were paid for a horn (WROUGHTON and DAVIDSON, 1918). In those years, its weight in gold was paid in Laos (GYLDENSTOLPE, 1914). About 1930 a horn would fetch about 1,000 Rs (ALI, 1927; SHEBBEARE, 1935). In 1960 the Kachin state ministry estimated the value of a whole dead rhino to a northern hill tribe as $900; and in Saigon a large horn is worth $2,000 (TALBOT, 1960). In Bangkok the price was $60 per ounce (28 gram) in 1972 (MCNEELY and CRONIN, 1972).

In Malaya a horn was worth 300–400 Malayan $ in 1937 (COMYN-PLATT, 1937). HUBBACK (1939) mentions a price of $10 or more per ounce (28 gram). In 1960 the price was $105–$210 per inch (2.5 cm) (ALI and SANTAPAU, 1960) and in 1968 Mal.$350 per ounce (28 gram) (MEDWAY and BALASINGAN, 1968).

In Sumatra MÜLLER and SCHLEGEL in 1844 paid 60 guilders for a whole rhinoceros. In 1905 a horn was worth 50–70 guilders (SCHNEIDER, 1905). About 1920 it was valued at 200–400 guilders per kg (DAMMERMAN, 1929). HAZEWINKEL (1932) got 4.000 guilders for the horn of a *Rhinoceros sondaicus* and writes that for the horn of a *D.sumatrensis* at most one tenth of this price is paid. In 1939, 250 guilders were paid for 612 grams of powdered horn (MILLER, 1942). In 1960 a new American car was offered for a dead rhino in Palembang and $2,500 in Telukbetung (TALBOT, 1960). In 1961 in Atjeh 9,000–42,000 rupiah ($1=44 rupiah, black market about 1000 rupiah) was offered for an ounce of horn (MILTON, 1961). In 1970, 80.000 rupiah per ounce was offered to a rhino hunter (KURT, 1970).

In 1933 dried blood in Burma was valued at its own weight in silver (PEACOCK, 1933); and in 1960 blood was worth $2 per ounce fresh and dried (ALI and SANTAPAU, 1960). In 1968 in Malaya dried rhino blood could be sold at 45 dollars an ounce (28 gram) (MEDWAY and BALASINGAN, 1968), and in 1972 in Bangkok fresh blood was worth $65 per kg, and dried blood $75 per kg (MCNEELY and CRONIN, 1972).

Bones were sold at about $6 per kg and skin at about $12 per kg both in Burma in 1960 and in Bangkok in 1972 (ALI and SANTAPAU, 1960; MCNEELY and CRONIN 1972). Teeth were sold in 1972 at $25 a piece in Bangkok (MCNEELY and CRONIN, 1972). Regarding the economic situation in these countries and the fancy prices paid for dead rhinos it is easy to understand that the hunters will take any risk.

This chapter is extracted from the literature dealing with *D.sumatrensis*, but these uses are not restricted to this species. Although not always equally valued parts of all kinds of rhinoceros, even the African species, are used.

In the literature dealing with the other Asiatic rhinos, comparable and also other virtues of rhino products are recorded, which can be equally referred to parts of *D.sumatrensis*. These references are not included in this study. They are extensively summarized by HOOGERWERF (1970).

## 39. INDIGENOUS TALES ON RHINOS

A significant part of the data written down in this paper, especially those on distribution and habits, are derived from local information. It is often not clear what are the author's experiences and what is more or less taken over from the local people. There are a number of native stories on the habits of rhinos which one need not to believe but which are interesting, and there could be a nucleus of truth in some of them.

Quite often the fire-eating habits of rhinos believed by the Burmese (Karen,

Kachin) are mentioned (EVANS, 1905; U TUN YIN, 1956; BLYTH, 1862). Rhinos, especially *D. sumatrensis*, are said to be attracted by campfires or smoke. Whenever it sees a fire it runs up and tramples and devours it, causing a lot of damage and panic in the camp. F. MASON (1882 - U TUN YIN, 1956) writes that the Karens state that this fire-eating rhinoceros is a different kind and that it also approaches horses instead of fleeing from them.

Other Burmese stories concern the slow rate of increase. Female rhinos are said to be fond of tossing large branches or small logs which come in their way and this sometimes injures the young calf at heel (REYNOLDS, 1954). A related story says that the scarcity of rhinos is largely due to the mother's brutal treatment of frequently tossing their young over their backs (ANSELL, 1947).

In the neighbourhood of the Shwe-U-Daung sanctuary, Burma, there is a legend that the best time to come across rhinos is during the full moon of Waso (July) when they usually congregrate together (U TUN YIN, 1954). Burman hunters believe that all big game are more agressive when the moon is on the increase and nearly full (THOM, 1943). The Karens in Burma believe that it is a bad omen to kill a rhinoceros, as doing so will result either in the death of some member of one's family or in crop failure, or similar retribution. However, this does not prevent the Karens from hunting the rhinos (ANSELL, 1947).

HARRISSON (1966) mentions some accounts from Malaya concerning the horn. Some say that the horn is hollow and that the animal can breath air or squirt water through it; others say that it sheds its horn each year and buries it in the ground. If this horn is carefully replaced by wooden imitations three times, the animal will continue to plant its horn there year after year. Also in Sumatra it is believed that rhinos shed their horns (ULLRICH, 1955). Another method of collecting was to rig up a fence of rotting wood; the animal likes to lean against fences, the fence breaks, the animal falls down, cannot get up quickly and is easily killed.

In Borneo it is said that when *D. sumatrensis* has deposited its excrements in a stream it turns round and eats the stupefied fish that come to the surface. It is also said that they snore loudly when asleep and thus sometimes betray themselves to hunters (BANKS, 1931).

## 40. PROTECTION AND CONSERVATION

### 40.1. INDIA AND BANGLADESH

*D. sumatrensis* is supposed to be extinct.

### 40.2. BURMA

*D. sumatrensis* is protected under the Burma Wild Life Protection Act 1936 (Section 6). These rules came into force on the 11th January 1941 (U TUN YIN, 1954c). Although *D. sumatrensis* is completely protected there is a proviso to this section which reads as follows: 'Provided that it shall not be an offence for any physician or druggist to possess or sell, or for any person to possess for private

medical purposes, rhinoceros blood or any preparation thereof (ANSELL, 1947: U TUN YIN, 1954c).

In 1952 one rhino was legally shot in a sanctuary for 'medical reasons' (U TUN YIN, 1954a). This loophole makes the whole Wild Life Protection Act almost worthless with regard to *D. sumatrensis*. In 1954 this act also had a very restricted validity in the Union of Burma: it did not apply to the Kachins, Yawyins, Nungs, Marus, Lashis, Atsis and Chins (Nagas) and also Shans and Gurkhas permanently resident in a hill tract in the Bhamo and Myitkyina District, and Kachins in the Katha District. For the other parts of the Union there was no uniformity in the validity (U TUN YIN, 1954a).

A number of game sanctuaries were instituted by the Burma Game Rules of 1927. Two of these were constituted primarily to protect the few remaining specimens of *D. sumatrensis*.

*Kahilu Game Sanctuary* (Thaton forest division – 161 km$^2$).
Year of notification – 1st September 1928.
After 1948 there are no more reports on the status of this sanctuary (U TUN YIN, 1954c).

*Shwe-U-Daung* (Katha East Forest Division and Mong Mit Forest Division – 326 km$^2$).
Year of notification – 1918.
After 1950 there are no more reports on the status of this sanctuary (U TUN YIN, 1954c).

There is a possibility that *D. sumatrensis* survives also in the *Pidaung Sanctuary* (near Mytkyina – 673 km$^2$). (ANSELL 1947).
Year of notification 1913 (the Pidaung Game Sanctuary was created in April 1938) (IUCN, 1971). *D. sumatrensis* are known to migrate there from the Uyu drainage (REYNOLDS, 1954). In the list of national parks (IUCN, 1971). *D. sumatrensis* is not mentioned to inhabit this sanctuary.

Recently a new sanctuary, *Kyatthin* (Upper Chindwin Forest Division), was established and is said to harbour a small group of *D. sumatrensis* (Anon., 1973b).

The administration of the sanctuaries lies with the Forest Department of the Ministry of Agriculture (IUCN, 1971). The present government is in power since 1962 and the situation is rather stable. Insurgents operate from the Thailand-Burmese border and in the northern mountainous regions near the Chinese border. The country is practically closed to foreigners and the government refuses to give any information on the status of the sanctuaries and wild life protection (IUCN, 1971; BORNER, 1971).

### 40.3. THAILAND

The Wild Animal Preservation and Protection Act B.E. 2503 was passed in 1960 and came into effect on the 1st January 1961. *D. sumatrensis* belong to the

'reserved animals' and are not allowed to be hunted either for sport or meat (PONG LENG-EE, 1971).

There are four reserves where *D. sumatrensis* are said to live.

*Khao Saiob National Park* (4000 km$^2$)
Established 1961 (IUCN, 1971).

*Khao Luang National Park* (2056 km$^2$)
Established 1965 (IUCN, 1971).

*Phu Khieo Game Sanctuary* (Chaiyaphum province, 1300 km$^2$)
Established 1972 (Anon., 1973a).

*Khlong Vakha Game Sanctuary* (Ramong province, 700 km$^2$)
Established 1972 (Anon., 1973a).

The administration of the National Parks and Game sanctuaries lies with the Royal Forest Department of the Ministry of Agriculture (PONG LENG-EE, 1971).

The main current problems in the conservation of wildlife are overhunting and destruction of habitats. Further, Thailand is struggling with infiltration from Laos and Cambodia. The northern boundaries are impossible to visit due to the presence of Chinese guerillas and opium smugglers (BORNER, 1971, PONG LENG-EE, 1971).

## 40.4. LAOS

It is unknown if *D. sumatrensis* still survives in Laos. There are some 'hunting laws' but they are not enforced (BRIX, 1968). In 1969 there were ten 'Protected Forest Reserves' which are in principle strict reserves and in which no cultivation or hunting is allowed, except for the limited enclaves in which the local country people are allowed to gather fire wood. These protected areas are destined to be upgraded into National Parks. There are ten other forest reserves not intended or expected to qualify as national parks. The legal laws of all the reserves is a Royal Decree. The administration of these areas lies with the Services des Eaux et Forêts under the 'Ministère de l'Economie' (Anon., 1971).

Since World War II Laos has been continuously in war, and at the moment the largest part of the country is controlled by the Viet-Cong. It is very doubtful if anything of the very sparse legislation on conservation is enforced or will be enforced in the near future.

## 40.5. CAMBODIA

Nothing is known of the presence of *D. sumatrensis* in Cambodia. In 1965 the hunting law of 1940 was outdated. Until a new law can be passed the hunting of large wild animals is forbidden (Prakas No. 194). There was one national park (Angkor – 107 km$^2$) and a number of game reserves, but the legal basis

was still in preparation (Cambodian authorities, 1968; IUCN, 1971). At the moment the largest part of the country is under control of the Red Khmer (National liberation forces) and it is doubtful if there is any effective conservation.

### 40.6. VIETNAM

It is unknown if *D. sumatrensis* is still surviving in Vietnam. Because of the war, large tracts of wood are completely destroyed and there is no information on the fauna in the remaining areas. There is a decree, signed by the Secretary of Rural Affairs 1959, fixing game and hunting rules and wildlife protection. The killing of *D. sumatrensis* is strictly forbidden. There are one national park (Bach-Ma Hai-Van – 780 km$^2$) and 5 game reserves. The Directorate of Forest Affairs, the Advisory Committee on hunting and the Ministry of Rural Affairs are responsible for wildlife conservation (PHUNG TRUNG NGAN, 1968; IUCN, 1971; NGUYEN VAN HIEP, 1971).

### 40.7. MALAYA (WEST MALAYSIA)

The law protecting wildlife is the Wild Animals and Birds Protection Ordinance No. 2 of 1955, which is accepted in all states of Malaya. Shooting, killing, taking or wounding a rhinoceros for any purpose whatsoever is prohibited and is punished by a fine of $1,000 or six months imprisonment (METCALFE, 1961). 'It is also forbidden for any person, whether holding a valid licence or not, to kill any mammal, or build a platform or wait, with the intention of killing any mammal, within a quarter of a mile of any natural salt lick'.

'It is equally forbidden to all, including licence holders, to set up an artificial lick with salt or any other substance attractive to mammals, or to hunt any kind of mammal by night with artificial light. It is also unlawful to set spring guns, pit falls, prop spears, spear traps or snares or to lay poison bait for any mammal.'

'The only possible exceptions are, firstly, cases in which a person has reasonable ground (the onus of proving which shall be upon him) for believing that the mammal is a source of immediate danger to himself or any other person. Secondly, an occupier of land, or his servant, may kill any mammal which is causing or appears likely to be about to cause material damage to any building or cultivated crops, or injury to domestic animals on or near such land. If a protected mammal is killed under such circumstances the killing must at once be reported to the Game Department or other authority' (MEDWAY, 1969).

The Game Department is responsible for the conservation of wildlife and for establishing and maintaining reserves and national parks (THONG, 1971).

*D. sumatrensis* still survive in:

*Taman Negara National Park* (Pahang, Kelantan and Trengganu - 4,400 km$^2$) This park was formerly called King George V National Park and was established in 1938 (IUCN, 1971).

*Sungei Dusun Game Reserve* (Southwest of Tanjong Malim, Perak – 433 km$^2$) (THONG, 1971)
This game reserve was established about 1962 and harbours at least 3 *D.sumatrensis* (STRICKLAND, 1967; BORNER, 1971).

*D.sumatrensis* survive in 2 forest reserves, the Bintang Hijau Forest Reserve (northern Perak) and the Gunong Inas Forest Reserve (south Kedah), and probably also in the Krau Game Reserve (central Pahang – 653 km$^2$) (HISLOP, 1966).

Although much has already been done on conservation, the survival of *D.sumatrensis* is far from secured in Malaya (MEDWAY, 1968; THONG, 1971). The largest number of the survivors live still outside the sanctuaries, and therefore new reserves have to be created. The enforcement of the laws on conservation and reserves is handicapped by the lack of staff, facilities and public support. Also the penalty for killing a protected animal is insufficient to act as a deterrent (THONG, 1971).

## 40.8. INDONESIA – SUMATRA

Indonesia has rather modern conservation laws and a large number of reserves have been established. The legal basis for conservation is the Game Ordinance 1931 and the Nature Conservation Ordinance 1941.

*D.sumatrensis* are totally protected: the hunting, catching, killing or selling alive, possession or exporting (alive or dead) is forbidden. Also the selling, possession, or exporting of parts of these animals or products made thereof is forbidden (APPELMAN and ENDERT, 1936; HOOGERWERF, 1954; BASJARUDIN, 1971).

*D.sumatrensis* still survive (or are said to survive) in a large number of reserves (strict nature reserves or animal sanctuaries).
*Mount Leuser* (Atjeh – 4,165 km$^2$), established 1934.
*Mount Wilhelmina* (Langkat – 2,000 km$^2$), established 1938.
*Berbak* (Djambi – 1,900 km$^2$), established 1935.
*Mount Indrapura* (Kerintji – 125 km$^2$), established 1929.
*South Sumatra I or Sumsel I* (Lampong – 3,568 km$^2$), established 1935.
*Way Kambas* (Lamporg – 1,300 km$^2$), established 1937.
*Kerumutan* (Riau – 1,200 km$^2$), established 1968.
*Bangkinang* (Riau – 1,500 km$^2$), established 1968.
*Sungai Rangan* (Riau – 800 km$^2$), established 1968.
*Taluk* (Riau – 1,200 km$^2$), established 1968.
(Directorate General of Forestry, 1971).

Note: Of the last 4 reserves, established in 1968, only Kerumutan was indicated on recent maps provided by the Indonesian authorities. On the status of the other three nothing is known.

The administration lies with the Department of Forestry (Division of Nature Conservation and Wild Life Management). Apart from the usual difficulties in enforcing the law, due to shortage of personnel, equipment and funds, the In-

donesian conservationists are struggling against the effect of a rapidly increasing population and extensive 'exploitation' of the forests (BASJARUDIN, 1971; BORNER, 1971).

## 40.9. BORNEO

Borneo is no political unit. The eastern and southern parts are Indonesian (Kalimantan), the north and the west (Sabah and Sarawak) form a federation (Malaysia) with Malaya. Brunei, a sultanate under British portection, is situated on the north west coast, between Sabah and Sarawak.

The legislation mentioned for Sumatra applies also for Kalimantan. There is only one animal sanctuary said to harbour D.s.: *Kutai* (3,060 km$^2$), established in 1936 (Directorate General of Forestry, 1971). For the largest part of Kalimantan logging concessions have been issued to local and foreign timber companies. It is very doubtful whether any law on conservation is maintained. Compared with Sumatra and Java the conservation in Kalimantan lies far behind.

In Sarawak *D. sumatrensis* is most probably extinct; nevertheless it is protected under the Wild Life Protection Ordinance (1958). The administration lies with the Forest Department. There is one National park and 10 others are proposed (ANDERSON, 1968).

*D. sumatrensis* probably still survive in Sabah, and they are completely protected under the Fauna Conservation Ordinance 1963: the maximum penalty for killing one is five years imprisonment and a fine of $5,000. The responsible authority is the Game Branch of the Forest Department (DE SILVA, 1968; CARSON, 1968). There is one National Park in which *D. sumatrensis* possibly survives, *Kinabalu* (690 km$^2$), established 1964 (IUCN, 1971).

In the sultanate Brunei there is no effective legislation on nature conservation. *D. sumatrensis* does not occur here and was never reported in Brunei (Brunei delegation, 1968).

*D. sumatrensis* are protected by law throughout their present distribution area, but this does not mean that the last remaining individuals are safe. The enormous sums of money paid for a dead rhinoceros are a great temptation to native hunters. Only a very severe punishment, at least imprisonment, will be able to stop the purposeful hunting of these animals. This punishment has to be applied not only to the hunters but also to anyone dealing in rhino products. At the moment the maximum penalties are too low, and the chances of being caught and condemned too small to stop the slaughter.

There is inefficacy of the authorities to maintain the law, due to a shortage of funds, staff and equipment, corruption, envy between governmental departments, loopholes in the law, uncertainty about boundaries of reserves and many other factors. *D. sumatrensis*, especially the animals outside the reserves, are endangered also by rapidly increasing cultivation and timber exploitation. Especially the activities of timber companies are a severe threat to the large ani-

mals. In recent years vast concessions in the lowland forests are being given to foreign and native companies.

The cutting of the trees, mostly rather extensively, will not necessarily make an area uninhabitable for ground living animals, provided that there is a suitable refuge for the time of the operation. But the indigenous people who settle in an area opened up by timber extraction, form a great obstruction, through their cultivation and hunting practices, for the repopulation of an area.

Generally speaking, the best chances for *D. sumatrensis* are in Sumatra and in Malaya. In Sumatra the Gunung Leuser complex of reserves (Atjeh) form the greatest stronghold. The Indonesian authorities, assisted with funds and advice from the WWF-Gunung Leuser Committee, pay special attention to these reserves and there is good hope that a sufficient number can be saved here for the future.

These lines on general aspects of conservation are a personal view, formed after reading many articles and reports on this subject, and therefore no references are given.

## 41. SUMMARY

In this paper the literature dealing with *Dicerorhinus sumatrensis* (FISHER), the Sumatran or Asiatic two-horned rhinoceros, is summarised, with the accent on the distribution and ecology.

*Dicerorhinus sumatrensis* is the smallest of the five living species of rhinoceroses. It is, or was, living in the largest part of Southeast Asia, to the Brahmaputra valley in the north and the South Vietnamese mountains in the east, and on Sumatra and Borneo. The second Asiatic species, *Rhinoceros sondaicus* DESMAREST, the Javan rhinoceros, inhabited largely the same area, but also on Java and not on Borneo. The third species, *Rhinoceros unicornis* L., the Indian rhinoceros, lived in a broad belt south of the Himalaya.

*Dicerorhinus sumatrensis* is characterised by the presence of two horns on the snout and by two distinct skinfolds, encircling the body. The maximum hight is about 135 cm and the weight is estimated between 1,000 and 2,000 kg. Another remarkable feature is the rather dense hair-cover, especially on young animals.

Much attention is paid to the external characteristics as well as the development of the dentition, the young animal, the physical capability, the senses and the voice.

Since the study of tracks, footprints etc. is very important in a field-survey these features are dealt with extensively.

In the chapters on distribution every record of *Dicerorhinus sumatrensis* is listed chronologically and indicated on a map (Map 1), thus forming the known historical distribution. On another map (Map 2) the recent distribution, with much reservation, is indicated. *Dicerorhinus sumatrensis* is exterminated or much reduced in numbers in the whole of its former territory, but there are still a number of places where it is supposed to survive. Only for a few places on

Sumatra and in Malaya its excistance is confirmed. The number of the survivors is generally estimated as between 100 and 200.

*Dicerorhinus sumatrensis* can live in a wide range of habitats, from sea-level to high in the mountains, but is mostly found in densely wooded hill-tracts. They are great wanderers which seldom stay long in one place.

It is a typical browser, feeding on a large number of trees and shrubs and fruits. A list of 102 food-species is given (Appendix B). They mostly feed on twigs and saplings and they have the habit of pushing over young trees to reach the crown.

One of the most important parts of the daily routine of a *Dicerorhinus sumatrensis* is the mud bath. These mud baths are taken at least once a day and therefore the skin is constantly covered with a layer of mud. Without regular wallowing the skin will crack and become inflamed and the animal will finally die.

*Dicerorhinus sumatrensis* is generally not agressive towards humans, mostly it will flight long before it can be seen in the jungle, but sometimes it is known to charge.

It is mostly roving around solitary and almost nothing is known about rut, mating and reproduction. However it is clear that the propagation is very slow.

Since *Dicerorhinus sumatrensis* is almost exterminated by the ruthless persecution to supply the local markets with all kinds of 'medicine' made from parts (horns, hoves, teeth, blood etc.) of rhinos, much attention is paid to the various hunting techniques and the use of rhino-products.

Finally the status of conservation, as concerning *Dicerorhinus sumatrensis*, is summarised.

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## 43. SAMENVATTING

In dit artikel wordt alle literatuur over *Dicerorhinus sumatrensis* (FISCHER), de Sumatraanse neushoorn, samengevat. Het accent ligt hierbij op de verspreiding en de levenswijze.

*Dicerorhinus sumatrensis* is de kleinste van de 5 nog levende soorten neushoorns, waarvan 3 in Azië en 2 in Afrika. Het oorspronkelijke verspreidingsgebied besloeg het grootste deel van Zuid-oost Azië, in het noorden tot in het Brahmaputra-dal en in het oosten tot in het gebergte van Zuid-Vietnam en verder op Sumatra en Borneo. Een tweede soort, *Rhinoceros sondaicus* DESMAREST, de Javaanse neushoorn, had grotendeels hetzelfde verspreidingsgebied, exclusief Borneo, maar kwam (en komt nog) voor op Java. De derde Aziatische soort, *Rhinoceros indicus* L., de Indische neushoorn, bewoonde de zône bezuiden de Himalaya.

De Sumatraanse neushoorn wordt vooral gekenmerkt door de 2 hoorns op de neus en door 2 grote huidplooien rond de romp, direkt achter de voorpoten en voor de achterpoten. Verder is, in vergelijking met andere neushoorns, het dichte haarkleed opvallend. Vooral jonge dieren zijn op romp en poten vrij sterk behaard.

De maximale schouderhoogte is ongeveer 135 cm, en de lengte, van snuit tot staartwortel, ongeveer 250 cm. Van het gewicht zijn geen metingen bekend, maar het wordt geschat tussen 1000 en 2000 kg. De huid is, in vergelijking met andere neushoorns, dun en grijs tot bruin gekleurd.

De hoorns, de voorste is steeds veel sterker ontwikkeld dan de achterste, zijn over het algemeen niet erg groot; de achterste hoorn is vaak niet meer dan een knobbel. De record hoorn is iets langer dan 80 cm., maar over het algemeen worden ze niet langer dan 50 cm.

Over de ontwikkeling van het gebit, vaak belangrijk voor de bepaling van de leeftijd, is wel iets af te leiden uit schedels, maar er is geen tijdsduur te geven voor de verschillende ontwikkelingsstadia.

Driemaal is in gevangenschap een jong geboren en een aantal malen is een jong gevangen. Hierdoor is een en ander bekend over de ontwikkeling van het jonge dier. Waarschijnlijk is een Sumatraanse neushoorn binnen 3 jaar volgroeid.

Over het algemeen wordt met veel bewondering gesproken over het uithoudingsvermogen en de behendigheid van deze dieren. Ondanks de logheid dalen en stijgen ze schijnbaar moeiteloos langs zeer steile hellingen en verplaatsen ze zich met forse snelheid over grote afstanden.

Men is het er over eens dat de reuk zeer goed is en het gezichtsvermogen slecht. Over de scherpte van het gehoor bestaat geen eensgezindheid. Hoewel ze over het algemeen vrij stil zijn, is er toch een aantal verschillende geluiden beschreven, zowel van ongestoorde dieren als van opgeschrikte exemplaren.

Aan de afmetingen en de vorm van de voetafdrukken is veel aandacht besteed omdat deze zeer belangrijk zijn bij veld-onderzoek aan dergelijke dieren (Fig. 2).

In de hoofdstukken over de verspreiding zijn alle waarnemingen van *Dicerorhinus sumatrensis* per land chronologisch gerangschikt. Deze waarnemingen zijn ook alle op een kaart (Kaart 1) ingetekend. Tezamen vormen zij de bekende historische verspreiding. Ook de huidige verspreiding is, onder veel voorbehoud, op een kaart (Kaart 2) ingetekend. Hoewel *Dicerorhinus sumatrensis*

over het grootste gedeelte van zijn vroegere verspreidingsgebied is uitgeroeid, zijn er nog een aantal gebieden waar hij mogelijk nog voorkomt. Evenwel slechts in een enkel gebied in Malakka en op Sumatra (o.a. Gunung Leuser-reservaten) is het voorkomen zeker. De schattingen van het aantal dieren dat is overgebleven liggen meest tussen 100 en 200.

De Sumatraanse neushoorn blijkt in een grote verscheidenheid van terreintypen te kunnen leven, van moerasgebieden op zeeniveau tot hoog in de bergen, maar wordt verreweg het meest aangetroffen in dicht beboste berggebieden. Belangrijk zijn de aanwezigheid van voldoende voedsel, water en schaduw.

Het zijn grote zwervers en blijven zelden lang op een plaats. Ze bewonen een gebied van minstens 10 vierkante kilometer, dat geregeld wordt gewisseld.

Evenals de meeste herbivoren brengt *Dicerorhinus sumatrensis* geregeld (één à twee maal per maand) bezoeken aan zout likplaatsen. Op deze manier voorzien ze in hun zout-behoefte en tevens wordt waarschijnlijk het darmkanaal van parasieten gereinigd door het verorberen van grote hoeveelheden zilte modder.

*Dicerorhinus sumatrensis* is een typische 'knabbelaar', die zich voedt met een groot aantal gewassen, meest bomen en struiken, en vruchten. Een lijst met 102 voedsel-planten is achterin opgenomen (Appendix B). Het grootste gedeelte van het voedsel bestaat uit bladeren, twijgen en takken. Jonge bomen worden vaak omgedrukt met het lichaam, teneinde de kroon te kunnen bereiken.

Ook de uitscheidingsproducten, faeces en urine, kunnen belangrijke aanwijzingen geven bij veld-onderzoek, o.a. over leeftijd en geslacht van de producent. Een punt van discussie is of *Dicerorhinus sumatrensis* al of niet gedurende enige tijd de mest op één bepaalde plaats deponeert, waardoor grote hopen ontstaan.

Een van de belangrijkste onderdelen van de dagelijkse routine van een Sumatraanse neushoorn is het modderbad. Minstens éénmaal daags zoeken ze een, veelal zelf gegraven, modderkuil op om een uitgebreid bad te nemen. Hierdoor is de huid steeds met een laag modder bedekt. Deze laag beschermt tegen ongedierte, maar is ook van vitaal belang voor de gezondheid van de huid. Als het dier niet regelmatig kan baden droogt de huid uit, gaat scheuren en er treden infecties op die tenslotte tot de dood kunnen leiden.

Sumatraanse neushoorns zwerven meestal solitair rond. Een enkele maal werden twee of meer dieren tezamen waargenomen. Ook de binding binnen het paar schijnt vrij los te zijn.

Ten opzichte van de mens is *Dicerorhinus sumatrensis* meestal niet agressief: lang voor ze zichtbaar zijn in de dichte jungle slaan ze reeds op de vlucht. Een enkele maal slechts wordt gemeld dat een neushoorn zonder provocatie mensen aanviel.

Over de voortplanting is zo goed als niets bekend. Het is evenwel zeker dat de vermenigvuldiging zeer langzaam gaat, een bijzonder gevaarlijke situatie voor een dier, dat zo fel wordt vervolgd.

Aangezien de geweldige achteruitgang van de Sumatraanse neushoorn vooral te wijten is aan de onvermoeibare vervolging van deze dieren omwille van de hoorn en andere 'medicijn', is veel aandacht besteed aan de jachtmethoden en

het gebruik van neushoorn-producten. Voor de jacht worden meest valkuilen en speervallen gebruikt en wanneer in een gebied, zoals vaak gebeurd, alle paden van dergelijke installaties worden voorzien zijn de dieren binnen korte tijd verdwenen.

Hoorns en andere delen van neushoorns hebben, vooral voor chinezen, zeer grote medische en magische waarde. Vooral als liefde-wekkend middel zijn ze zeer gewild. Er worden de meest fantastische bedragen voor geboden, zodat de jagers ieder risico zullen willen nemen om ook de laatste exemplaren te pakken te krijgen.

Tot slot wordt een overzicht gegeven van de maatregelen die in de verschillende landen worden genomen om de laatste Sumatraanse neushoorns te beschermen. In het gehele verspreidingsgebied zijn ze volledig beschermd door de wet, maar door allerlei oorzaken kunnen deze wetten vaak zeer moeilijk worden gehandhaafd.

## APPENDIX A

### LIST OF VERNACULAR NAMES OF DICERORHINUS SUMATRENSIS

When collecting local information it can be useful to know the vernacular name of *D. sumatrensis*. Therefore all these names found in literature are listed below:

| | |
|---|---|
| Burma: | Burmese – Kyan, Wet-Kyan, Kyan-chyaw, Kyan-shaw, |
| | Karen – Ta-do, Ta-do-khaw, Da du chaw |
| | Shan – Sawon, Lawon |
| | Malay Bankachon – Badak-ryia |
| Thailand: | Kra-su, Kra-sco, Rat* |
| Laos: | Su, Rat*, Het*, Ret* |
| Malaya: | Malay – Badak Kerbau, Badak Himpit |
| | Badak Sumbu, Badak Berendam, Badak Api |
| | (fire rhinoceros) |
| | Chinese Hokkien – Sai goo |
| | Cantonese – Sai Ngow |
| | Kheh – Sai Ngew |
| Sumatra: | Malay – Badak Kerbo, Badak Kerbau, |
| | Badak Gajah, Badak Sumatra |
| Borneo: | Malay Badak |
| | Tagal – Camansur |
| | Iban – Schimaru |
| | Murut – Tembaiungan |
| | Dusum – Tampak |

* According to GARDNER (1919) these names are used for *Rhinoceros sondaicus*.

# APPENDIX B

## LIST OF FOOD PLANTS

The list of food plants is compiled from the data given by ALI and SANTAPAU (1960), EVANS (1905), FOENANDER (1944), HEYNSIUS-VIRULY (1935), HUBBACK (1939), KURT (1970), METCALFE (1961), MILTON (1961), STRICKLAND (1967), THOM (1935, 1943).

*Food Plants of Dicerorhinus sumatrensis.*

(B = Burma, M = Malaya, S – Sumatra)

| *Scientific name* | *Vernacular names* | *Parts eaten* | *Country* |
|---|---|---|---|
| *Angiopteris caracea* (Marattiaceae) | S-palit gadjah | young leaves | S |
| *Apama corymbosa* (Aristolochiaceae) | M-akar julong dukit | leaves | M |
| *Artocarpus elasticus* (Moraceae) | M-terap | leaves | M |
| *Artocarpus integer* (Moraceae) | S-nangka | leaves | S |
| *Artocarpus rigidus* (Moraceae) | M-tempunai (tempuni) Perak-gias Kedah-jejatoh Pahang-pesiah | fruits | M |
| *Baccaurea malayana* (Euphorbiaceae) | S-tampu (tampi) | leaves and young plants | S |
| *Bhesa paniculata* (Celastraceae) | M-aha tung, bintan, madang bura | leaves | M |
| *Bidens pilosa* (Compositae) | S-lantjing | entire plant | S |
| *Bischofia javanica* (Euphorbiaceae) | S-tjinkam | leaves and seedlings | S |
| *Boehmeria hamiltoniana* (Urticaceae) | B-satsha | leaves, twigs | B |
| *Calamus sp.* (Palmae) | B-kyein | | B |
| *Campnosperma montana* (Anacardiaceae) | M-terentang | leaves | M |
| *Canthium sp.* (Rubiaceae) | M-kahwa utan kopi-utan | leaves | M |
| *Careya arborea* (Lecythidaceae) | B-ban-bwe | fruits | B |
| *Cassia spp.* (Leguminosae) | S-bumbung | leaves | S |
| *Castanopsis diversifolia* (Fagaceae) | B-kyan-sa (pyan-sa) | leaves, twigs | B |
| *Castanopsis tribuloides* (Fagaceae) | B-kyan-sa (pyan-sa) | leaves, twigs | B |
| *Chrysophyllum sp.* (Sapotaceae) | | fruits | M |
| *Cicca* (=*Phyllanthus*) *macrocarpa* (Euphorbiaceae) | B-zibyu | fruits | B |
| *Claoxylon indicum* (Euphorbiaceae) | M-lampin budak (lamping budak) | leaves | M |
| *Claoxylon longifolium* (Euphorbiaceae) | M-salang, sanglon | leaves | M |

| *Scientific name* | *Vernacular names* | *Parts eaten* | *Country* |
|---|---|---|---|
| *Clerodendron sp.* (Verbenaceae) | M-panggil panggil, bunga panggil | leaves | M |
| *Crotalaria spp.* (Leguminosae) | M-gegili (gegiling) | leaves | M |
| *Cryptocarya sp.* (Lauraceae) | | leaves | M |
| *Cycas rumphii* (Cycadaceae) | S-rebung pakisadji | young leaves | M |
| *Dehaasia sp.* (Lauraceae) | M-medang tandok | leaves | B |
| *Dillenia pulcherrima* (Dilleniaceae) | B-byu | fruits | M |
| *Dissochaeta gracilis* (Melastomaceae) | | leaves | M |
| *Dyera spp.* (Apocynaceae) | M-jelutong | leaves, twigs | M |
| *Endiandra sp.* (Lauraceae) | | leaves | M |
| *Endospermum malaccense* (Euphorbiaceae) | M-bulan bulan, bebulan, membulan, sendok, sendok sendok, sesendok | leaves | M |
| *Eugenia sp.* (Myrtaceae) | M-kelat merah kelat kuning | leaves, twigs | M |
| *Eurycoma longifolia* (Simaroubaceae) | S-tonkat ali | bark | S |
| *Evodia pilulifera* (Rutaceae) | | leaves | M |
| *Fagraea fragrans* (Loganiaceae) | M-tembusu, temusu, tmensu, temesu, semesu | leaves | M |
| *Ficus alba* (Moraceae) | M-ara | leaves | M |
| *Ficus aurata* (Moraceae) | M-ara | leaves | M |
| *Ficus bengalensis* (Moraceae) | M-ara | leaves | M |
| *Ficus fistulosa* (Moraceae) | M-ara | leaves | M |
| *Ficus glandulifera* (Moraceae) | M-ara | leaves | M |
| *Ficus glomerata?* (Moraceae) | B-tha-hpan | figs | B |
| *Ficus roxburghii?* (Moraceae) | B-sin-tha-hpan | figs | B |
| *Forrestia griffithii* (Commelinaceae) | | leaves | M |
| *Garcinia eugeniaefolia* (Guttiferae) | M-kandis | leaves | M |
| *Garcinia lambronica* (Guttiferae) | S-mangis hutan | leaves, fruit | S |
| *Garcinia forbesii* (Guttiferae) | M-kandis | fruit | M |
| *Gigantochloa apus* (Graminae) | S-bambu tali | young leaves | S |
| *Gluta rengas* (Anacardiaceae) | S-rengas, rangas | leaves, bark | S |
| *Grewia tomentosa* (Tiliaceae) | M-chenderai | leaves | M |
| *Gymnacranthera sp.* (Myristicaceae) | | leaves | M |
| *Harrisonia bennetti* (Simaroubaceae) | B-ta-bu, ta-ma | leaves, twigs | B |
| *Hibiscus tiliaceus* (Malvaceae) | S-waru | bark | S |
| *Kayea kunstleri* (Guttiferae) | M-gaha | leaves, twigs | M |
| *Knema kunstleri* (Myristicaceae) | N-pemaraham | leaves | M |
| *Laportea microstigma* (Urticaceae) | S-djelatang | leaves, bark | S |
| *Luvunga sp.* (Rutaceae) | | leaves | M |
| *Macaranga triloba* (Euphorbiaceae) | M-mahang, mesepat, melokan, kubin | leaves | M |
| *Madhuca sp.* (Sapotaceae) | M-nystoh | leaves | M |
| *Mallotus paniculatus* (Euphorbiaceae) | M-balek angin | leaves | M |
| *Maoutia puya* (Urticaceae) | B-satsha | leaves, twigs | B |

| *Scientific name* | *Vernacular names* | *Parts eaten* | *Country* |
|---|---|---|---|
| *Mangifera lagenifera* (Anacardiaceae) | M-lanjut | fruit | M |
| *Mangifera sp.* (Anacardiaceae) | M-machan berlawin | fruits | M |
| *Melanorrhoea sp.* (Anacardiaceae) | M-rengas, kurbou jalang | leaves | M |
| *Melastoma sp.* (Melastomataceae) | M-sendudok, kedudok | leaves | M |
| *Melocanna bambusoides* (Gramineae) | B-kayin wa<br>M-kayen-wa | flowers,<br>fruits, twigs, young shoots | B |
| *Memecylon garcinoides* (Melastomataceae) | M-nipis kulit, mangas, delek | leaves | M |
| *Mezzettia leptopoda* (Annonaceae) | M-mempisang, pisang pisang | fruits | M |
| *Millettia sericea* (Leguminosae-Papilionaceae) | | leaves | M |
| *Mussaenda villosa* (Rubiaceae) | | leaves | M |
| *Myristica spp.* (Myristicaceae) | M-penarah | leaves, twigs | M |
| *Palaquium gutta* (Sapotaceae) | M-taban merah | leaves, twigs | M |
| *Palaquium spp.* (Sapotaceae) | M-nyatoh | leaves, twigs | M |
| *Panicum viride* (Gramineae) | S-betak | leaves | S |
| *Parkia insignis* (Leguminosae) | B-myauk-tanyet | fruit | B |
| *Pavetta indica* (Rubiaceae) | M-bunga jarum, jarum jarum nyarum2, gading2 | leaves | M |
| *Payena costata* (Sapotaceae) | M-mengelut, sabut | fruit | M |
| *Payena spp.* (Sapotaceae) | N-nyatoh | leaves, twigs | M |
| *Pithecellobium sp.* (Leguminosae-Mimosaceae) | M-keredas | leaves, twigs | M |
| *Plumbago indica* (Plumbaginaceae) | S-binaba | leaves, bark, wood | S |
| *Polyosma sp.* (Saxifragaceae) | | leaves | M |
| *Pouteria maingayi* (Sapotaceae) | | fruits | M |
| *Pternandra coerulescens* (Melastomataceae) | M-sisal menshun, lidah leatak | leaves | M |
| *Randia scortechinii* (Rubiaceae) | M-randa utan, tinjau bekekar, ulai ulai | leaves | M |
| *Sandoricum indicum* (Meliaceae) | B-thit-to | fruits | B |
| *Sapium baccatum* (Euphorbiaceae) | M-memaya | leaves, twigs | M |
| *Saraca sp. (indica)* (Leguminosae) | M-tengalan | flowers | M |
| *Sarcochlamys pulcherrima* (Urticaceae) | B-satsha | leaves, twigs | B |
| *Scaphium macropodum* (Sterculiaceae) | M-kembang, sa-mangkok | leaves | M |
| *Solanum torvum* (Solanaceae) | M-rimbang | entire plant | S |
| *Sonneratia caseolaris* (Sonneratiaceae) | B-ta-bu, ta-ma | leaves, twigs | B |
| *Symplocos fasciculata* (Symplocaceae) | M-menasi, nasi nasi nenasi | leaves | M |
| *Terminalia catappa* (Combretaceae) | S-ketapang | leaves, bark | S |
| *Ternstroemia sp.* (Theaceae) | M-medang bungalawang | leaves | M |

| *Scientific name* | *Vernacular names* | *Parts eaten* | *Country* |
|---|---|---|---|
| *Tetrameles nudiflora* (Datiscaceae) | S-kalimohomoh | leaves, bark | S |
| *Toddalia aculeata* (Rutaceae) | B-pyan-sa, kyan-sa | leaves, twigs | B |
| *Toona sinensis* (Meliaceae) | S-rimorimo, surian | leaves | S |
| *Trema orientale* (Ulmaceae) | B-satsha | leaves, twigs | B |
| *Urophyllum glabrum* (Rubiaceae) | | leaves | M |
| *Urophyllum spp.* (Rubiaceae) | M-manai badak, manai pahit, manai rumpah | leaves, twigs | M |
| *Xylopia ferruginea* (Annonaceae) | M-antoi jangkang | leaves | M |
| *Zizyphus calophylla* (Rhamnaceae) | | leaves | M |

# APPENDIX C

## LIST OF PICTURES

Below, pictures of *D. sumatrensis* or tracks of it, printed in books and periodicals are listed.

*Pictures of wild animals*

HUBBACK (1939): In the Journal of the Bombay Natural History Society 4 good pictures of the same animal (male) are printed. Two of these are also printed with the same paper by HUBBACK (1939) in the Journal of Mammalogy. One of the pictures is also printed in WETHERBY (1940) and two of them in FOENANDER (1944).

ALI and SANTAPAU (1958): 2 good pictures made by P. G. BAZIN in 1957 (Malaya). These pictures were printed before in the Strait Times and one of them is also printed in GRZIMEK (1958) and METCALFE (1961).

MEDWAY (1968b): 1 picture by Mhmed Khan (Malaya).

Directorate General of Forestry (1971): 1 picture, possibly of a wild specimen, is printed very badly in the guide of Nature Reserves in Indonesia. On the other hand it could be the animal living in the Bogor Zoo from 1959 until 1961.

*Pictures of Captive animals*

Pictures of the specimen in the London Zoo (type specimen of *lasiotis* called Begum, 1873–1900): SELOUS?, DANDO (1902).

Pictures of the 2 specimen in the Vienna (Schönbrunn) Zoo (called Jenny, 1900–1908, and Mary 1902–1919): BREHM (1920), ANTONIUS (1937), and probably also the second picture in SELOUS?

Pictures of the animal in the Basel Zoo (called Betina 1959–1961): SODY (1959), GRZIMEK (1960).

Pictures of the animal in the Copenhagen Zoo (called Subur 1959–1972): ANDERSON (1961) (2 pictures), LUKASZEWICZ (1962), Anon. (1974), VAN STRIEN (1974).

Of the animals captured by RYHINER and SKAFTE in 1959 in Sumatra, a number of pictures were taken when still in the capture enclosure. They are printed in SKAFTE (1961) (Acta Tropica and Natural History Bulletin of the Siam Society) and VOLLMAR (1967).

Pictures of the young animals kept in Sumatra in 1928 and 1930 (called Bong) are respectively printed in ULLRICH (1955) and COENRAAD-UHLIG (1933).

*Pictures of shot animals*

Pictures of shot animals are printed in: MJÖBERG (1930), PEACOCK (1931), THOM (1935) (2x), and HUBBACK (1939).

*Pictures of tracks etc.*

Pictures of footprints are printed in: WEATHERBY (1940), SKAFTE (1961), METCALFE (1961), MILTON (1963b), STRICKLAND (1967) (2x), and MEDWAY (1968b).

Pictures of wallows are printed in: HUBBACK (1939) (2x).
A picture of dung is printed in: METCALFE (1961).
A picture of mud smears on a tree is printed in: MEDWAY (1968b).
A picture of a sapling fed upon by *D. sumatrensis* is printed in: STRICKLAND (1967).

*Pictures of mounted specimens*

Pictures of mounted specimens, heads and horns are printed in: NEUVILLE (1927), DOLLMAN (1928), Anon. (1934), HUBBACK (1939), HARRISSON (1956), GROVES (1967).

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