

FAMILY RHINOCEROTIDAE

The Rhinoceroses

The Family Rhinocerotidae ("nose-horn") was a dominant family in the Oligocene and Miocene Epochs, with at least 7 evolutionary lines occupying a wide range of grazing and browsing niches throughout Eurasia, Africa, and North America. Among the many forms was *Baluchitherium grangeri* from Mongolia, the largest land mammal known, with a shoulder height of nearly 6 meters and total length of almost 9 meters. During the Pliocene, rhinoceroses became extinct in North America and many forms died out in Eurasia and Africa; a very few lines continued into the Pleistocene, when they were faced with the selective pressures of severe climate, hunting by early man, and widespread habitat change (Martin and Wright, 1967). As a result, the family is now reduced to just four genera and five species: *Ceratotherium simum*, the White Rhinoceros of south and central Africa; *Diceros bicornis*, the Black Rhinoceros of south and east Africa; *Rhinoceros unicornis*, the Greater One-horned or Indian Rhinoceros of India, Assam, and Nepal; *Rhinoceros sondaicus*, the Lesser One-horned or Javan Rhinoceros of Java, Sumatra, and mainland Southeast Asia; and *Dicerorhinus sumatrensis*, the Asian Two-horned or Sumatran Rhinoceros of Borneo, Sumatra, and mainland southeast Asia. Both *R. sondaicus* and *D. sumatrensis* occur in Thailand.

Although some early authors considered all five species to belong to the same genus *Rhinoceros*, it is now evident that as a result of adaptations to different niches, the various genera became distinct at a very early period of their history and represent four distinct lines of parallel descent. Based on the presence of two horns, Simpson proposed that *Dicerorhinus* be included with the two African species in the Subfamily Dicerorhininae, with the two single-horned members of *Rhinoceros* put in a separate Subfamily Rhinocerotinae. But this overemphasized the taxonomic importance of the number of horns (a non-skeletal character) while ignoring more important characters; on the basis of cranial and dental characters, including the presence of incisors in adults, all Asian rhinoceroses are included here in the same Subfamily Rhinocerotinae. The African species lack incisors in the adults, and are placed in the separate Subfamily Dicerotinae (following Pocock, 1945).

Rhinoceroses are large, heavy animals with short, stout legs with three toes on each foot, each digit

terminating in a small hoof; the middle toe carries most of the weight. The eyes are small and pig-like, located on the side of the head; vision is not especially acute. The ears are erect, tubular, tufted with hair, and fairly large, and hearing is excellent. The skin is thinly covered with hair in *Dicerorhinus* and is nearly naked in the other species; in *Rhinoceros* the skin is deeply folded across the back. One or two horns consisting of agglutinated hair rest upon a rough vascular cushion of bone developed on the midline of the nasal bones for the anterior horn and on the midline of the frontal bones for the posterior horn, when present; the only other living land mammal with a horn on the middle of the head is the African Giraffe, though its horn is bony rather than dermal. Rhinoceros horns grow throughout the animal's life, and are regrown if lost.

According to Winge (1942), the habit of using the head as a lever (probably for removing branches which hindered their passage through forests or thickets) has greatly influenced the shape of the rhinoceros skull, with its concave profile, prominent occipital crest, and strong nasal bones elevated and extending far forward; all the bones of the upper side of the skull are exceptionally thick, with internal airspaces. The hind part of the orbit is not rimmed with bone as it is in horses (Family Equidae).

The skulls of the Thai rhinos are easily distinguished, since *sondaicus*, with one horn in the living animal, shows a rough tuberculation only on the nasals, while *sumatrensis*, with two horns, shows a similar pattern both on the nasals and the frontals. Also, *sondaicus* has the occipital crest located well forward, directly above the zygomatic arch, while in *sumatrensis* the crest is located further back, well behind the zygomatic arch; this reflects the relatively lower position in which *sondaicus* carries the head. A complete discussion of cranial characteristics is found in Pocock (1945).

Dentition in the family is variable: $\frac{0-1}{0-2} \frac{0}{0-1} \frac{3-4}{3-4} \frac{3}{3}$

$\times 2 = 24-34$. The premolars are similar to the molars, so that the entire row of cheek-teeth forms a continuous grinding surface. In adults of the Asian forms, there is one pair of broad and blunt incisors in the upper jaw, and one or two pairs in the lower jaw, developed into short, sharp tusks. While the African species use their horns as weapons, the Asian species generally use their incisors, seldom, if ever, using their horns for

aggressive purposes. Among the Thai species, *sondaicus* lacks the protocone fold of *sumatrensis* on the cheek teeth (indicating slightly more efficient browsing for *sumatrensis*). In addition, *sondaicus* has four lower incisors, while *sumatrensis* has only two. See Hooijer (1946) for a complete discussion of dental characters.

In Thailand, *sondaicus* and *sumatrensis* are quite similar in feeding habits and have roughly similar distributions, so it may be difficult to distinguish between signs of them in the field. However, *sondaicus* leaves tracks which are over 25 cm wide, while *sumatrensis* tracks average 20–22 cm, and the toes seem slightly less splayed. Tapir tracks are somewhat similar to rhino tracks in showing three hoofed toes (at least on firm ground), but tapir tracks are much smaller, 14–17 cm wide, and the toes are more pointed (Medway, 1969).

Most species are solitary, though several individuals may come together at a favored wallowing area or salt lick, and mated pairs may form for a short time. One calf is born after a gestation period of 7–8 months for *sumatrensis* and about 16 months for the other four species. The calf may nurse

for 3 to 4 years, until shortly before the next calf is born. If the female loses her new calf, the previous calf may return (Andrew Laurie, pers. comm.). Puberty is reached at 4–6 years for females and about 10 years for males; some rhinos have lived over 40 years in captivity.

Although habitat destruction (i.e., direct competition with man) has played an important part in the reduction of rhinoceros distribution, it is commercial hunting which is driving them to extinction. Every part of the rhinoceros is valuable for various medicinal purposes, with typical prices being \$25 for each molar tooth, \$20/liter for urine, \$75/kg for dried blood, \$65/kg for fresh blood, \$6.50/kg for bone, \$12.50/kg for skin, and \$3000/kg for rhino horn (prices in US\$—McNeely and Cronin, 1972). Rhino horn is well known as an aphrodesiac, but is also used for easing labor pains, removing thorns, closing cuts, detecting poison, shrinking lumps, and mending broken bones. While most modern authorities assert that rhino horn has no pharmacological basis for its reputed medicinal qualities, such logical empiricism has little influence with the Chinese who are the main consumers of rhinoceros “medicine.”

Size Comparison of *Rhinoceros sondaicus* and *Dicerorhinus sumatrensis*.

Character	<i>R. sondaicus</i>	<i>D. sumatrensis</i>
Shoulder Height	1600–1750	1000–1400
Head and Body	3000–3200	2400–2600
Tail	700	650
Hind Foot	250–300	190–230
Weight	1500–2000 kg.	900–1000 kg.
Skull Length	514.5	525.8
Basal Length	575.8	507.0
Zygomatic Breadth	347.5	283.3
Occipital Breadth	296.0	128.0
Occipital Height	158.8	114.0
Interorbital Breadth	120.1	100.0



**LESSER ONE-HORNED or
JAVAN RHINOCEROS**

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Rhinoceros sondaicus Desmarest, 1822

Synonyms: *Rhinoceros inermis* Lesson, 1840;
R. floweri Gray, 1867.

Diagnosis: Three folds of skin across the back, including one in front of the shoulder; mosaic pattern on the skin.

Size: Shoulder: 1600–1750; HB: 3000–3200;
T: 700; HF: 250–300; W: 1500–2000 kg.

Distribution: Within the past hundred years, *sondaicus* was found from the Sundarbans of Bangladesh throughout Southeast Asia to Sumatra and Java; although most authorities say the species is now confined to Ujung Kulon Reserve in southwestern Java, where about 20–30 still exist, Dr. Fred Kurt found that there may be as many as 21–28 *sondaicus* in the Gunung Loeser Reserve in northern Sumatra. More recent studies have not confirmed Kurt's findings. Milton and Estes

(1963) say that a few *sondaicus* may still be found along the Tenasserim; this is corroborated by reports periodically received from Karen hunters in Kanchanaburi Province, saying that *sondaicus* occasionally cross into Thailand from Burma during the rainy season. Villagers in remote areas of Ranong, Phangnga, Krabi, and Trang Provinces in the South assert that *sondaicus* are still found in the rainforests of those provinces. Neese (1975) suggests that there may still be at least 7 Javan rhinos in the Bolovens Plateau area of Laos and Cambodia.

Description: In many ways *sondaicus* is similar in appearance to *R. unicornis*, the Indian Rhinoceros; both are the same dusky gray color, and the shoulder height is roughly equal. *R. sondaicus* however, is a less massive animal, with a much smaller head, and with less developed folds of skin on the neck. Both species have thick skin, heavily folded; *sondaicus* has three folds across the back,

one in front of the shoulder, the second behind the shoulder, and the third over the rump, while in *unicornis* the fold in front of the shoulders is lacking. The entire tail is visible in profile; in other species, there is a deep groove on the rump which hides the tail for much of its length. The upper lip is pointed and prehensile, used for drawing browse towards the mouth.

The single horn, already visible in new-born calves, is quite short, with the record horn only 250 mm long; the average for males is closer to 150 mm. In contrast with *unicornis*, where both sexes have nearly equal horns, the female *sondaicus* often lacks a horn or has only a small bump. The lack of a horn in females is questioned by Schenkel (1969) on the basis that all adult rhinos which he saw at Ujung Kulon had a definite horn, so "clearly among all these individuals were some females."

R. sondaicus are generally silent, but are capable of a wide range of snorts, grunts, whistles, and squeals (Hoogerwerf, 1970).

Ecology and Behavior: *R. sondaicus* inhabit dense rain forests with a good supply of water and plentiful mud wallows; they generally prefer low-lying areas, though some have been found at altitudes of over 1000 m. in Java and *R. sivalensis*, the direct ancestor of *sondaicus* (Lydekker, 1922), has been found in fossil form as high as 4900 m. in the Himalayas. In the recent past they built up large populations in a single area (Groves, 1967),

but there is little indication of the structure of these populations. At the present time, *sondaicus* are generally solitary in nature, though pairs may form at mating periods. They tend to have loosely defined centers of activity where they may spend several days at a time, and to which they will periodically return; some *sondaicus* may travel 15 to 20 km within 24 hours.

The diet consists of shoots, twigs, young foliage, and fallen fruit; almost 150 species, mostly typical of secondary growth, have been identified as food plants (Hoogerwerf, 1970; Schenkel, 1969). In the course of feeding, branches up to 15–20 mm thick are torn off, stems at different heights above the ground are broken, and trees up to 150 mm in diameter are uprooted by leaning a shoulder on the tree, and then, as the tree starts to give way, walking over it, forcing the tree down between the front legs (Talbot, 1960). According to Hoogerwerf, "Owing to the fact that the damaged trees



Range of *Rhinoceros sondaicus*

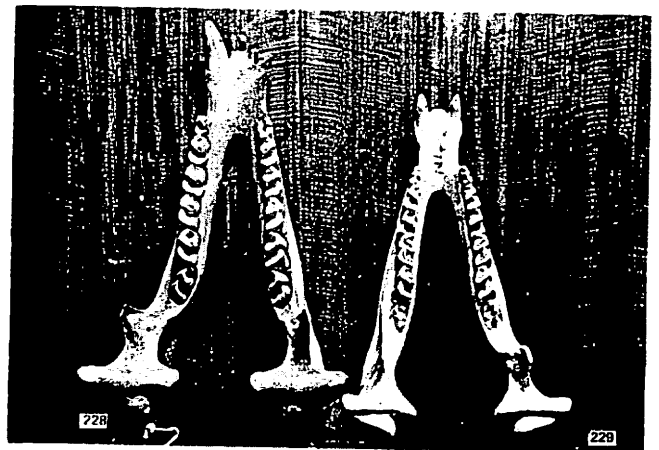
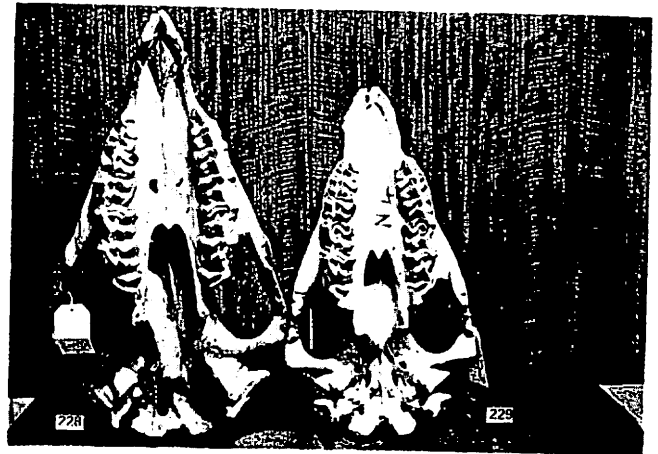
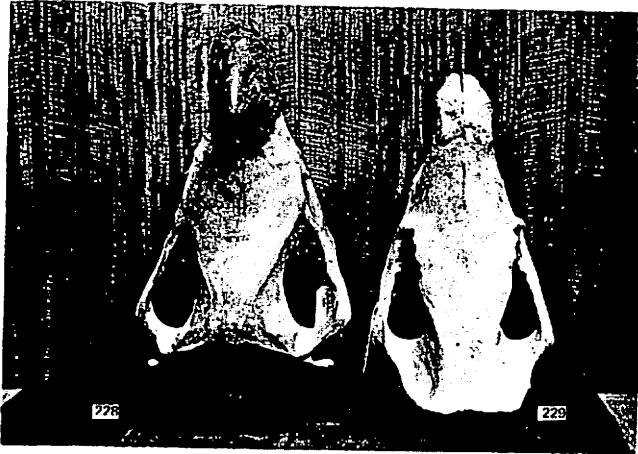


and shrubs often survive and after some time put out new shoots if they were cracked or continue to grow in a horizontal direction if they were uprooted, certain localities are of a 'rhino character.' In such regions regeneration of the forest is of course hampered, so that they continue to form suitable forage ranges for the rhino for long periods." The Javan Rhinoceros thus modifies his environment to meet his dietary needs.

Reproduction of *sondaicus* is little known, since there have been no captive births, no close determination of gestation, and no detailed observations of mother-young relationships. *R.sondaicus* are probably polyestrous, coming into heat every 46–48 days (as in the Indian rhino) ; a single calf is born after a gestation of about 16 months (Crandall, 1964). The calf is suckled for at least a year and perhaps as long as two years; mature females probably do not breed more often than every fourth or fifth year (Fischer, et al, 1969),

Sexual maturity is reached at about 3–4 years for the female and about 6 years for the male (Schenkel). Only 9 are definitely known to have been in captivity, and the captive longevity record is 21 years (Reynolds, 1960)

Kurt (1971) has shown that rhinoceros hunting methods are selective for females, and since hunting is the major mortality factor among Javan rhinos, females have a much higher mortality rate. In 1955, the male: female ratio at Ujung Kulon was at least 2:1 (Hoogerwerf); Fischer *et al.* report that in the period 1955–1965, only six calves were born. If, as Schenkel and Talbot propose, the sexes are equal in number and the females breed every fourth or fifth year, at least 20–30 calves should be expected; six calves in ten years represents the output of at most three females. This has serious consequences for the continued survival of the species.



Comparison of skulls of *Rhinoceros sondaicus* (228, left) and *Dicerorhinus sumatrensis* (229, right). Skull photos by J. McNeely, of specimens

in the British Museum (Natural History). Live specimen photographs of both species courtesy World Wildlife Fund.



ASIAN TWO-HORNED or SUMATRAN RHINOCEROS

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Dicerorhinus sumatrensis (Fischer, 1814)

Synonyms: *Didermocerus sumatrensis* Brookes, 1828 (although this generic name has precedence over *Dicerorhinus* Gloger, 1841, it was published in a sale catalog and was not intended for purposes of permanent scientific record as required by the International Code of Zoological Nomenclature; therefore, the later name must be used); *Rhinoceros lasiotis* Buckland, 1872; *Ceratorhinus niger* Gray, 1873.

Diagnosis: A small, hairy rhinoceros with one fold of skin crossing the back just behind the shoulder; two horns.

Size: Shoulder: 1000–1400; HB: 2400–2600; T: 650; HF: 200–220; W: 900–1000 kg.

Distribution: Historically, *D. sumatrensis* ranged from the Chittagong Hills of Bangladesh throughout Burma as far north as Putao (28 degrees N.), south through Thailand and Malaya to Borneo and Sumatra (not found in Java, even in fossil form, indicating that it was a later arrival to Southeast Asia than was *R. sondaicus*). Groves (1967) reports only 1 specimen from Indochina (Cam Ranh, Vietnam), but Talbot (1960) says that *sumatrensis* was common in the Mekong Valley in

the 1920's. In Thailand, they are now found only along the Tenasserim, on the Malayan border, at Khao Soi Dao in Chantaburi (where a track was found in 1974), and in Chaiyaphum Province in the Petchabun Range where 3 individuals were reported in 1972 (McNeely and Cronin, 1972); an expedition in July, 1976 found tracks of at least two individuals in Phu Kheo Game Reserve in Chaiyaphum (McNeely and Laurie, 1977). There may be as many as 10 *sumatrensis* in Thailand, with a total world population of up to 200. The subspecies in Thailand is probably *D. s. lasiotis* (Buckland, 1872); it differs from the typical form in being larger, paler in color, with smoother skin, longer and more rufescent hair, shorter and more tufted tail, and a broader head.

Description: *D. sumatrensis* is the smallest, hairiest, and most primitive of the rhinos. While other species are generally hairless (an advanced character), young *sumatrensis* are covered in a coat of long, soft, brown hair, reduced in the adult to short black bristles, with long hairs found only on the flattened surface at the tip of the tail. The skin is thinner, and the folds are much less pronounced than in *Rhinoceros*. Color is buff to gray, with the underside of the body, insides of legs, and lips a light flesh color.

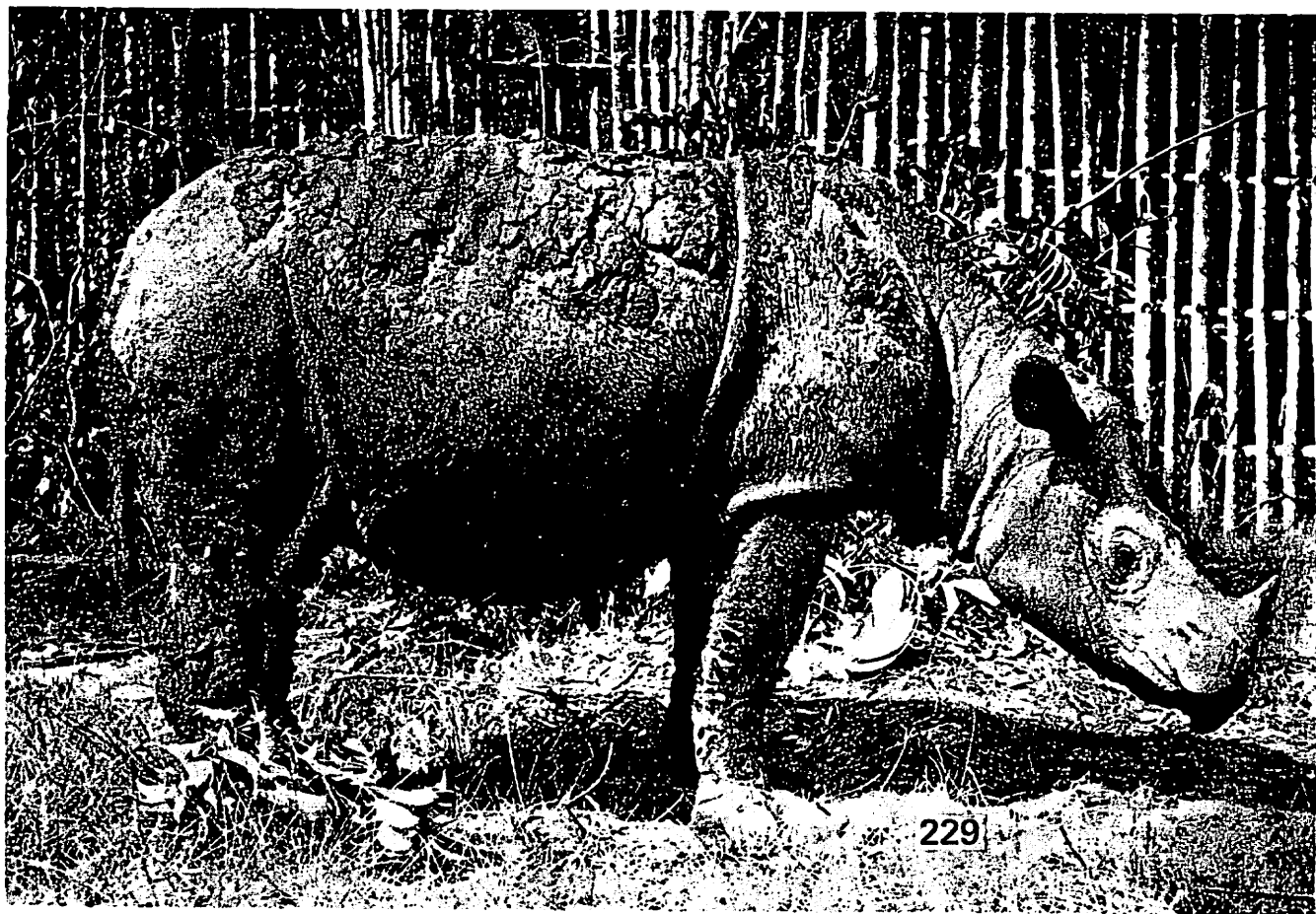
The horns are thick and massive at the base, but

more slender above, with the anterior horn sweeping back in a graceful curve, useful for plowing through thick vegetation; in old males, the entire surface of the nose may become a mass of horn, with one or more supernumerary horns developing (Hubback, 1939). The front horn is usually about 250 mm long, with the rear horn about 100 mm; the rear horn may be represented by only a horny thickening of the skin in females. Dollman and Burlace (1935) quote records for anterior horns of 810 mm and 705 mm, but since localities and measurements for rear horns are not given, the identification of these horns must be questioned. For the other six horns on their list, localities and rear horn measurements are given, and the longest horn is only 380 mm, with the following horns much smaller still.

As in other rhinos, the sense of smell is well developed; the large nasal cavities "no doubt enhance the power of scent, and the habit the animal has of curling up its pointed upper lip when testing the wind is no doubt an effort to utilize more of the inner surface of the nostrils to try to discover the direct line of scent" (Hubback, 1939). *D. sumatrensis* is also capable of a wide range of

sounds from a noise "something between the bark of a dog and the quack of a duck" to a series of snorts and grunts when wallowing to a squeal when dying a violent death "not unlike the screaming of the sambar under similar circumstances" (Hubback, 1939).

Ecology and Behavior: *D. sumatrensis* was formerly found in a wide range of habitats, including swamps and low-lying forests, and some have been seen swimming in the ocean near Ranong Province; but the species now seems to be confined (on the mainland) to the most remote areas of steep montane forests, up to 2000 m altitude. According to Hubback, "They particularly favor the heads of narrow valleys, where they generally have well-used wallows, plenty of thick undergrowth and precipitous sides to the valley so that they can have plenty of exercise." Talbot (1960) adds, "Even while following its tracks, 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 4 or 5 feet deep, with slippery rounded rocks for a bottom....From the tracks and



other signs, the most frequented rhino paths were stream beds. Next came game trails, ruts in the mud up to 3 feet deep with roots and logs worn smooth by elephant and rhino. They also just wandered cross-country. Judging by the tracks, muddy, vine-covered slopes too steep for men to climb straight up, were ascended with ease by the wandering rhinos." The inaccessibility of the *sumatrensis* habitat is a vital factor in the continued existence of the species.

Diet and feeding habits are roughly similar to those of *sondaicus*. Over half the plants identified as *sumatrensis* food plants by Strickland (1967) are characteristic of secondary forest or fringe areas (the edge of clearings, land slips, stream and river banks, wind falls, etc.). Strickland also found that 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, he found trees that had been scraped, but not eaten, from which he deduced that this is one of the ways the rhinos distinguish the plants they prefer. According to Hubback, *sumatrensis* when feeding will "get a sapling behind his front horn and twist it round and round until it is thoroughly decorticated and covered with mud from his head"; this is a distinct field sign for the species. A favorite fruit seems to be *Mangifera*, a type of wild sour mango; during the fruiting season, *sumatrensis* feces are full of mango seeds, and young seedlings have been seen sprouting from old deposits; in this way, *sumatrensis* spreads the wild mango and other fruits throughout the jungle.

Social behavior in *sumatrensis* is somewhat different from *sondaicus*, with the females having a fairly well defined home range and the males wandering widely. Strickland found that the *sumatrensis* he studied in Malaya had ranges of at least four square miles, and that these ranges overlapped somewhat in the most favored area. According to Ripley (1964), "Even if there were only a dozen Sumatran rhinos in a thousand miles of tumbled hills and ridges, it may be possible for these creatures to work north and south along their game trails and occasionally encounter each other." This is supported by the sexually distinct signs that rhinos often leave, and by the fact that rhinos tend to follow old and well-worn trails, and use the same seasonal wallows over long periods of time; so if a female stays in one locality, the wandering male can come to her territory during

the mating season, said to be between July and October (Hutchinson and Ripley, 1954).

A single calf is born after a gestation period of about 7–8 months (Bartlett, 1873); this figure has often been questioned, since the other rhinos have gestation periods of about 16 months, but there are indications that Bartlett may have been essentially correct. Bourliere (1962) says that duration of gestation is roughly proportional to size, and the adult *sumatrensis* is only half the weight of adult *sondaicus* or *unicornis*. The birth weight in *sumatrensis* is about 25 kg (Sanyal, 1892), 42% of the 60 kg birth weight of *unicornis* (Crandall, 1964) (no birth weights are known from *sondaicus*). The *sumatrensis* calf has a much faster growth rate than *sondaicus*; Groves (1967) studied 49 *sumatrensis* and 46 *sondaicus* skulls, dividing them into 6 growth stages, using tooth eruption. Although the sequence of eruption corresponded in both species, the duration of the various stages differed; in *sumatrensis*, Stage 2 skulls were about 90% the size of Stage 6 skulls, while in *sondaicus*, Stage 2 skulls were only about 75% the size of Stage 6.

The first rhinoceros bred and born in captivity was a *sumatrensis* in the Calcutta Zoo (Sanyal, 1872); by the age of 2 years 7 months it was the size of its mother, though it still suckled on occasion. Unfortunately, this was the last recorded captive *sumatrensis* birth, and there are none in captivity today (the last one died at the Copenhagen, Denmark Zoo in 1972). The captive longevity record is 32 years 7 months (Reynolds, 1960).



Range of *Dicerorhinus sumatrensis*