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Asiatic Rhinoceroses

by Rudolf Schenkel

Indian Rhinoceros *(Rhinoceros unicornis)*

Diet. The second largest species of rhinoceros, the one-horned Indian rhinoceros, feeds primarily, but not exclusively, on grasses. W. A. Laurie, who observed the rhinoceroses at Chitawan National Park in Nepal, determined that tall, usually reedy grasses are their most common foraging plants, followed by short species of grass. They also eat small amounts of aquatic plants, herbaceous plants, bushes, tree twigs, and tree sprouts.

The Indian rhinoceros has two eating techniques. Short grasses are grasped and plucked with the upper and lower lips, which curve inward towards the mouth. It uses its prehensile upper lip to feed on all other types of plants. The plants are either seized and torn off with the upper lip or pushed between the molars and then simultaneously torn and bitten off under pressure applied by the jaws.

The animal's method of feeding on underwater plants is similar to that of the elk. It sticks its entire head underwater and pulls the plant out by the roots or tears part of it off. It then lifts its head out of the water to chew and swallow the plant.

Habitat and Range. In historical times, the Indian rhinoceros lived on the vast floodplains of the great Indus, Ganges, and Brahmaputra river systems. Its range extended a distance of 1400 mi (2400 km) from the border of Burma in the east to the central Indus Valley in the west in a band 60 to 240 mi (100 to 400 km) wide.

The habitat of the Indian rhinoceros undergoes greater seasonal change than that of any other species of rhinoceros. Large parts of its range are flooded during the rainy season. Some areas become so flooded that they no longer provide a

suitable habitat. During such floods, soil is often washed away, and new river channels are formed; the soil is deposited elsewhere, and old river channels are filled in. The system of tributaries and the pattern of drainage and discharge are in a state of continuous change. During the dry season, riverbeds dry up, and only the largest tributaries carry water. Branches of the river system are cut off from the rest of the system and become large basins of water that gradually decrease in size until the start of the next rainy season. The continuous changes occurring on the flood plain have a tremendous effect on plant life, which in turn affects the food supply of the Indian rhinoceros. The extreme variability of its habitat explains why it does not have a specialized diet and why it has developed more than one feeding technique.

Resting, Wallowing, and Bathing. Rhinoceroses are occasionally seen sleeping on dry ground on the morning Sun in Kaziranga. Riding by elephant



The population of Indian rhinoceroses has been reduced to only about 1400, most of which live in protected areas. This population is dangerously low, but it is much greater than the populations of the other two Asiatic species, the Sumatran rhinoceros and the Javan rhinoceros.

through certain areas with tall grass, one comes across wallowing holes made by rhinoceroses in the clayey soil. The rhinoceroses rest and wallow in the muddy water in these holes for hours at a time. In old water basins, one often sees a cattle egret standing in the middle of the water, surrounded by three peaks sticking out of the water



– the ears and horn of a rhinoceros. About once a minute, the rhinoceros lifts its head just far enough out of the water to enable it to breathe. The rhinoceroses have such rest periods both at night and during the day. In the water and in wallowing holes, they do not have to work so hard to support their weight. In addition, they are protected from bloodsucking flies and from the oppressive heat of the day. The dry mud that later coats their hides also protects them.

Social Behavior. In the vast majority of cases, Indian rhinoceroses are solitary animals. The only social group that is commonly seen is a cow with her calf. Two half-grown bulls are very rarely seen together. However, temporary groups are not uncommon. For example, individual animals and cows with their calves may be seen grazing on short grass near one another, but independently, or several rhinoceroses may be seen at an oxbow lake, some of them sleeping, and others feeding on aquatic plants. In such collections of rhinoceroses, the animals do not react to one another or at least do not show any discernible interaction. The varied development and outcomes of encounters between rhinoceroses show that the relationships between them are also varied. There are varying degrees of trust and tolerance and varying degrees of insecurity and intolerance.

Tensions become apparent when there are shortages of certain essential things. This is especially true of wallowing places during the dry season. To be able to wallow, a newcomer must approach the animals that are already there. Such a newcomer is viewed by the others as an intruder, and they make unfriendly sounds to drive it away. When this happens, the newcomer veers from its direct course towards the wallow and moves left or right until the wallowing animals have settled down. It is then able to take an unoccupied place in the wallow.

Observations suggest that even in this type of encounter, the degree of familiarity of the animals with one another is an important factor affecting the outcome of the confrontation.

Fighting Among Conspecifics. In species of solitary animals, a high population density stimulates aggressive behavior. Such is the case in Kaziranga. If one remains in the middle of the park after darkness has fallen, one often hears the characteristic sounds of violent fighting between rhinoceroses. The character of the sounds indicates whether the animals are having a pitched battle or whether one is fleeing and the other pursuing. In many of these fights, it is not simply a case of one animal reacting threateningly to the innocent approach of another animal. W.A. Laurie established that of 22 rhinoceroses that had died in Chitawan National Park, six had been killed by other rhinoceroses. Fighting among conspecifics is an important natural cause of death when population density is too high. This is confirmed by observations in Kaziranga. Which animals become involved in fights? Fighting occurs fairly often between cows and is often preceded by a phase in which the two



The Indian rhinoceros lives in swampy terrain and on the floodplains of large rivers. The grasses that thrive in such areas are its principal source of food, but it also feeds on aquatic plants and twigs.

cows stand facing each other, horn to horn. However, such disputes between females hardly ever result in injury or persistent chasing. Almost all violent attacks are made by dominant bulls, either against other bulls (young and almost adult animals) or, under certain circumstances, against adult cows. Both of these cases will be examined.

In a population of Indian rhinoceroses, there are dominant and inferior bulls. The dominant bulls have the greatest social status in the population. However, unlike dominant white rhinoceros bulls, they do not live in a fixed home range that they



defend as a territory against other dominant bulls. Both the seasonal changes in living conditions and the difficulty of overseeing a large area make strict territoriality impossible. In the course of the year, dominant bulls continually shift the main area of their activity, and the boundaries of this area are never exactly established. Under these conditions, enforcing their dominance requires a great deal of effort on the part of dominant bulls in the form of extensive marking and emphatic intolerance of other bulls.

Inferior bulls usually retreat from a dominant bull or flee in haste. A dominant bull will sometimes pursue a fleeing inferior bull. Fighting can lead to serious injury and even death, especially under the following conditions:

1. The dominant bull notices the first signs of approaching estrus in a cow that has a male calf. Threats made by the bull for the purpose of chasing the calf away may cause the calf to attach itself more closely to its mother. Such behavior only causes the bull to become even more aggressive towards the calf.
2. Occasionally, a full-grown or almost full-grown bull fails to flee when a dominant bull aggressively advances towards it. In this case, a real battle may ensue. The weaker bull can sustain severe wounds in such contests, and when it finally takes flight, it is still exposed to attack from the rear by its pursuing adversary.

However, the intolerance of dominant bulls does not explain why they sometimes attack cows.

Mating Behavior. Now and then a dominant bull associates with a loosely organized group of cows and juveniles without displaying any aggressive behavior. Oddly enough, fighting occurs very frequently between a bull and a cow in preestrus. There have been only partial observations of this behavior in animals living in the wild, but the whole process has been observed in zoos. Therefore, we shall now give a detailed description of the entire mating process as we have observed it many times at the Basel Zoo.

When the bull and the cow are let out of their

separate stalls and into the outdoor enclosure, the cow produces a two-part mating sound, often with each breath. The two parts of this sound are a squeal followed by a noisy expulsion of air. The cow often approaches the bull, but sometimes the bull goes to meet the cow. This is usually followed by brief nose-to-nose contact, after which the bull suddenly lowers its head. This is a threatening gesture and indicates readiness to attack. The cow responds by lowering her head in defense. This may be followed by a phase in which static periods alternate with sudden charges by the bull. The cow reacts to the bull's charges by opening her mouth wide, bellowing, drawing back her ears and assuming a posture indicating readiness to flee.

Sometimes the bull will stop at this juncture, turn, and gallop a short distance from the cow in a seemingly playful way. In this case, the cow usually follows him and produces more mating sounds. However, it is usually the cow that gallops away. She flees from him and he follows at a gallop. During such phases in the pre-mating activity, both animals often produce a cry that sounds like



a low-pitched trumpet blast. There are two possible further developments:

1. After chasing the cow for about 300 ft (100 m), the bull stops chasing her and just stands there. Then the cow also stops running and soon returns to the bull and starts producing her mating sounds again. At this point, there may be a repetition of the entire confrontation scene, or the bull may lie down or continue standing

The Indian rhinoceros likes to rest in the water. The buoyancy of the water makes it easier for the animal to support its tremendous weight. In addition, it is protected from the hot Sun and from blood-sucking insects.



quietly. In the latter case, the cow displays symbolic infantile behavior, that is, she assumes the same position with respect to the bull that a calf assumes with respect to its mother when it suckles. At the same time, she produces the mating calls.

2. The bull chases the cow for a long distance. If he catches up with her, he runs with the front half of his body alongside the rear half of her body, or places his weight laterally against her, or bites her flank. After this tumultuous chase, they usually stop and rest in the manner described above.

During the confrontation and chase, the cow often sprays small amounts of urine. During the resting phases, the bull sniffs the ground where the female urinated, senses the sexual scent secretions (pheromones) in the urine, and then sprays small amounts of his own urine. The relaxed phase (the bull laying or quietly standing, and the cow in an



infantile stance and making her mating sounds) is usually interrupted by the bull. He starts to approach the cow from the rear. At first, the cow eludes him by turning her head towards him. This leads to further confrontation, as described above, and often to chasing.

A new phase begins as soon as the female ceases to thwart the bull's attempts to approach her from behind. He increasingly shows signs of wishing to initiate copulation. He places his head on the cow's croup; he places his head on her croup and then partially mounts her; he mounts her completely and then remains in this position. Before intromission occurs, mounting is often repeatedly

interrupted, either spontaneously by the bull or by the cow, which moves forward, forcing the bull to dismount. After the bull has dismounted, he remains standing behind the cow for a short while. He then mounts her again, and sooner or later, intromission occurs, followed by copulation, which often lasts for more than an hour. After copulating, the bull and cow pay no attention to each other. In the case of wild rhinoceroses, however, the bull may remain near the cow for two days. As a result, other bulls are discouraged from staying in the immediate vicinity.

These observations still fail to explain the bull's markedly aggressive mating behavior. It seems that the bull's attacks initially cause the preestrus cow to assume an "infant's role", a role which simultaneously entails subordination and attachment. Apparently, however, the cow is not yet ready for mating and rejects the bull's advances. This in turn provokes aggressive behavior in the bull. It is uncertain whether the bull's aggressive behavior merely serves to encourage further submissive, infantile behavior in the cow or also stimulates her willingness to mate.



(Far left) Confrontation between two bulls. The animal on the left has just taken flight. (Left) Indian rhinoceroses do not forage at any specific times and occasionally are even active at night.

Communication. In direct encounters between Indian rhinoceroses, as in the two African species, various methods of communication can be observed alone and in combination. These include optical, acoustic, and olfactory signals. The most important optical signals, which may be used alone or in combination, are the stance of the body, the attitude of the head, the position of the ears and possibly the tail, the degree of opening of the mouth, and certain forms of movement. These



optical signals are usually accompanied by specific vocalizations. We have already mentioned the double mating call of the cow, the bellowing of the inferior animal during a confrontation, and the trumpetlike cries of pursuing bulls and fleeing cows prior to mating.

Other vocalizations include:

1. Loud snorting, accompanied by powerful exhalation, in cases of sudden alarm.
2. A loud "cracking" sound produced in a rapid rhythm when the animals are running at a fast trot. I have heard this sound produced by rhinoceroses in Kaziranga as they fled from the elephant on which I was riding or sometimes as they charged at the elephant on the path and then ran away from it.
3. A soft, rather high-pitched bleating sound; calves make this sound when they beg for milk (half-grown female animals in zoos also produce this sound as they wait in their outdoor enclosure to be let into their stalls at feeding time).
4. The rhythm and loudness of breathing, which also serve as communication signals.

We have already mentioned the discharge of small amounts of urine in connection with mating behavior. This is apparently a form of mating communication.

The discharge of dung has a "contagious" effect, especially between a bull and a cow. Dung heaps stimulate sniffing and defecation. This leads to the

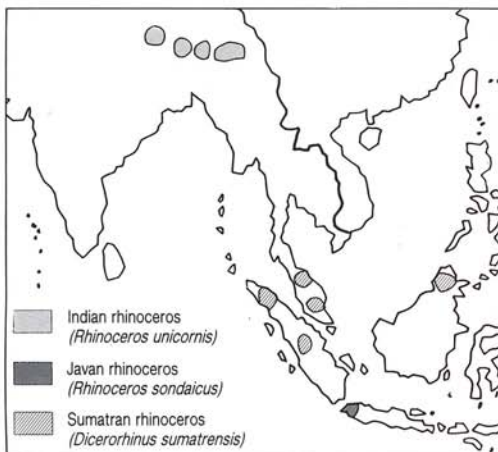
formation of irregular rows of dung piles and to the formation of huge dung heaps here and there along frequently used paths.

However, the most important forms of direct communication are the spraying of plants with urine, especially at the boundary between two types of vegetation (for example, short grass and napier grass), and the production of foot-dragging tracks. Such tracks are sometimes quite long, and in exceptional cases may extend several hundred yards. They serve not only as optical signals, but also as olfactory signals that indicate the presence of their creators, namely, dominant bulls. Urine spraying and the production of foot-dragging tracks are often stimulated by the scent tracks of another rhinoceros.

Population. The human population of India has increased tremendously over the past few centuries, resulting in the confinement of wild animals to smaller and smaller areas. This is also true of the great floodplains on which the Indian rhinoceros lives. These plains are now extensively used for agriculture. The parts of the floodplains that are not used for agriculture are subject to severe annual flooding and thus are not suitable habitats for rhinoceroses at all times of the year. Furthermore, the continuing destruction of forests is increasing the severity of the annual flooding.

At the beginning of the twentieth century, the Indian rhinoceros was brought to the edge of extinction by destruction of habitat, legal hunting and poaching. In 1903, there were no more than 15 rhinoceroses living in Kaziranga, and only about 100 survived in Nepal.

Rhinoceros hunting was outlawed in India in 1910. To prevent the few surviving rhinoceroses from falling victim to poachers, preserves were established. The most suitable area in India for rhinoceroses was Kaziranga. Since about 1910–1915, the population of 15 animals has grown to about 1000. The residual population in Chitawan National Park in Nepal was also saved and has grown to about 300 animals. The total population of this species is now about 1400.





Forest-dwelling Rhinoceroses

The JAVAN RHINOCEROS (*Rhinoceros sondaicus*) is closely related to the Indian rhinoceros, but from an ecological standpoint, it is more natural to discuss it in connection with the SUMATRAN RHINOCEROS (*Dicerorhinus sumatrensis*).

The Javan and Sumatran rhinoceroses are both forest-dwellers and feed on almost the same species of plants. At one time, they both lived in Burma, Thailand, Laos, Cambodia, Vietnam, Malaysia, and Sumatra. Only the Javan rhinoceros occurred in the Sunderbans and in Java, and only the Sumatran rhinoceros lived in Borneo.

How were both species able to live in the same areas, and why did the Sunderbans, Java, and Borneo each have only one species?

Only the Javan rhinoceros lived on the wooded floodplains of large rivers within its range, including the Sunderbans. In Java, which it did not share with the Sumatran rhinoceros, it inhabited both flat lowlands and mountainous terrain. Borneo was inhabited only by the Sumatran rhinoceros. On this island, the rhinoceroses lived at all elevations but never lived on extensive plains. In countries in which both species lived, the Java rhinoceros occurred mainly in lowlands and flat terrain, while the Sumatran rhinoceros occurred from the highlands to the mountain forests. Apparently, each of these species is especially well adapted to one type of terrain, in which it is able to dominate the other species and drive it out. However, in those countries which are inhabited by only one of the species, the animals are also able to live in habitats to which they are not optimally adapted.

The presence of rhinoceroses on Sumatra, Java, and Borneo is doubtless the result of an ice age, during which the level of the oceans dropped, and the Greater Sunda Islands and the Sunda Shelf (which is now submerged) formed a continuous land mass with the Asian mainland. However, we still do not know why Java and Borneo had only one species each.

The world population of Javan rhinoceroses has

been reduced to only about 60 animals living on the Ujung Kulon Peninsula at the western tip of Java. Reports of sightings in other locations are more than 20 years old and were considered unreliable even at that time.

There are small populations of Sumatran rhinoceroses in Sumatra, Borneo and Malaysia. The total population is perhaps 300.

The Javan rhinoceros is rarely seen, and it is almost impossible to track down a Sumatran rhinoceros. Consequently, field studies are usually limited to detailed observation and careful interpretation of physical evidence left behind by these animals. In the last 20 years, the Javan rhinoceros was studied in this indirect fashion by my wife and me and later by Hartmann Ammann, while the Sumatran rhinoceros was studied by Markus Borner, Rodney Flynn and Nico van Strien.

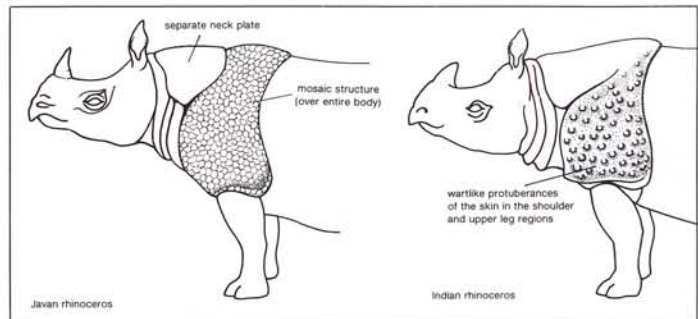
The most important results of these studies are summarized here.

Diet and Feeding Technique. Both species eat branches of young trees and bushes as well as lianas and herbaceous plants. The Javan rhinoceros also eats the hanging branches of certain trees at the edge of the forest. The Sumatran rhinoceros eats the fallen fruit of certain species of trees.

The Javan rhinoceros forages especially in areas in which the forest canopy is open and more light reaches the ground. It also forages in areas of mixed vegetation consisting of scattered trees, bushes, and herbaceous plants, hung with creepers and rattan palms.

The plant communities of the valleys, slopes, and

The Indian rhinoceros and the smaller Javan rhinoceros belong to the same genus and are very similar in appearance. However, they are easily distinguished on the basis of the features shown in the illustration.





ridges provide food for the Sumatran rhinoceros.

Both species use their jaws or chest to break or bend young trees with trunk diameters of up to 4 in. (10 cm). This enables them to feed on the young branches in the crown of the tree. Small trees bent down in this way often do not die and later grow new branches.

When a rhinoceros finishes feeding on a plant, it usually wanders more than 120 ft (40 m) and then stops to feed on a different species of plant. This is probably an adaptation that keeps the rhinoceros from eating too much of certain species of plants that contain poisonous substances. The feeding activity of these rhinoceroses limits the growth of young trees and the density of the forest canopy. It also promotes the growth of shoots and new young plants, that is, the principal diet of the rhinoceroses.

Resting, Wallowing, and Bathing. Both species rest by lying on the ground amid dense vegetation, on a ridge with a strong wind or under the roots of a large, uprooted tree. They also rest in wallows. The Javan rhinoceros digs wallows in wet, loamy soils. It usually uses a wallow for only a few days. Some wallows of Sumatran rhinoceroses simultaneously serve as salt licks. Successive generations of rhinoceroses expand these wallows into deeper and deeper pits, and well-worn paths are found leading to the pits. After wallowing, the Sumatran rhinoceros rubs its body against tree trunks.

The Javan rhinoceroses in Ujung Kulon do not dig such pits; they obtain their salt from the sea.

The Javan rhinoceros often rests in large streams with only its nose and forehead above the surface of the water. It has a symbiotic relationship with certain fishes and crabs in these streams: the fishes and crabs feed on the ticks on the rhinoceros' hide, and the rhinoceros gets rid of its ticks.

Defecation and Urination. Both species often drop their dung in shallow streams and on or at the side of their paths. Old dung stimulates the animals to add more dung to the pile. Dung is often dropped two to four times in the same place. In rare in-

stances, dung is dropped ten or more times in the same place. In all of these cases, the dung does not seem to be very important as a marker.

The Sumatran rhinoceros has another form of defecation, namely, defecation combined with scraping the ground; in many cases, it also sprays urine and beats plants with its horn at the same time. When it strikes and pushes the small trunks of saplings with its horn, they become bent into loops and tangled together. The bark of large tree trunks is damaged from the ground to a height of 20 in. (50 cm) by this activity. The animal also beats bushes and herbaceous plants with its horn. In these cases, the animal is apparently leaving territorial marks and thus is probably the dominant bull in the area.

Urine spraying by Sumatran rhinoceroses is not limited to dominant bulls. Cows and inferior bulls also spray urine. This shows that this form of urine discharge is not an expression of dominance, but rather a means of marking paths and announcing an animal's presence. This is not the case with the Javan rhinoceros. Javan rhinoceroses do not scrape the ground in connection with urination or defecation. In any given area, there is only one animal that engages in frequent urine spraying. Presumably, this animal is the area's resident dominant bull.



The two forest-dwelling species of rhinoceros are seriously endangered. The total population of Javan rhinoceroses (right) is only about 60. The total population of Sumatran rhinoceroses is about 300. (Above) Young rhinoceros in the Melaka Zoo, Malaysia.

