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REPRODUCTIVE BEHAVIOR IN SUMATRAN RHINOCEROS AT ZOO MELAKA

BY

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A B S T R A C T

The Sumatran rhinoceros is one of the most endangered species of large mammals in the world. Efforts are being carried out to save the existing captive and wild population. Currently, there are 19 animals in captivity throughout the world.

Since 1984, a total of 27 Sumatran rhinoceros were caught and kept at 8 facilities throughout the world. The high captive mortality rate of 29.6% is similar to the Black (*Diceros bicornis*) and the Indian (*Rhinoceros unicornis*) rhinoceros in other modern sophisticated zoos. Aspects of reproductive biology is very different in the Sumatran rhinoceros.

The study done at zoo Melaka revealed certain facts about the behavior pattern during contact promotion and estrus. Tail wagging and vocalization are two important criteria apart from the frequency of anogenital contacts, that were observed during estrus and estrus. Mounting and erection subsequently occur during the period of standing heat.

DISCUSSION

The Sumatran rhinoceros is one of the most endangered species of mammals in the world. Efforts are being carried out to try to conserve the existing captive and wild population. Currently there are 16 (10 males, 14 females) animals in captivity throughout the world. The subspecies from West Malaysia consist of 1 male and 7 females, while the subspecies *D.s. harrisoni* consist of a male and 7 females. The only recorded birth in this century is from Zoo Negara of the subspecies *D.s. sumatrensis*. There were three successful matings recorded at the zoo involving 2 different females.

Presently, the estimated wild population of Sumatran rhinoceros is 55, of which 47% is located in Taman Negara and Borneo. The remaining population are located in unsecured areas that is unstable for natural propagation. Between 1975 - 1980 the population had stabilized below 100, possibly due to the habitat destruction and a long calving interval.

Between 1944 - 1945 a total of 27 Sumatran rhinoceros were caught and housed in facilities throughout the world. The high captive survival rate of 29.6% is similar to the Black (*Diceros bicornis*) and Indian (*Rhinoceros unicornis*) rhinoceros in other modern sophisticated zoos (Lang, 1977; Beehler and Bush, 1981; Charney, 1984; Fowler, 1986).

Although we are gathering much information on the clinical and management problems, there is insufficient information on breeding.

Currently, there is no information on the milk composition of Sumatran rhinoceros which is essential as a guideline for the rearing of the Sumatran rhinoceros calves in the future. With increase in habitat destruction, the chances of acquiring young Sumatran rhino increases. In hand raising rhino calves, the use of appropriate formulation is important in ensuring adequate nutrition. Data on the milk constituents of the Black, White and Indian rhinos are available (Fowler, 1986; Gregory et al., 1965). This report reports the milk analysis of the female, Rima, which gave birth in captivity at Zoo Melaka in 1987. Milk was collected from the female on the third day of lactation from both mammary glands. Prior to the collection, the calf was allowed to suckle briefly. Suckling was normally done between 0830h to 1100h. The milk was collected in a 4-inch-diameter wide-mouth container before transferring it into a 30 ml bottle, which was then immediately sealed. The samples were sent to the Veterinary Public Health Laboratory, Petaling Jaya, Malaysia for analysis of the major milk constituents. Similarly, milk was collected at 14 weeks, 16 weeks and 2 years lactation.

Due to the insufficient knowledge on the reproductive biology of this species, captive breeding programs cannot be carried out in an efficient manner. Aspects of estrus, gestation, milk, nursing and diseases related to its reproduction is very lacking. However, for other rhinoceros species, studies on pattern of estrogen and progesterone during breeding has been quite successful (Kassam, 1980; Lasley, 1980).

CONTACT-PROMOTING BEHAVIORS

When the female was introduced into the male's paddock a number of responses were exhibited by the 2 animals. The main areas contacted are head, snout, shoulder, forelimb, thorax, abdomen, back, hindlimb and perineum. In the male, during the first 10 minutes of introduction, only 0.7% of the contact promoting behavior was on the perineum and hindlimbs of the female. In the female, 2.1% of the contact promoting behavior involves the perineum. The contacts involving the head and neck accounted for 70.4% and 47.4% in the female and male respectively (Table 1).

Table 1: Changing form of contact promoting behavior

a. Male snout to female (first 100 minutes)

	Head/Snout	Neck	Flank	Back	Foreleg	Hindleg	Anogenital
8	9	5	5	1	0	0	0
9	11	7	2	0	0	0	0
10	9	6	7	1	0	0	0
11	13	4	7	1	0	0	0
12	8	5	7	5	0	0	1
13	11	4	0	3	0	0	0

rubbing of each others' flanks
 on either left or right flanks
 facing each other
 tail raising was only exhibited

Female snout to male (first 100 minutes)

	Head-Snout	Neck	Flank	Back	Foreleg	Hindleg	Anogenital
	10	10	6	16	2	2	1
	11	7	2	11	0	5	4
10	9	9	6	10	0	1	2
11	11	6	7	10	1	3	1
12	9	6	3	8	1	3	0
13	12	1	0	7	0	0	0

However, the contact promoting behavior involving the neck and head of the female decreases during the pro-estrus period (10). Aggression involving head butting, biting, nose to nose rubbing and horn clash were observed. During clashes, the mouth was open and frequently, attempting to bite each other. Similarly, in Indian rhinoceros, the male would inflict severe injuries on the female (Krishne Gowda, 1969). Head bobbing was displayed by the female when the male approaches its perineum. [On the day of estrus, contact on the head and snout of the female was common (Fig. 11). Sniffing, licking and biting of areas on either side of the vulva were also observed to increase a day before estrus (Fig. 12)] Flanking involves rubbing of each others' flank. There was no preference for either left or right flank. Occasionally during flanking, the animals would be facing each other in the opposite direction. Tail raising was only exhibited

by before standing heat. The frequency increases on the day of estrus (Fig.13). In the Indian rhinoceros, lifting of the tail is reported on the day of estrus (Krishne Gowda, 1969).

During the study, the male was observed to urine spray in 10 of the days observed. A high rate of urine spraying was also observed in the Indian rhinoceros. This was partly associated with dominance and physical status of the breeding male. Timid males do not display such behavior (Laurie, 1978).^{In the male} Flow urination were observed on 2 occasions. The female only exhibited flow urination.

Vocalization was observed in the female throughout the study period. They ranged from a squeal to a blow and averaged 13.6 times per day.^{Vocalization ↓ during estrus} Wallowing involves either one or both animals. The use of same or different wallows was recorded.

PRECOPULATORY BEHAVIOR

Very prior to the onset of estrus, the male and female were observed to display tail raising. However male female interactions were absent when the male wallows. This activity occurred on 3 occasions, each lasting between 5 to 10 minutes. Spray urination was displayed by the female while within the night stall. Feeding operation was not interrupted. In the paddock, chasing occurred over short distances. Sniffing the ground was displayed by the rhinoceros. As the male places his chin on the female's back she reacted by moving forward, initiating a driving reaction similar to the Asian elephant (Eisenberg et al., 1970). Vocalization was from a puffing snort to a squeal, similar to the Black rhinoceros.

The squeal may be abrupt or may drag several seconds.

On the day of estrus, the female continues to vocalize (squeal or low), followed by increased frequency of tail raising. The female reverses towards the male. Frequency of anogenital contact increases in the male. At the same time tail raising frequency increases in the female. Penile exposure was displayed on two occasions. The male rests its head on the rump before advancing to mount. The first mount was attempted at 0943h followed by a second at 1043h. The male was observed to mount the female while she was on her sternum or standing. At both times, the penis was fully extended. The subsequent mount occur at 1212h, 1305h, 1415h and 1515h.

In another pair, snout to snout contact was the first contact preceding mating behavior observed. The female snorted and squeal as the

luffed her rump. Whenever the male made contact to the female, the female would reverse. Rapid swinging of the tail was noted in the female. In the horn sparring behavior, the female charges and swings her head, initiating the male to charge. This behavior is repeated several times. All other contact promoting mounting (flanking, necking, head to head etc) will end up with the female reversing into the male. This is followed by mounting.

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OBSERVATIONS ON THE SKELETON OF THE SUMATRAN RHINOCEROS
(Dicerorhinus sumatrensis sumatrensis)

SUMMARY: The present paper is the result of the study of a Sumatran rhinoceros that died in captivity at Zoo Melaka. The skeleton of the Sumatran rhinoceros is briefly described and compared with the skeleton of the horse.

Key words: Sumatran rhinoceros, skeleton, Dicerorhinus sumatrensis sumatrensis.

INTRODUCTION

There are five living species of rhinoceros, of which, two species are found in Africa and three in Asia (Grizimek, 1972). The Sumatran rhinoceros (Dicerorhinus sumatrensis sumatrensis) is the smallest and it is considered to be the most primitive of all the living species of rhinoceros (Walker, 1964; Grooves, 1967; Grizimek, 1972). It has two horns on the nose and carry two permanent folds on the skin (Vanstrien, 1974; Medway, 1978).

There is a dearth of information concerning the skeleton of the rhinoceros in general, and of the Sumatran rhinoceros in particular. The objective of the paper is to describe briefly the skeleton of the Sumatran rhinoceros and compare some of the features of the skeleton with those of the horse.

MATERIALS AND METHODS

An adult male Sumatran rhinoceros was captured during June, 1986 at Tongamba, Indonesia and brought to Zoo Melaka in April, 1987. On 6th August of the same year it succumbed to severe colic that resulted in shock and death (Zainal-Zahari et al 1988).

The carcass was removed of skin, meat, fat and tendons. The bones were boiled in a commercial detergent for 2 hours, cleaned of remaining tissue and dried. Excess fat was removed by soaking in the same commercial detergent several times.

The length of the cervical, thoracic, lumbar and sacral vertebrae were obtained by using a vernier calliper (Mitutoyo, Japan).

RESULTS AND DISCUSSION

The skeleton of the Sumatran rhinoceros consists of 265 bones compared to 205 bones in the horse (Sisson and Grossman, 1975). The number of bones in the various segments of the skeleton is given in Table 1.

The vertebral column comprises of seven cervical, twenty thoracic, three lumbar, four sacral (fused) and twenty-six caudal (coccygeal) vertebrae. Thus its vertebral formula is $C_7 T_{20} L_3 S_4 Ca_{26}$, by comparison the vertebral formula of the horse is $C_7 T_{18} L_6 S_5 Ca_{15-21}$. The total number of vertebrae in the cervical, thoracic, lumbar and sacral regions in the Sumatran rhinoceros and the horse are 34 and 36 respectively. In the rhinoceros there has been an increase in the number of thoracic vertebrae and reduction in the lumbar and sacral regions. The measurements of the body lengths of the cervical, thoracic, lumbar and sacrum regions are given in Table 2. It is

interesting to note that the length of the cervical and thoracic regions comprise 18.03% and 63.9% of the vertebral column (excluding the caudal vertebrae) in the Sumatran rhinoceros, while the corresponding values are 33.33% and 40.95% in the horse. The shorter cervical and the longer thoracic regions in the rhinoceros are adaptations to counter the weight of the large head.

The vertebral column of mammals form a complicated girder to support the body and for movements (Young, 1975, 1981). Large graziers and browsers that are relatively free from predators need not be agile and the evolutionary trend has been towards a skeleton with graviportal features (Hilderbrand, 1982).

The rhinoceros are the only surviving perissodactyls with a graviportal type of body (Young, 1975, 1981) where the vertebral column carry increased number of ribs, and together with the long thoracic spines forms a beam to support the abdomen and counter balances the weight of the head on the fore limbs. The hind limbs provide the main thrust for locomotion. Such a structural arrangement is more suited for charging rather than for swift movement.

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RINGKASAN

PEMERHATIAN KE ATAS TULANG RANGKA BADAK SUMATERA

(Dicerorhinus sumaterensis sumaterensis)

Kertas kerja ini adalah keputusan daripada kajian ke atas badak Sumatera yang mati dalam kurungan di Zoo Melaka. Tulang rangka badak Sumatera diterangkan secara ringkas dan dibandingkan dengan tulang rangka kuda

Table 1

The bones of the various segments of the skeleton of the Sumatran rhinoceros (Dicerorhinus sumatrensis sumatrensis) and the Horse (Equus caballus).

	Sumatran rhinoceros	Horse*
Vertebral column	60	54
Ribs	40	36
Sternum	1	1
Skull (including auditory ossicles)	34	34
Thoracic limbs (including <u>sesamoids</u>)	64 ⁺	34
Pelvic limbs (including <u>sesamoids</u>)	66 ⁺	40
Total	265	205

+ estimated number of sesamoids for each limb = 9

** Sisson and Grossman, 1975

Table 2

Length of the bodies of the cervical, thoracic, lumbar and sacral regions of the Sumatran rhinoceros (Dicerorhinus sumatrensis sumatrensis) and the Horse (Equus caballus)

Region	Sumatran rhinoceros*		Horse**	
	mm	%	mm	%
Cervical	250	18.03	700	33.33
Thoracic	875	63.09	860	40.95
Lumbar	132	9.52	340	16.19
Sacral	130	9.37	200	9.52

* excluding the intervertebral disc.

** including the intervertebral disc (Sisson and Grossman, 1975).