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IDENTIFICATION OF GREAT INDIAN ONE HORNED RHINOCEROS (*RHINOCEROS UNICORNIS*) BY FOOT IMPRESSION

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THREE TEXT-FIGURES

Abstract

The footprint of an individual rhino is distinguishable. Distinctions can be inferred through minute examinations by comparative analysis, which is also a methodology to work out a near accurate population figure besides home range and habitat use pattern.

Introduction

Wildlife research workers may face great difficulties to identify the individuals during their study on animal population or other behavioural aspects such as home range, habitat use pattern, etc. There have been much work on the ungulates (Mukinya, 1976; Owen-Smith, 1971; Frame, 1980) and carnivores (Schaller, 1972; Frame and Frame, 1976) for spot identification either by prolonged or repeated direct observations or by maintaining a photographic recognition file (Van Lawick, 1970). These methods are applicable only where the observation is carried out for long period and where the density of population is fairly good. The presence of tall reeds, thick vegetation and below normal population of rhinoceros in the two eastern Sub-Himalayan Sanctuaries, continuous observation of these animals may not be possible and under such restricted condition recognition of rhinoceros by its footprint may prove to be effective. The survey of Javan rhinoceros was done successfully on the basis of footprints (Schenkel and Schenkel-Hulliger, 1969) but individual recognition had not been carried out. The only other mammal for which the sex class has been reported by measuring the footprints is the tiger (Panwar, 1980).

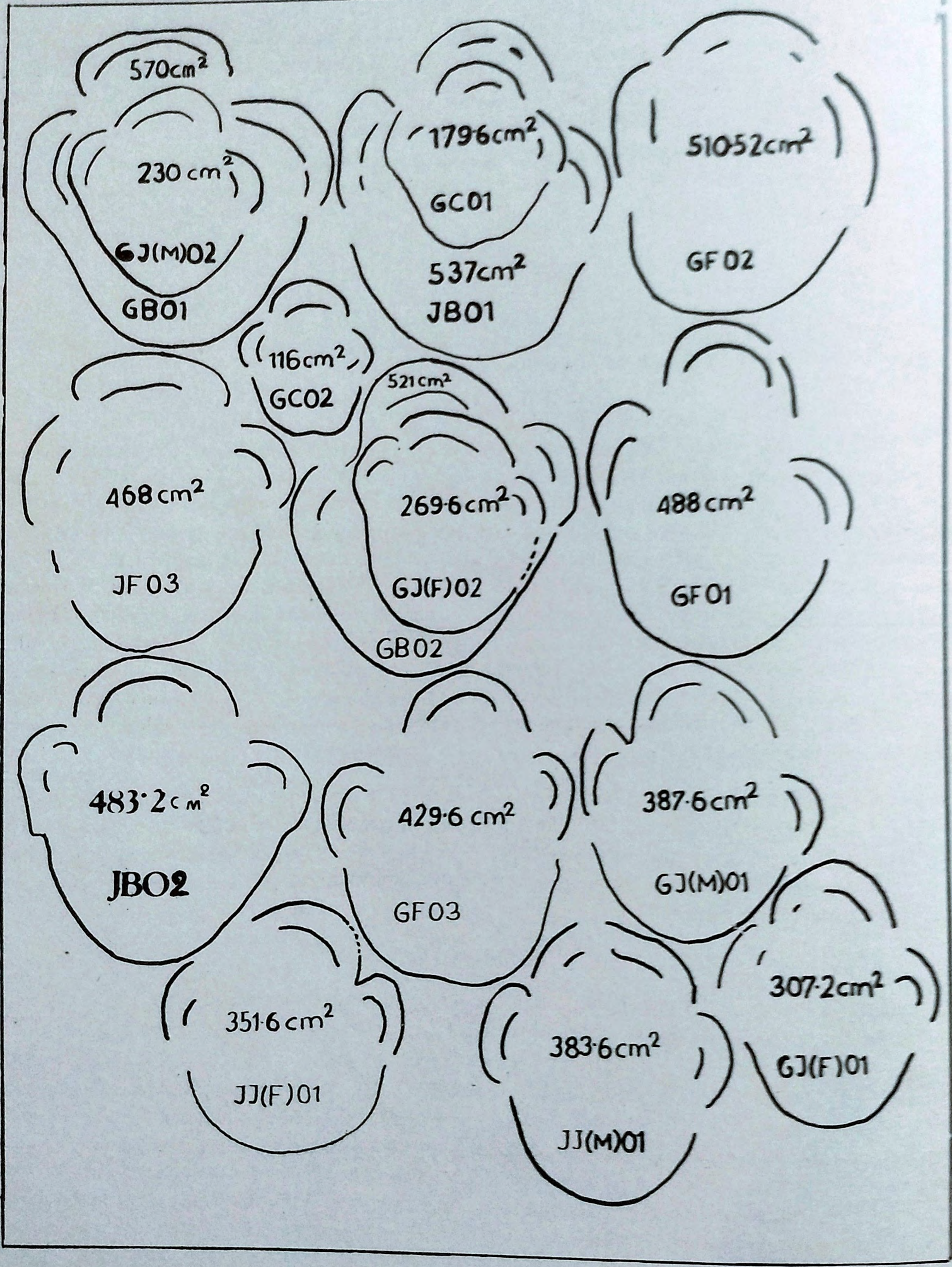
The Great Indian rhinoceros (*Rhinoceros unicornis*) is a large sized herbivore animal living in the grassland zones along with the mudpools. The adult males almost lead a solitary life unless they form pairs in the breeding time. The social association, to some extent, is observed in the juveniles, sub-adults and females. They spend a considerable time of a day in the wallowing mudpools particularly in the summer season (Bhattacharya and Pal, 1982).

Study Areas

Study on footprints and other behaviours (excepting the study on social associations, which was carried out in Kaziranga National Park during October, 1983 to March, 1984) began in May, 1980 and ended in June, 1983. The main study areas were Gorumara (1980-'82) with an area of 8.33 km^2 (26°40'N, 89°00'E) and Jaldapara (1982-'83) with an area of 115 km^2 (25°58'N, 89°55'E). Both these sanctuaries are located in the northern district of the state of West Bengal and in north eastern India. Gorumara contained a small population of 11 rhinos (including a calf) and Jaldapara, though being much larger in area, contained only 28 rhinos. During the study period seven rhinos were poached by horn hunters at Jaldapara and three rhinos were killed at Gorumara by professional poachers. Besides this, tiger predation on a lone calf at Gorumara was also reported. No case of natural death or death from disease was recorded either at Gorumara or at Jaldapara during the period of study.

Methods

The method adopted here consists of a colourless rectangular glass plate of 35 cm X 32 cm X 0.3 cm, a free flowing



TEXT-FIGURE 1. Reductional views of sixteen footprints with their respective sole areas of Great Indian one horned rhinoceros showing the individualities.

fibre micro-tip pen, some papers, a couple of rubber bands and a meter steel tape. This is much more simpler than the technique adopted by S. R. Choudhury [quoted by Panwar (1980)] for the identification of tiger at Simlipal National Park in Orissa. A lot of tracing practice and experience in analytical comparison enabled us to visualise the intricate differences which help to identify one rhino from another. The special features hidden in the morphology of the footprints were studied. The impressions of either right or left hind feet were taken into account for comparative study as the fore footprints were partially or completely superimposed by hind footprints while walking.

The impressions may look bigger on a slushy soil and compact and smaller on a hard surface. Even in such situations, as far as practicable, perfectly normal rear footprints were selected for keeping records. The glass plate was placed lightly above the well formed rear impressions and cares were taken to avoid errors owing to parallax while tracing the outlines by placing the eyes vertically above the impressions. The tracings on the glass plate were transferred to the paper sheets. Tracings were done by holding the glass plate along with the overlaid sheet of papers against light.

Results and Discussions

Rhinos being the perissodactyl animal and having the mesaxonic type of foot, only three digits along with the sole get an imprint on the soil. The imprint reveals that the middle digit is somewhat horizontal guarded on both sides by two lateral vertically placed digits. Individuality remains in the shape and angular orientations of the digits from the centre point, shape of the sole (Text-fig. 1) etc. No identical impression of different individuals was recorded during the field study. The sex could, however, not be identified which is possible in case of tiger (Panwar, 1980). The sole is broader at the top and narrows down at the base (Table 1).

TABLE 1. *Ratio (δ) between maximum breadth of sole (B_m) and breadth of the posterior region (B_p) of the sole (1/4th position from the posterior tip) showing the narrowness of the posterior region [$\delta \alpha 1/B_p$] or [$\delta \alpha B_m$], and corresponding angular orientations of the toes in respect to individual rhinos.*

Individual Nos. of rhinoceros	Maximum breadth (B_m) of sole (in cm)	Breadth of the posterior region of sole (B_p) (in cm)	Ratio (δ) between B_m/B_p	Angular orientation (°) of toes from centre point	
				2nd	4th
GB01	31.6	21.6	1.463*	39	58
GB02	28.8	20.4	1.412*	21	45
GF01	25.6	20.8	1.231	47	25
GF02	26.4	21.2	1.245	43	38
GF03	25.6	20.0	1.280	43	45
JB01	28.0	22.4	1.250	47	35
JB02	27.6	20.0	1.380	36	27
JF01	31.2	24.4	1.279	34	33
JF02	28.4	21.6	1.315	18	33
JF03	26.4	18.4	1.435*	43	45
GJ(M)01	24.0	18.4	1.304	36	12
JJ(M)01	24.8	17.2	1.442*	35	22
JJ(F)01	23.6	19.2	1.229	37	32
GJ(F)01	21.6	15.2	1.421*	39	30
GJ(F)02	20.0	15.2	1.316	42	40
GJ(M)02	19.2	13.6	1.412*	30	30
GC01	18.0	12.8	1.406*	40	32
GC02	13.6	10.0	1.360	30	30
$-CO_3^h$	10.0	8.94	1.119^h	—	—

* = Maximum Narrowness found

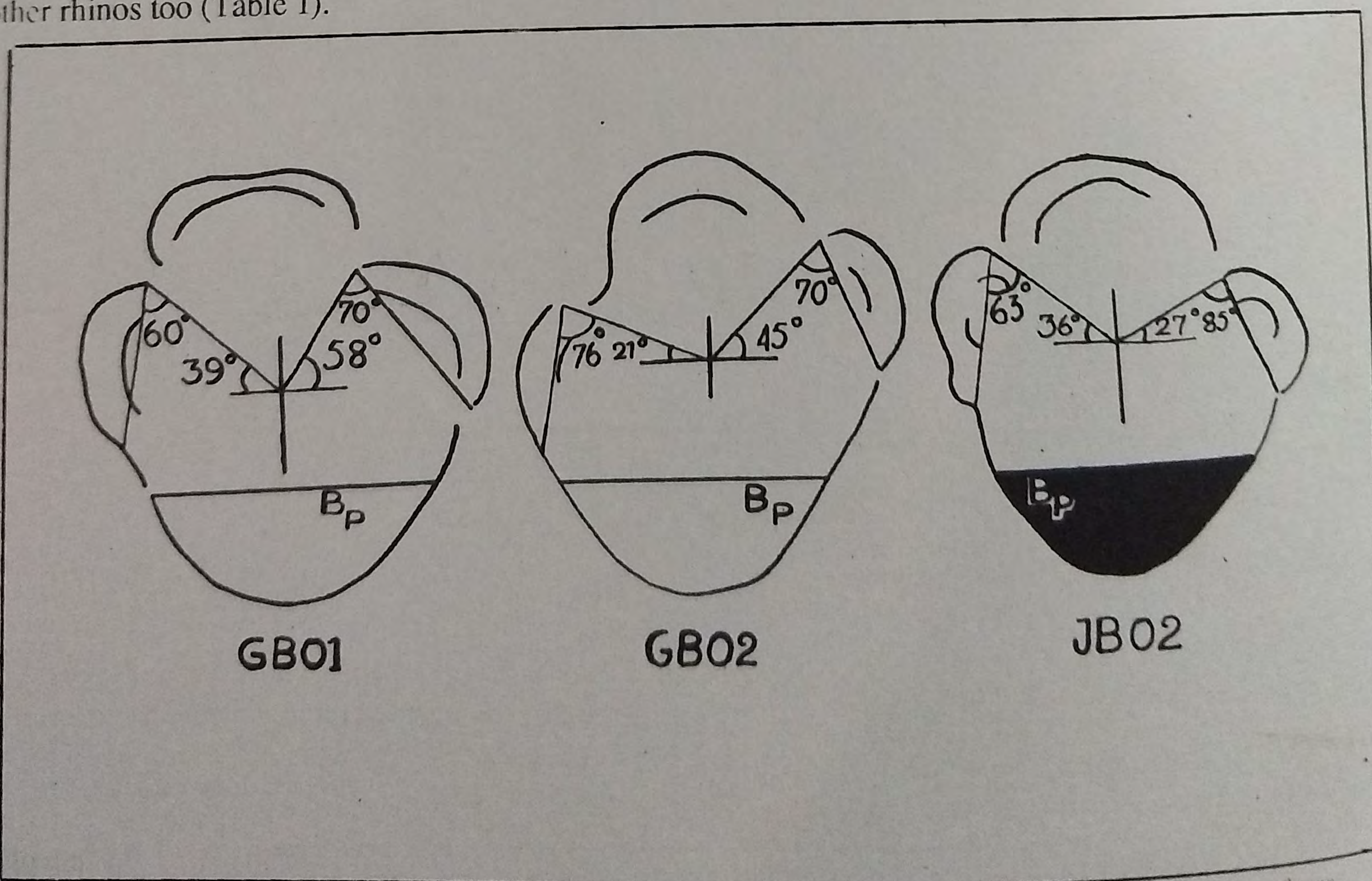
h = Hypothetical Case (New Born Baby)

Since the animals lead almost a solitary mode of life, on rare occasions the confusing multiple tracks were seen. The multiple tracks were created when the rhinos formed the breeding pair or a mother with a calf. Bringing up the calves is entirely the responsibility of the mother, therefore, the mother-calf association is quite usual. The track analysis suggests that sometimes the subordinate bulls are allowed to get included with superficial relationship in the family groups consisting of adult females, juveniles and calves.

The 1/16th graphical reduction of life-sized foot impressions (Text-fig. 1) were carefully made on a graph paper having 0.25 cm^2 as the smallest unit. 'G', 'J' or '–' signify the places of Gorumara, Jaldapara or anywhere else. 'B', 'F', 'J', 'M' and 'C' stand for bull (dominant adult male), female, juvenile, male and calf respectively. According to individuality GB01 carries almost a flat middle toe whereas GB02 bears a notch at the junction of second and middle (3rd) toe. In GB02, the 4th toe is placed at a much higher level in comparison to that of the 4th toe of GB01. Similar marked differences have been observed among the three Gorumara female rhinos as illustrated in Text-figure 1. GF02 bears almost spherical toes corresponding to the sole having only slight depressions at the junction of the toes. JB02 has an extra outgrowth at the posterior portion of the second toe. JF03 bears an inward crevice at the junction of the 4th toe and the sole. In GJ(F)02 the toes are comparatively shorter. JJ(M)01 has an inward depression at the middle toe while GC02 bears a depression at the posterior tip.

The maximum narrowness (δ) are found in three adults : GB01, GB02 and JF03; three juveniles JJ(M)01, GJ(F)01 and GJ(M)02; and in only one calf GC01 (Table 1). The value of δ is found to be the least for '–CO_3' which is purely a hypothetical case obtained from the regression technique as shown in Text-figure 3.

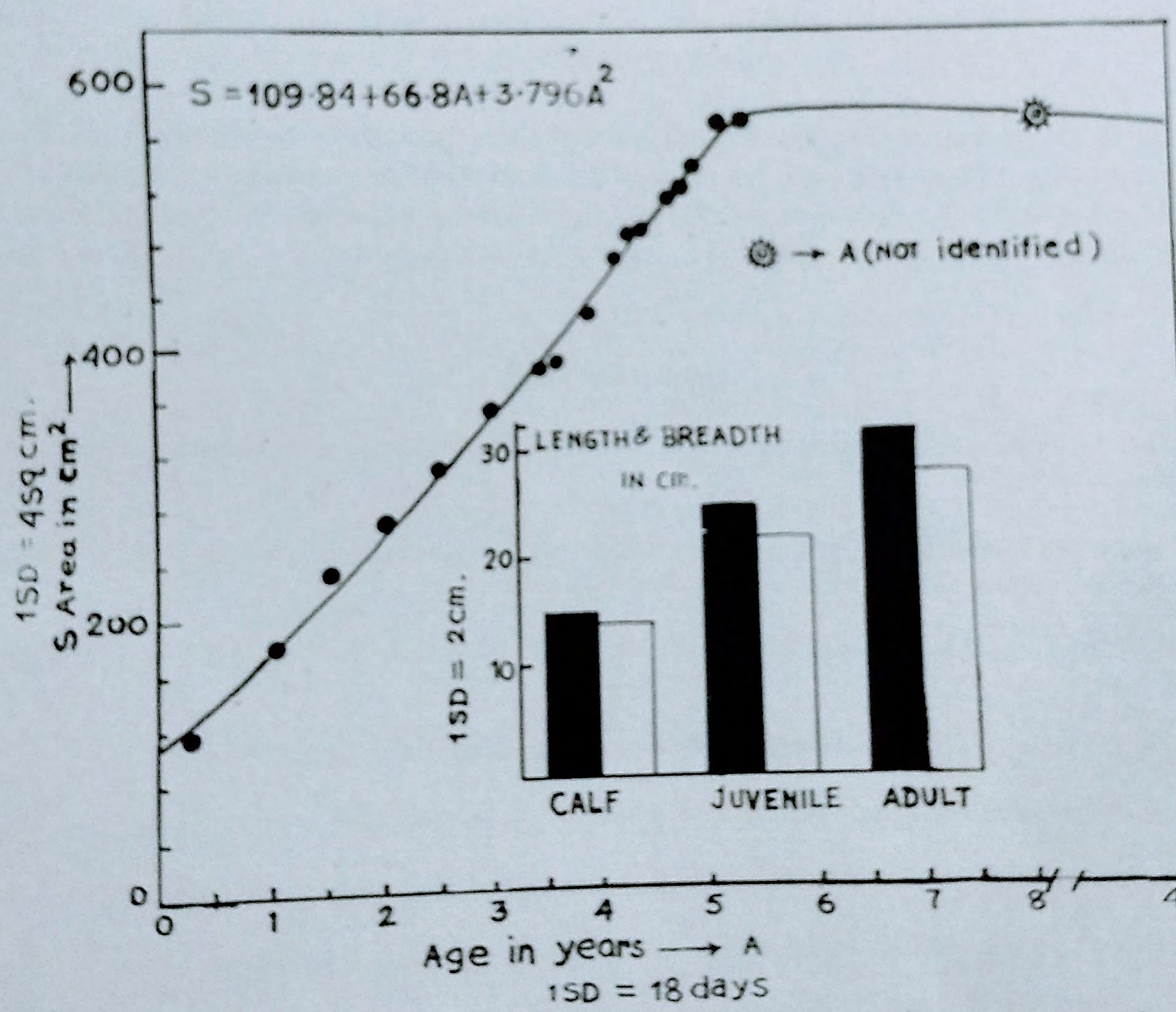
In respect to the angular orientation of the toes from the centre point, marked differences are noticed between GB01 and GB02. From the centre point of the area of the foot impression, GB01 shows 39° and 58° angular orientation for 2nd and 4th toe respectively. On the otherhand, GB02 shows only 21° and 45° which is interestingly a spectacular difference (Text-fig. 2). Similar remarkable differences are noticed among the other rhinos too (Table 1).



The areas were estimated by counting the unit blocks as well as the fractional segments of the blocks at the periphery of the foot impressions. On multiplication of the total number of blocks by 0.25 cm^2 X 16 (since the original impressions were reduced to one sixteenth graphically for convenience), nearly accurate actual areas (S) were obtained. The measured actual area S for sixteen samples out of eighteen (Text-fig. 1) were analysed to give a well fitted theoretical equation :

$$S = 109.84 + 66.8A + 3.796A^2 \quad \text{.....} \quad (1)$$

as shown in Text-figure 3 in terms of the age parameters A with only ± 2.28% error in the regression technique. This is the reason why the observed data were found to lie excellently about the theoretical curve (Text-fig. 3). At and from the age of $5\frac{1}{2}$ years onwards the theoretical curve (eq. 1) is made to be flat horizontal with the experimental points parallel to the age-axis. The important aspect of the Text-figure 3 is that when A = 0 the new born baby is likely to have its hind sole area in the close vicinity of 109.84 cm^2 ± 2.28 cm^2 which is marked as '$-CO_3$' in Table 1. The age (A) excepting those for the calves as observed were supplied by the respective Forest Departments.



TEXT-FIGURE 3. Curve showing the relationship between sixteen sole impressions and their respective ages and comparative lengths and breadths of sole impressions in three age-classes.

For the lower value of 'A' the contribution of the second term in eq. (1) will be more, but due to third term it will be larger as 'A' increases. This indicates that after the first year there is a rapid growth up to 5-1/2 years followed by a kink on the verge of adulthood. After attaining the flat horizontal plane for the maximum area of 572 cm^2, the S-A curve has a tendency to reach a slightly lower value of 564 cm^2, probably due to aging.

Similar study is made in terms of histogram for the corresponding maximum length and breadth of the foot impressions in cm for the three age classes (Text-fig. 3). It indicates that the maximum length and breadth

of the foot-print of an adult rhino is almost double than that of the calf. The juveniles lie in between these two. During a recent census on Javan rhinoceros population in Ujung Kulon National Park, the largest footprint measured was 31.0 cm (in width) for adult and 24.0 cm for sub-adult (Santiapillai *et al.*, 1990). In a previous census, the calves and juveniles were not recorded since their footprints were less deeply embedded on the soil owing to lesser weight and because of their small footprints being overlooked (Ammann, 1985). So, often the young age classes are not properly represented.

Conclusions

From the above discussions it can be concluded that the Great Indian one horned rhinoceros bears individual recognition characteristics in their soles. So by following their tracks and trails, valuable data could be obtained about their home range, habitat use pattern, daily activity cycle, population study, etc; without viewing them. Needless to mention here that the recognition of sole impression requires some days observations for accurate identification of the individual.

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