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Rhinoceros *unicornis* in India since Prehistoric Times

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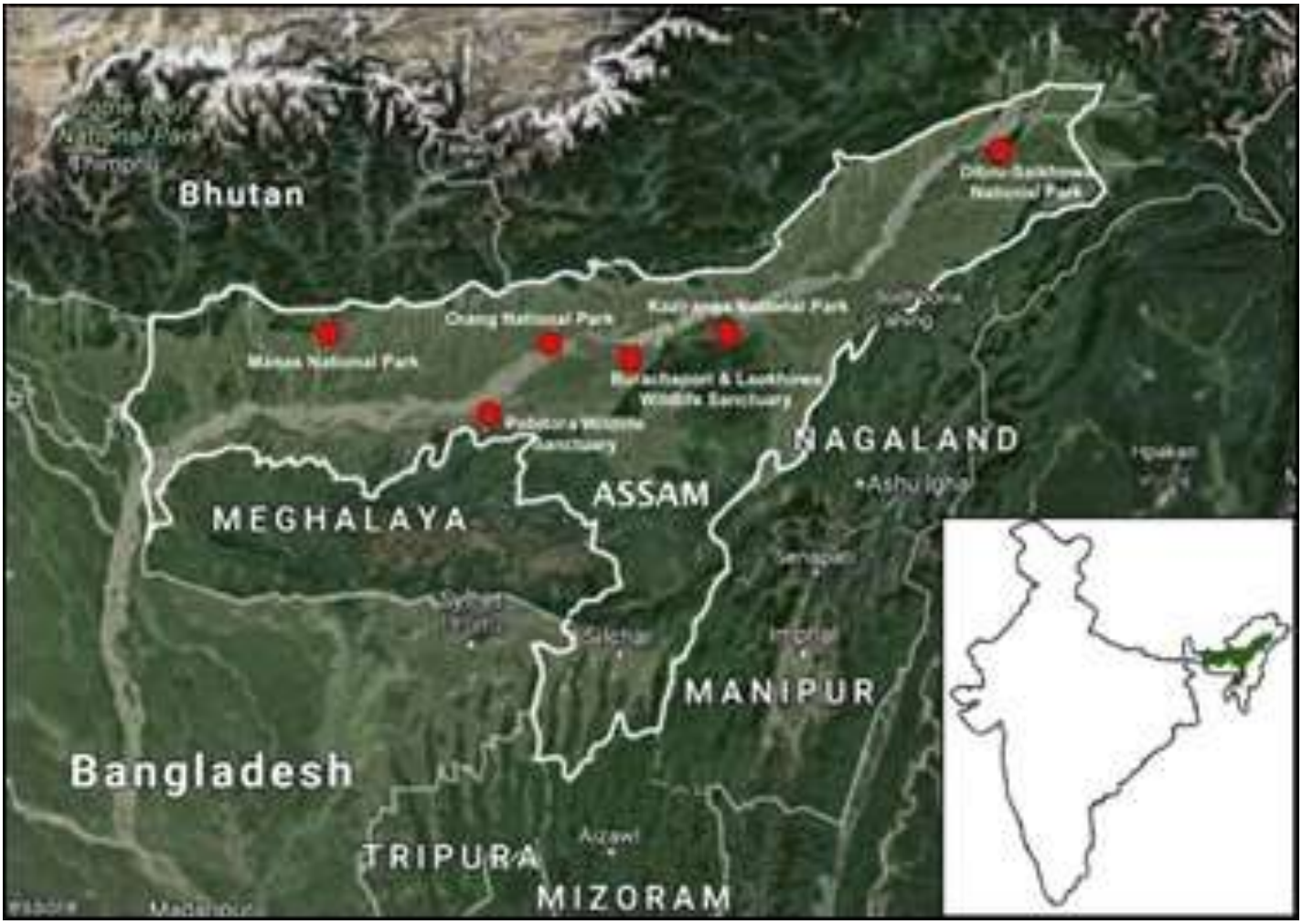
Introduction: Rhinoceros is one of the oldest land mammal species existing, and is of immense cognitive value to scientists from the view point of its ecological attributes. The great one horned rhinoceros or *Rhinoceros unicornis Linnaeus* 1758, is a mighty animal that immediately brings forth the picture of a landscape of north east India, which is eventually their only home in India today. The antiquity of rhinoceros and its ancestors in India can be traced way back in the fossiliferous beds of Shiwaliks in North West India. Its occurrence in the Narmada valley, Manjra valley, Ghataprabha valley, Kurnool caves (late-mid-Pliestocene to Terminal Pleistocene) and portrayal of rhinoceros hunting in Bhimbetka, their bones found at Langhnaj, several Neolithic and Harappan sites amply demonstrate their uninterpretted physical presence in India. Fossil rhinos of Siwaliks and Peninsular India are supposed to have a phylogenetic relationship with *Rhinoceros unicornis*. Rhinoceros has retained its original characteristics for millions of years and can provide paleontologists with a deeper insight in to the process of evolution. This animal, in the past enjoyed a wide distribution stretching from Shiwaliks in the north to Indus valley in the west, Sumatra in the South East Asia, to the Deccan in the South India. Human interference in its habitats as well as merciless hunting by poachers has reduced their population to over one and a half thousand, confined to the evergreen tropical rain forests of north east India, especially in the state of Assam. "*Rhinoceros indicus fossillis*", the name given to its first fossil finds in the Upper Siwalik beds by Baker and Durand (1836), marks its first report in Indian paleontology. The distribution of the great Indian one horned rhinoceros in the world is at present confined to some parts of Nepal, North Bengal and Assam. Though it prefers swampy areas with extensive grasslands, in Nepal it also inhabits in low hills of woodland forests having extensive grasslands and numerous streams.

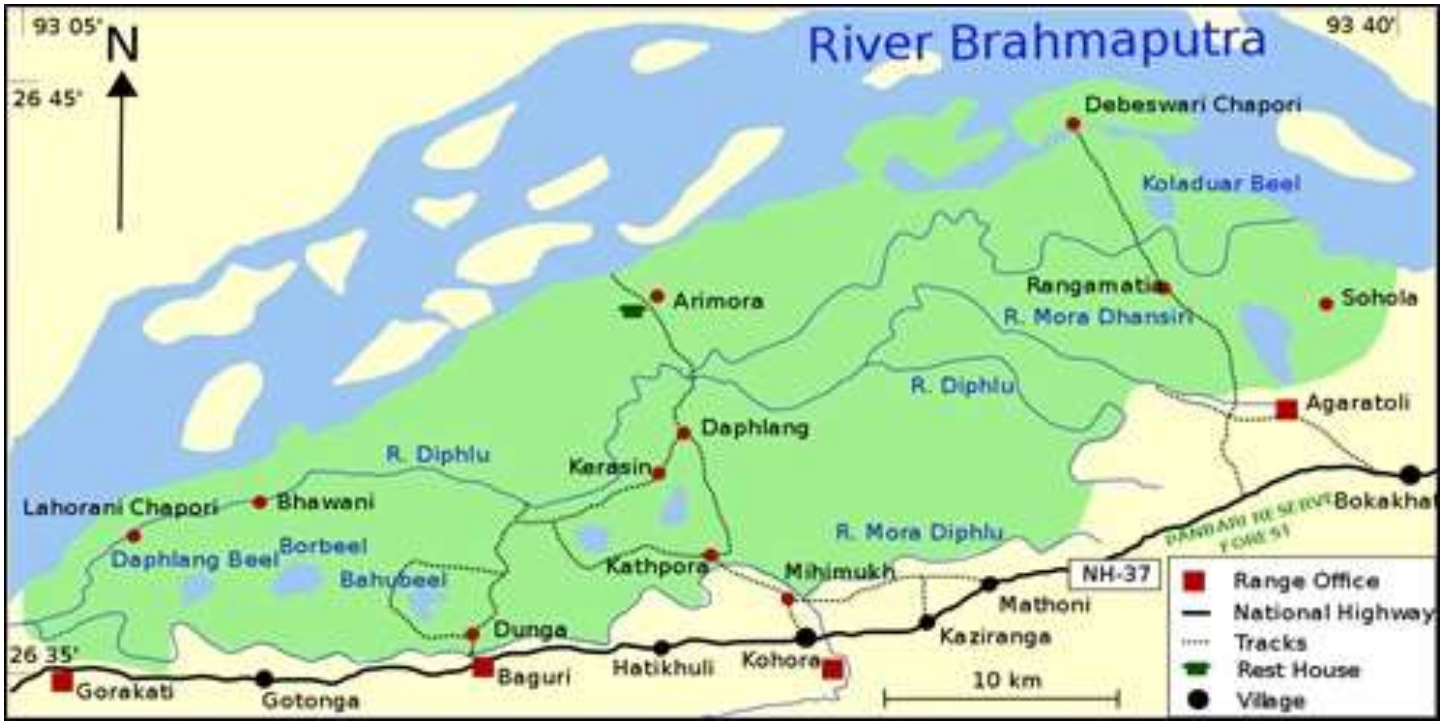
The proposed study intends to do a review of paleontology, its contributions in ancient human populations (though mostly as a prey species) and detailed atonalistic ecological study in Kaziranga National Park. First hand data on the rhino behavioral biology and diet gathered from within India

will be a native source material for analogy as well as palaeological interpretations for future researchers of rhinoceros. This endeavor is aimed at making fresh first hand data which sets for future studies if similar evidence from fossil record is collected. The research includes almost entire life system of the great one horned rhinoceros including his past distribution in India. The research methodology has been structured in three parts such as the reference work, field work (Actualistic studies) and synthesis and review of archaeological and fossil record.

Study Area: Kaziranga National Park is the most populated area of present day one horned rhinoceros. It is situated in Golaghat District of Assam, on the south bank of the river Brahmaputra (Map no. 1 & 2 and Table no. 1). It was first established as a sanctuary in 1908, on the initiative of Lady Curzon and attained the status as a National Park in 1974. It provides a natural habitat for a number of rare, threatened and interesting species. A symbol of dedication for the conservation of animals and their habitat, Kaziranga with a National Park status represents the single largest protected area within the Northeast Brahmaputra valley.



Map No. 1: Map of Assam showing the course of Brahmaputra and highlighting ideal ecological locations that enable rhino prolification



Map No. 2: Map of Kaziranga National Park indication its forest ranges

Area of Kaziranga	430 sq. km
Elevation	80 metre (262 feet)
Coordinates	26°40′00′′ N 93°21′00′′ E
Climate	Summer: 37°c (99°F) Winter: 5°c (41°F)
Location	271 km, east of Guwahati

Table No. 1: Table indicating the area, elevation, coordinates climate and location of Kaziranga National Park

The rhinoceros is a solitary animal and territory has not been representated. The association of two animals is confined to mother and calf or two mating rhinos. During the pre-monsoon season many rhinos have been seen in the same wallow. During the night they sleep in the dry grounds. During winters, wallowing activities are markedly reduced and they graze for long hours both in the morning and evening. The rhinos make their stay around such wallows and move to the nearby areas

for feeding. Normally they do not migrate for long distances. Only during flood, they are forced to seek shelter away from their normal areas. The rhinos have a peculiar habit of defecating in regular dung heaps. The dung heap can be used by more than one rhino for a given period of time. Another habit of rhino is that it always uses well laid out tracks from its wallowing place to the feeding grounds and vice versa while roaming in the grassland. The present study focusses on detailed review and also includes some of the recent methodological innovations (viz. Trails and track ways and dung analysis)

Taxonomy: All the five existing specie of rhinoceros are grouped in a single family, Rhinocerotidae. They are massive, graviportal, pachyderms (hoofed nonruminants, characterized by thick, solid bones and short, stumpy legs. The limbs are broad and massive and are padded with elastic connective tissues designed to bear their weight. The sheer size of animals makes them free from natural predation except in the calf stage. Though belonging to one family and possessing the broad characteristics of that family, the five existing species of rhinoceros differ from each other in diverse ways. As a result of adaptation to different environment, the extant species became distinct from each other at very early stage in their evolutionary history. A group of rhinos is called a crash. All the species of rhinoceros have 82 chromosomes (diploid number, 2N, per cell), except the Black Rhinoceros, which has 84. This is the highest known chromosome number of all mammals. Geological factors, climatic changes as well as biotic factors have ensured that most of the several dozen genera of the family Rhinocerotidae have become extinct. At present there are only five living species distributed in four genera in the world, two in Southern and Eastern Africa and three in tropical Asia. All five extant species today are also declared endangered (Fig. 01).

The extant Rhinoceros species are:

1. The African White or Square Lipped Rhinoceros (Ceratotherium simum)
2. The African Black Rhinoceros (Diceros bicornis)
3. The Asiatic Two Horned or Sumatran Rhonoceros (Dicermocerus or Dicerorhinus sumatrensis)
4. The One Horned or Javan Rhinoceros (Rhinoceros *sondaicus*)
5. The Great Indian One Horned Rhinoceros (Rhinoceros *unicornis*)

Fig. No. 1: The five species of Rhinos in the world

Rhino in Antiquity: Its Palaeontological and Archaeological Record: Rhinoceros have been roaming upon the earth for more than 60 million years. Their fossil history is somewhat convoluted. They are believed to have evolved from the early tapiroids, but took a different evolutionary route. Fossils and other palaeo-zoological remnants reveal that the ancestors of the family Rhinocerotidae first appeared during this period. Prehistoric rhinoceros species began to be recognizable towards the end of the Eocene. Fossil remains in the Shiwalik Hills show that the Sumatran rhinos existed in India during Pliocene. In India the Rhinoceros made its first appearance in the Eocene. Apart from six species of rhinoceros, fossilized remains found in Upper Siwalik beds reveal remarkable mammalian diversity in the region during Plio-Pleistocene period.

The progress of the Cenozoic era saw several dozen genera that can be said to belong to the Rhinocerotidae family. The largest among these in the past were the *Baluchitherium gangeri and Indicotherium* in the Oligocene and Miocene (25 million years ago) epochs. They were denizens of Asia, and were perhaps the largest terrestrial mammals ever known. The Rhinoceros therefore was common in North America in the Tertiary period and probably died out there during Pliocene (10 million years ago). But in Eurasia many different species survived right up till the Quaternary period, become extinct only in the Pliestocene (1 million years ago). Large horns were a prominent characteristic of rhinoceros in the Pliocene epoch. In Pleistocene there was the Ceolondonta, or wooly rhinoceros whose bones have been found in almost intact form in caves and river beds from the

British Isles across Eurasia to China. The coelondonta has been immortalized by Stone Age artists in cave paintings.

S. No.	Rhinoceros *sivalensis*	Rhinoceros *unicornis* + Rhinoceros *indicus*	Rhinoceros *sondaicus* + Rhinoceros *javanicus*
1	Large	Large and robust	Smaller and lighter
2	Nasals expanded into large rounded horn boss	Deep saddle in the cranial profile	Shallow saddle in the cranial profile
3	Deep saddle in the cranial profile	Deep saddle in the cranial profile	Shallow saddle in the cranial profile
4	Occiput forwardly inclined	Occiput high and narrow	Occiput low and broad
5	Skull considerably deep	Skull deep	Skull comparatively shallow
6	Ectoloph of cheek teeth flat	Ectoloph of cheek teeth flat	Ectoloph of cheek teeth sinuous
7	Parastyle butress present	Parastyle buttress suppressed	Parastyle buttress prominent
8	Well-developed crochet and indistinct crista	Well-developed crochet and crista	Crochet present but crista generally absent
9	Teeth hypsodont	Teeth sub-hypsodont	Teethless- hypsodont
10	Premaxillaries broad	Premaxillaries broad	Premaxillaries narrow

Table No. 2: Comparison of characters of three species[1]

The great Indian one horned rhinoceros, which once roamed in great numbers throughout the Indo-Gangetic plains and the Brahmaputra valley, survives in few places in Assam, West Bengal and Nepal. Their survival is precarious, and yet providing encouraging figures in Assam and Bengal today:

Assam	Kaziranga National Park	1,400
West Bengal	Jaldapara Sanctuary	30
Nepal	Chitawan National Park	400

Indian rhino in archaeological record: Rhinoceros, for virtue of being an aggressive and large beast has evoked a response that has either driven early man away from it for safety or confrontation with hunting as an inevitable reaction. Prehistoric rock art offers rhino-human encounters where hunting or an attempt of hunting provides a direct evidence of rhino presence especially when their fossil

record gets patchy in archaeological assemblages towards the end of Terminal Pleistocene. A close suvey of published archaeofaunal records reveal that rhinoceros has had a distribution throughout the length and breadth of Indian Sub-continent until historic times, rhino has not so far been reported from any Iron Age and early historic sites of India. Skeletal remains of several protohistoric sites is again a reminder that it was an important animal at a site whose exploitation was driven by primary products. For e.g.: Rhino bones as part of 'use assemblage 'comes from Langhnaj.

Skeletal records of rhino has been reported from Neolicthic, Indus valley and Chalcolithic sites in Indian subcontinent. Prehistoric rock art mostly from Central India offers rhino-human encounters where hunting provides a direct evidence of rhino presence especially when their fossil record gets patchy in the archaeological assemblages towards the end of Terminal Pleistocene. The excavations at Mohenjadaro yielded a seal (Fig. 02) bearing the figure of a one horned rhino. It indicates the region then was green and fertile. The Fifth Pillar Edict of Ashoka, the Great in 3rd century B.C also mentions the Indian Rhino which enumerates the animals that were to be preserved.

From ancient times the Indian rhino was a favourite game for hunters who saw in its intimidating appearance and size vindication of their own process as hunters. As early as 1398 Timur Beg hunted the animal on the frontiers of Kashmir. In 1519 the Emperor Babur hunted rhino in Peshawar and bank of the river Sorju (Ghagra) in North India. In the book of Sidi Ali is mentioned the sighting of rhino near Kothal pass, west of Peshawar in 1554. Abul Fazl states that rhinoceros could be seen in Sambal Sarkar of Delhi during the reign of Akbar. Shrinking of home range of rhino is primarily attributed to climatic change and hunting by man in the recent history of humanity. Supposed medical properties of the horn and its mythological associations have been detrimental to its survival, but its antiquity may be pushed to several hundred years.

Location	***Rhinoceros sivalensis***	***Rhinoceros palaeoindicas***	**Rhinoceros *unicornis***	**Rhinoceros *kernuliensis***	**Rhinoceros *deccanensis***	**Reference**
Siwaliks	✓	✓	×	×	×	Falconer & Cautley, 1847
Narmada	×	×	✓	×	×	Pilgrim, 1905
Godavari	×	×	✓	×	×	Pilgrim, 1905
Manjra	×	×	✓	×	×	Sathe, 2005[2]
Kurnool	×	×	×	✓	×	Lydekker, 1886
Ghatprabha valley	×	×	×	×	✓	Foote 1876

Table No. 3: Occurrence of rhino fossils in quaternary fossil sites of India

Upper Paleaolithic site:

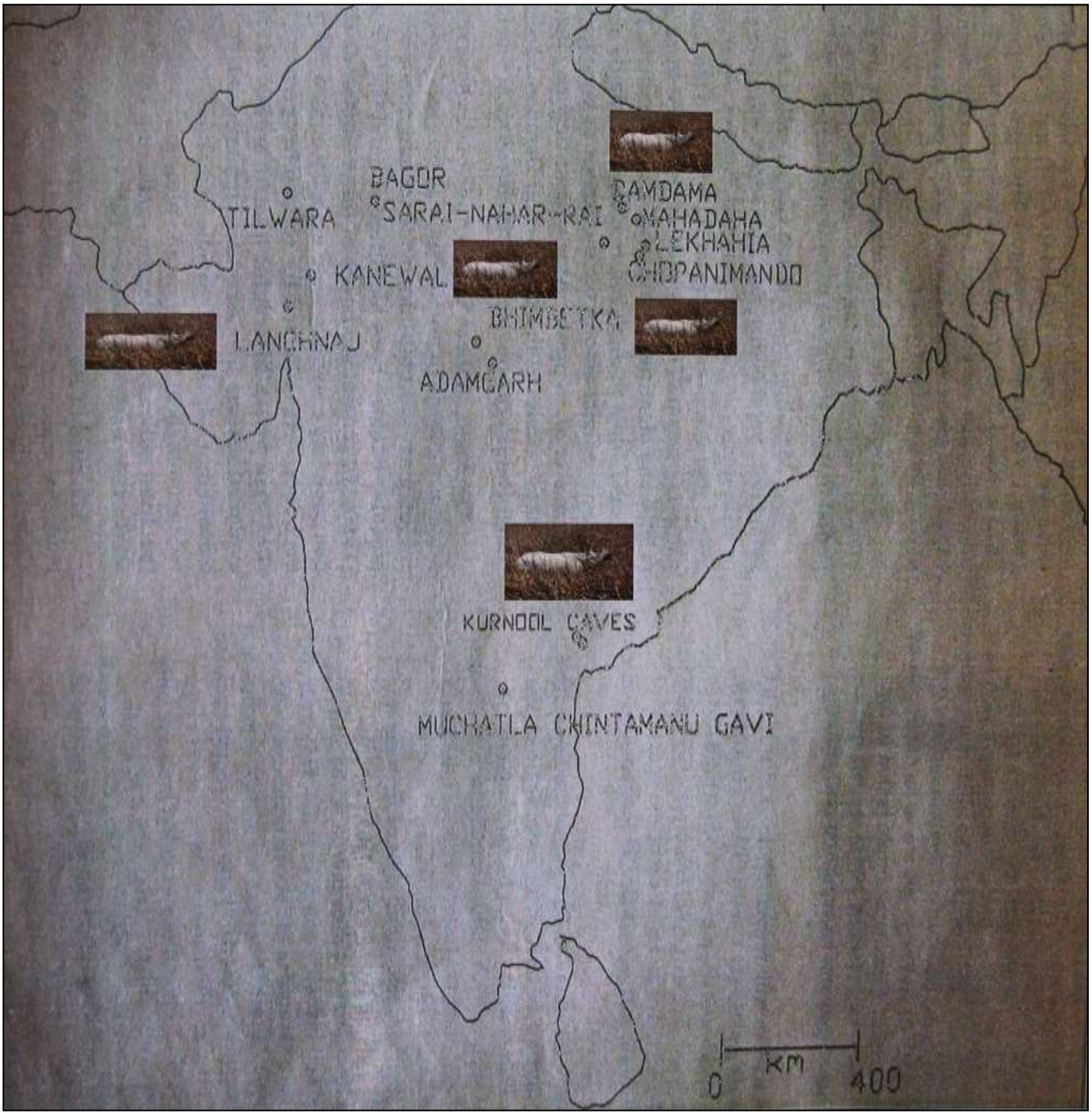
Scientific name	**Site**
Rhinoceros *kernuliensis*	Kurnool caves

Table No. 4: Occurrence of rhino in Upper Paleolithic site[3]

Mesolithic sites:

Scientific name	**Site**
Rhinoceros *unicornis*	Langhnaj
Rhinoceros *unicornis*	Kanewal
Rhinoceros *unicornis*	Damdama
Rhinoceros *unicornis*	Bhimbetka

Table No. 5: Occurrence of rhino in Mesolithic sites[4]



Map No. 3: Indicating the occurrence of rhino in Upper Palaeolithic and Mesolithic sites in India

Harappan sites:

Scientific name	Site
Rhinoceros *unicornis*	Harappan
Rhinoceros *unicornis*	Kalibangan
Rhinoceros *unicornis*	Lothal
Rhinoceros *unicornis*	Kuntasi
Rhinoceros *unicornis*	Surkotada

Species doubtful	Orio Timbo
Rhinoceros *unicornis*	Khanpur
Rhinoceros *unicornis*	Shikarpur

Table No. 6: Occurrence of rhino in the Harappan sites[5]

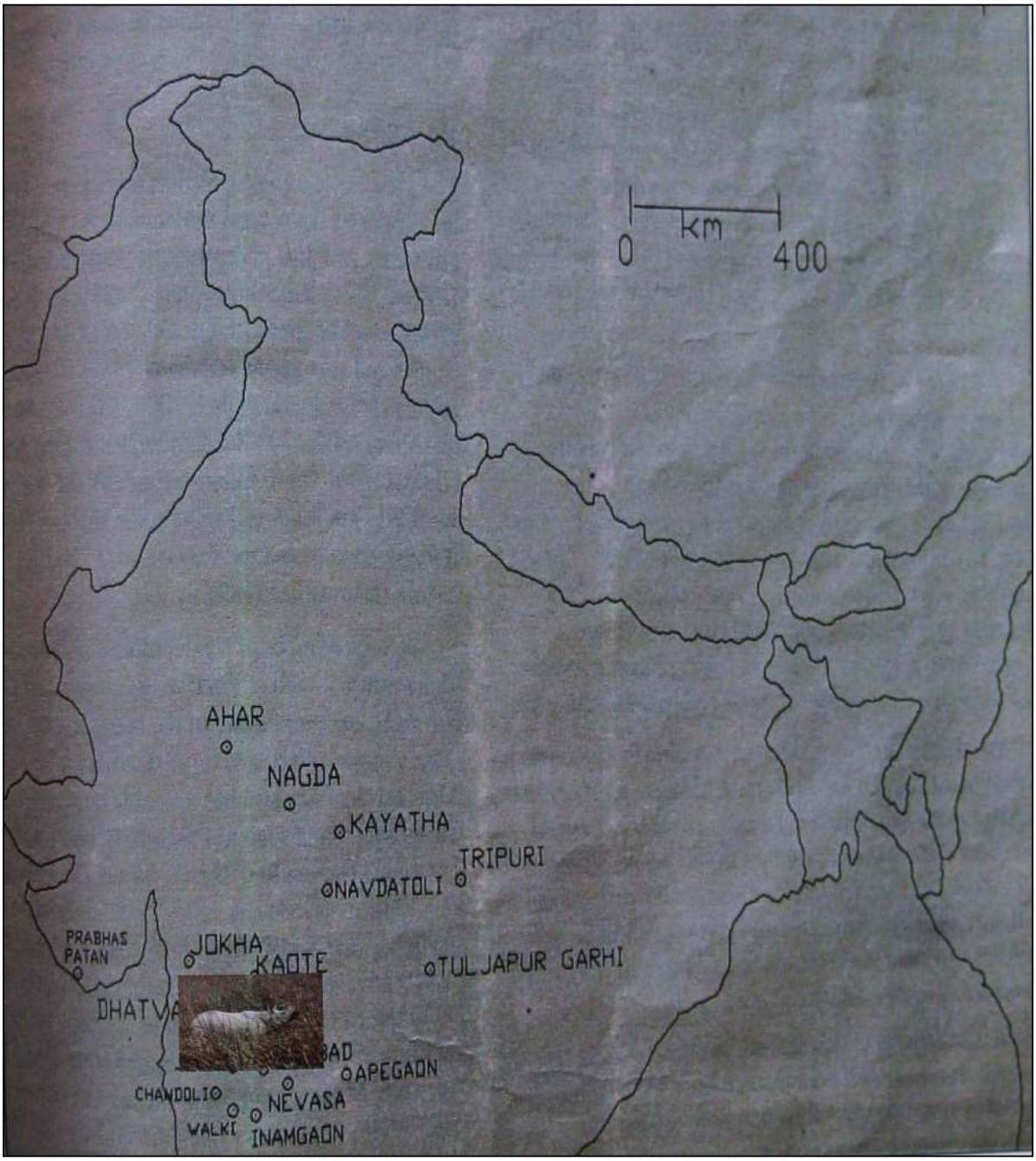
Fig No. 2: Seal bearing Rhino image found in Mohenjadaro[6]

Map No. 4: Indicating the occurrence of one-horned rhino in the Harappan sites in India

Chalcolithic sites:

Scientific name	Site
Rhinoceros *unicornis*	Nevasa
Species doubtful	Inamgaon

Table No. 7: Occurrence of rhino in the Chalcolithic sites of India[7]



Map No. 5: Indicating the occurence of rhino in Chalcolithic sites of India

The Neolithic site (Northern and Eastern India):

Scientific name	Site	References
Rhinoceros *unicornis*	Chirand	Nath and Biswas, 1990

Table No. 8: Occurrence of rhino in the Neolithic sites of India[8]

Map No. 6: Northern and Eastern Indian Neolithic sites occurring rhino

However Rhino has not so far been reported from Iron Age and early historic sites of India. The fertile plains and the grassy areas, ideal as rhino habitats, unfortunately were equally ideal for cultivation. So with an increase in population such areas were taken over by man, and the rhino habitat was irrevocably destroyed in these regions.

Fig. No. 3: Rock painting showing rhinoceros *unicornis* in Bhimbetka rock shelter

Dung Analysis of Living Rhino: "Coprolite" is a scientific name for the fossilized excrement, faces or droppings of ancient animals. They form an important class of objects studied in the field of archaeology. The recognition of coprolites is added by their structural pattern, such as spiral or annual markings, their content, such as undigested food fragments and also by associated fossil remains. In past it might have been sufficient for an archaeologist to excavate a site and later report his finds solely in terms of ceramic, lithic and fibrous artifacts. However today, one tries to speculate upon aspects such as animals butchering techniques, seasonal uses of a site, subsistence pattern, palaeo environmental conditions or methods of artifacts manufacture. One such item which has only recently been saved with a degree of regularity during the excavation of archaeological sites is coprolites.

We chose to collect several samples of rhino dung using GPS for defining dropping locations, rhino movements and home range of individual rhinos in Kaziranga National Park. It is essentially intended to highlight the importance of such research methods in Indian context besides preparing vegetational profile of rhinos in Assam during winter. Since rhino fossils have been reported from several Pleistocene fossil sites in India, it is imperative that detailed vegetational and dietary profile of living rhinos is also prepared through dung specimens so that it could be used as analogical evidence for palaeoecological reconstruction. Existing methods of wildlife research focus on tracing

animal movements in different areas at different times but dung analysis is not yet considered a viable means of analyses. Hence it is being shown here that data pertaining to behavioral ecology available through pioneering researches on living rhinos, needs to be complimented by examining its dung specimens so that it could provide multiple lines of interpretations to augment a better picture of past ecology where these creatures lived and perished in slice of time.

Rhinos have a peculiar habit of revealing the droppings. Each heap denotes that of an individual for a month and after which he would choose another location for this activity. Hence it became possible to identify these droppings of five different individuals, thereby providing dietary profile of five different individuals. We collected five samples (R1, R2, R3, R4 and R5) of dung of Rhinoceros *unicornis* from different places of Kaziranga National Park to study the pollen profile, thereby identifying as to what type of vegetation was consumed by these individuals.

Fig. No. 4: Rhino dung (accumulation of over a month)

Fig. No. 5: Another heap of rhino dung

Pollen Results after sampling

Fig. No. 6: Slide showing pollen Fabaceae

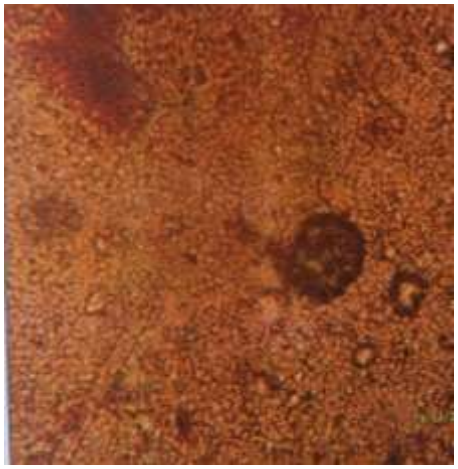


Fig. No. 7: Slide showing pollen Amaranthaceae

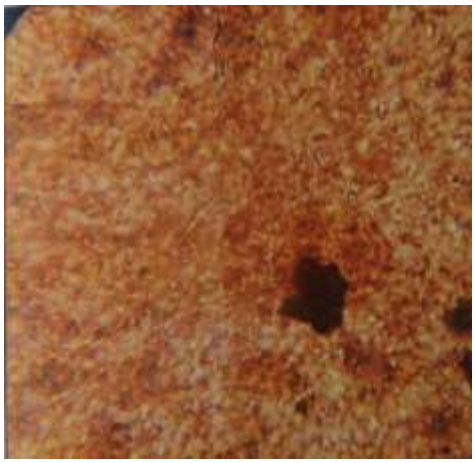


Fig. No. 8: Slide showing pollen Asteraceae

Fig. No. 9: Slide showing pollen Euphorbiaceae

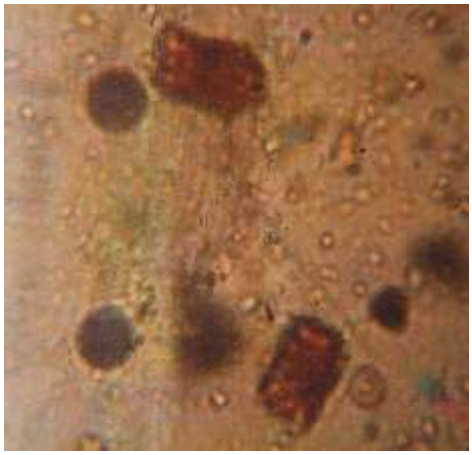


Fig. No. 10: Slide showing pollen Poaceae

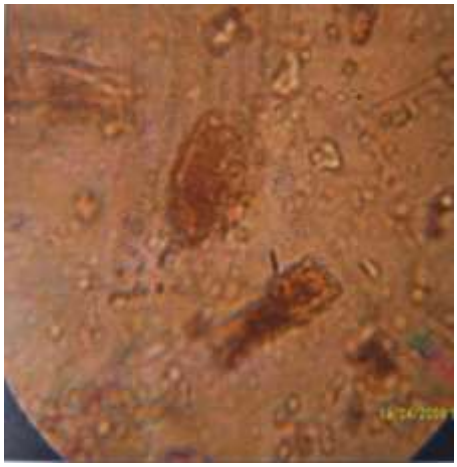


Fig. No. 11: Slide showing pollen Poaceae

Name of the Individual	Quadrents	Pollen Profile
R1	N 26°38.8′47′′ E 93°31.3′52′′	Mytraceae, Poaceae, Euphorbiaceae, Amarantaceae, Cyperaceae, fungal spores, Asteraceae
R2	N 26°38′909′′ E 93°21′895′′	Poaceae
R3	N 26°37′126′′ E 93°18′604′′	Amarantaceae
R4	N 26°41′320′′ E 93°33′930′′	Fabaceae
R5	N 26°40′145′′ E 93°25′708′′	Amarantaceae, Hamiaceae, Euphorbiaceae, Euphorbiaceae, Cyperaceae, Fabaceae

Table No. 9: Showing the pollen results

Results:

All these palynomorphs are typical indicators of wet moist environmental conditions. Particularly the families like, Poaceae, Cyperacea, Fabaceae, Myrtaceae etc. Such direct ecological affinities. Poaceae is abundant in the sample followed by Cyperaceae, Fabaceae, Amarantaceae, Euphorbiaceae etc. Poaceae and Fabaceae are generally used as fodder by these animals. Ocassionally Hamiaveae, Euphorbiaceae, herbaceous species are also seen. Overall diet suggest that these animals only prefer Poaceae, Cyperaceae, Fabaceae and few other herbaceous species. The diet is restricted to few species only.

Focus on the track ways of rhinos in Kaziranga National Park

Trace Fossils (or ichnofossils) are the biogenetic sedimentary structures that record biological activities such as burrowing, walking and feeding. As sedimentary structures, trace fossils are usually preserved insitu and are more accurate and reliable indicators of the sedimentary environment than body fossils, which are subject to postmortem transport. Assemblages of trace fossil form stable grouping that are widely used in the reconstruction of palaeo - environment. However, the relationship between the fossil species and the trace fossil is complex and there is no complex or simple correlation between species, activity and traces.

The simplest use to watch traces can be put in determining way-up in a sequence of rock. Most traces in soft sediment consist of depressions pressed or excavated by the passage of an animal, can be used in just the same way as flute marks, tool marks and flame structures. Trace fossils can even be used to deduce what kind of organism made it, and can lead to quite precise predictions by deductive

reasoning. Several organisms have been proposed and named on the evidence of trace fossils alone. It can also complete the picture of a vanished fauna by telling the paleontologists about the soft-bodied animals which helped compose it. Track ways provide direct clues to size and locomotion of the animal and how it progressed for several consecutive steps.

Through this research we hope that the study of foot prints of Rhinoceros *unicornis* will certainly help the future paleontologists to recognize the footprints of Rhinoceros *unicornis*, their locomotion, their behavioral pattern etc. in the archaeological field by comparing the fresh rhinoceros track ways. Findings of prints of rhino at the fringes of lakes at Bagori, Kohora and Agaratoli forest ranges reveals that all of them indicating rhino's movements towards water body for consumption at different times in a day. The tracks are a cluster of prints of young and adult rhinos, elephants, wild buffalos and deer species in moist sediments along the beels at Kaziranga. Documentation was confined only to a few lakes with detailed measurements of individual prints, gradient of the print bearing horizon. Documentation of detailed rhino movements to and from water body were noticed where the intra and inter - individual sole size becomes an interesting contribution to the complex study of ichno fossils. There were no prints indicating a mixed cluster of only rhinos but a combination of elephants, rhinos, wild buffalos and few deer species. The fact that all these animals had a common objective of consuming water, these prints may appear to be the signatures of their movements for such an obvious activity. However, the underline information as to how many of them visited in a day, what might have been the ratio of visiting male, female and calf in a day as well as what behavioral traits of rhino and other track makers can be studied are few lines of arguments, central to the study to highlight large mammalian behavior in a natural set up like Kaziranga. However, keeping in view a few practical constraints (high resolution 3D Photographic equipment's, inhospitable wildlife) documentation was confined only to a few lakes with detailed measurements of individual prints, gradient of the print bearing horizon and systematic documentation of prints of rhino, elephants, buffalo and deer for future analysis. Footprints were prepared for these animals so that a catalogue could be brought out for its exhaustive application in future paleontological sites. It also provided data to understand the rhino movements to and from water body where the intra and inter - individual sole size becomes an interesting contribution to the complex study of ichno fossils.

Individual	**Foot length (cm)**	**Foot breath (cm)**
1st individual	29	24
2nd individual	30	27
3rd individual	33	26
4th individual	30	27
5th individual	28	25

6th individual (of a baby of about 5-7 years old)	25	22
7th individual	30	28
8th individual	28	27
9th individual	29	24
10th individual	28	23
11th individual	28	22
12th individual	29	24
13th individual	30	25

Table No. 10: Measurements of footprints of 13 individuals of rhino from Kaziranga National Park

Fig. No. 12: Footprints of Rhinoceros *unicornis* in Kaziranga

Fig. No. 13: Rhino footprint at Kaziranga

Fig. No. 14: Shape of the foot print

Fig. No. 15: Cluster of footprints of Rhinoceros *unicornis* in Kaziranga

Fig No. 16: Clusters of footprints of rhino in the bank of the beel (lake) at Kaziranga

Conclusion: The present research is a detailed review which includes some of the recent methodological innovations (viz. Trails and trackways, and dung analysis) which are very significant piece of documentation that can be treated as a beginner's catalogue for analogical studies in palaeo - zoology. The authors have tried to include almost entire life system of the great Indian One Horned Rhinoceros including his past distribution in India depending on various archaeological sources. As mentioned earlier one of the significant attempts in this work is the study of the track ways of this animal in its present day home range in Kaziranga National Park. Till date no one has attempted to work on Rhinoceros *unicornis* in Kaziranga through Paleontological aspects. Hence an evolutionary, ecological and subsistence perspective of rhinoceros in Indian archaeology with special reference to ecology of living rhinos is proposed in present research. Data pertaining to behavioral ecology available through pioneering researches on living rhinos, needs to be complimented by examining its dung specimens so that it could provide multiple lines of interpretations to augment a better picture of past ecology where these creatures lived and perished in slice of time.

The present study includes rhino taxonomy, present day distribution with special reference to one horned rhinoceros in Indian subcontinent, origin and early history, human response to rhino during proto-historic times, ecology, behavioral aspect seen through tracks and trails, dung analysis and an

update on the status of rhino population in its only abode in India i.e., Kaziranga National Park in Assam.

A maiden approach towards documentation of fresh foot prints of several living rhinos in Kaziranga. The study of foot prints of rhino has been helpful in preparing a set of type specimens of rhino locomotion. To prepare a profile of foot impressions of different age and sex of rhino as a reference material for future studies. So far, no such trace fossils have been discovered in Indian Pleistocene, but in the event of their discovery from one of those several fossil localities may receive major inputs from this present reference collection. For the first time, the study of track ways of Rhinoceros *unicornis* has been documented in different sedimentary environment. The research will certainly help the future paleontologists to recognize the footprints of Rhinoceros *unicornis*, their locomotion, their behavioral pattern etc., in the archaeological field by comparing the fresh rhinoceros track ways. Likewise preparation of analogical record of dung specimens is always a necessity that can be rewarding. Dung specimens of rhinos were collected from Kaziranga National Park and were analyzed for pollen identification. Interestingly, the identification has however, remained to family or a genus level but that throws adequate light on what type of flora has been consumed by those five individuals as well as what flora might have been an intrusive species. This can be the points of beginning of research in the field of rhino palaeozology having great potential in reconstructing dietary behavior by identifying types of flora in different seasons of the year in present day rhino population.

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