# Lo and Behold: Zooarchaeological Evidence as Palaeoenvironmental Index in Prehistory of Middle Ganga Plain and Vindhyas, India

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***Abstract:*** *Middle Ganga Plain and Vindhyas together represent binary geological configuration encompassing both hills and the alluvial flood plains. No wonder it was an area of attraction for the Stone Age hunter-gatherers and early farmers who have left behind their imprints in the archaeological record of the region. The last two decades have seen a surge in palaeoenvironmental studies in Middle Ganga Plain and Vindhyas, and a considerable body of published data exists for changes in the palaeoenvironmental regime here. Present work focuses on the role of Archaeozoological evidence for Palaeoenvironmental reconstruction in the area under study and discusses their utility and limitations in such an enterprise.*

***Keywords***: Prehistory, Palaeoenvironment, Archaeozoology, Middle Ganga Plain, Vindhyas, Proxy Data, Macro Fauna

## Introduction

Palaeoenvironmental research is nowadays thriving in archaeology and knowledge regarding palaeoenvironments has also expanded impressively. The field has seen a proliferation of new techniques for gathering information about the past environment, an increased research emphasis on the nature of human interaction with environments and adoption of generalisations and concepts from bio-ecology (Jochim 1979: 77). Nevertheless, many sources are still not fully tapped as sources for such an enterprise. The same is the case regarding the utility of faunal remains in palaeoenvironmental reconstructions. Though the palaeozoologists themselves have long used taxa represented by ancient faunal remains to reconstruct palaeoenvironments (Lyman 2017: 315), however, in Indian archaeology, their role was rather limited during the last century. It has become increasingly apparent in the past two decades that the palaeozoological record comprises an archive of results concerning how biota responds to environmental change (Lyman 2017: 316). This, along with the growing interest in the study of ancient environment, has led to the use of archaeozoological sources as an important proxy for palaeoenvironmental studies. The current study represents one such work where data from archaeozoological sources has been utilized to study the palaeoenvironment in the Middle Ganga Plain and Vindhyas, India. This paper provides an overview of the growing body of research on palaeoenvironmental records from archaeo-faunal contexts.

## Key Assumptions

These assumptions, following Sharma (1973), Dinacauze (1987) and Lyman (2017), hold significance for the current study.

- Palaeoenvironmental reconstructions are typically speculative and generalised.
- Environmental causes will influence water supply, settlement pattern and distribution of plant and animal resources directly in such a way as to leave archaeologically accessible evidence.
- The enterprise of studying vanished environments in order to assess their effects on human life and culture requires borrowing techniques and data from many natural sciences.
- The potential for faunal remains to contribute data on palaeoenvironment has been relatively underutilised.
- Faunal data contributes both direct and proxy evidence for palaeoenvironmental reconstructions.
- Increased analytical sophistication in paleozoology is providing increasingly rigorous and detailed insights into paleoenvironments.
- Reconstructing paleoenvironments on the basis of faunal remains requires knowledge of species ecological tolerances, geographic ranges, habitats, environments, and niches.
- It also requires assumptions that extant species had the same ecological tolerances in the past as they do today and that changes in taxonomic composition or abundances reflect environmental change rather than sampling or taphonomic factors.
- Temporal changes and the presence and absence of fauna may be related to the palaeoenvironment.

## Area Under Study

The area of operation for the present study includes two geographically distinct but interdependent regions with interactive history- Middle Ganga Plain and the Vindhyas. The researcher chose these two areas rather than a singular area since palaeoenvironmental reconstructions can be better comprehended from two different regional perspectives. It is also important to understand here that Middle Ganga Plain is not a clear-cut physical unit. Delimitation of boundaries of this plain has been attempted by various scholars using varied baselines like temperature, precipitation and agricultural produce. I.B. Singh holds that Median Ganga plain marks the middle part of the Ganga plain and can be taken to indicate the area between Kanpur and Patna (Singh 2005: 7). For the purpose of current research, the limits and area of operation of Middle Ganga Plain are taken after the boundaries of Median Ganga plain as identified in I. B. Singh's classification. Vindhyas, for the purpose of this work, are taken to represent north-central India covering Allahabad, Mirzapur and Sonbhadra districts in U.P. and Rewa and Sidhi districts in M.P. (Tewari 1971: 102). It represents an amalgam of ridges and valleys, bare rock expansions, sheltered alluvial basins. This undulating plateau at many places merges gradually with the Gangetic alluvium in the north (Wadia 1973: 121). The present work will focus on the Archaeozoological observations in this area right from the Palaeolithic times down to the Neolithic period.

## Methods

The studies regarding knowing and understanding past environments must begin with an understanding of the types of data available and methods used in their analysis (Bradley 1985: 1). Palaeoenvironmental proxies are materials that are sensitive to a variety of climatic or environmental parameters. These can be grouped into three major categories (a) Lithological/Mineralogical, (b) Geochemical, and (c) Paleontological (Gornitz 2008: 716). Paleontological data may be botanical or zoological. Again, zoological parameters for palaeoenvironmental reconstruction may be divided into proxy data and direct data. Proxy data is the data that can inform about the antecedent conditions not directly accessible for observation (Denacauze 1987: 259). In contrast, direct data implies those sources which are directly available for knowing past environments. This can be better understood with the help of an example. Calculating the percentage of Magnesium and Strontium in ostracod shells can be utilized as proxies for ancient temperature and salinity. Finding remains of rhino and elephant from an area that is currently arid constitutes direct data as their mere presence is indicative of wetter conditions in the past. Direct data in the aforesaid timeframe chiefly include fossilized bones, charred bones, antlers and horns, tooth enamel, hoof impressions and rock paintings, whereas many types of proxies have been used in palaeoclimate reconstruction such as isotopic compositions (oxygen, carbon and hydrogen isotopes) of carbonates, Magnesium-Strontium percentage in shells, etc. They will be referenced as and when required. For the purpose of the current study, faunal remains from various Prehistoric sites in Middle Ganga Plain and the neighbouring Vindhyan region are considered. However, it must be made clear at the onset that the researcher has merely utilized the results of archaeozoological studies conducted by experts and has not done any faunal study on her own accord.

## Palaeoenvironmental Reconstruction Based on Archaeozoological Evidence

**Proxy Data:** Studies researching the palaeo-ecological implications of the presence or absence of microfauna are far and few in Middle Ganga Plain and Vindhyas. Amidst the dearth of such studies, some singular studies have proved helpful in deciphering the microenvironments of the human habitats in the study area. Analysis of proxy data from ostracod and gastropod remains of dispersed sedimentary sections of two lakes, Mesa Tal and Sanai Tal, along with the isotopic studies on the tooth enamel at the sites of Kalli Pachchhim, Dadupur and Charda, in particular, constitute few such studies of faunal records providing evidence for the changes in the microenvironment. The usage of ostracod shell chemistry as a palaeoenvironmental tool, scrutinizing the presence of Magnesium and Strontium as temperature and salinity proxies, has been documented at these sites.

Sanai Tal and Mesa Tal are located on the interfluve surfaces of Central Ganga Plain and are only 62 km apart; therefore, it can be assumed they had shared a similar climatic regime. The patterns and responses of lake level fluctuations, ecological changes, and variations in sedimentation rates and lithological changes are very well reflected in the specific associations of ostracod and gastropod assemblages from these lakes (Saxena et al. 2011: 34). From the Mesa Tal, 2.50 m thick sediment succession (dated ~8500 yrs BP - present) and from the Sanai Tal, 2.10 m thick succession (dated ~15,000 yrs BP - present), were analyzed. In Mesa Tal, the lower 1.5 m marl horizon has yielded rich and diversified micro faunal assemblage, whereas in Sanai Tal the fauna is recorded from the upper 1.05 m sequence. The inferred palaeo-ecology of gastropod and ostracod fauna in Mesa Tal sediments suggests that between 9100 to 6000 years BP, it was a relatively large lake with a low supply of terrigenous clastic sediments. This corresponds to the early Holocene climate maxima when rainfall was high due to more intense SW monsoon system. In the mid-late Holocene period, the lake shrank with increased supply of terrigenous sediments. In Sanai Tal, ostracod and gastropod faunal assemblage suggest a shallow but permanent water body since the onset of Holocene. The richness of the fauna further indicated enriched vegetation and climatic amelioration during early-mid Holocene (10,120 - 7600 yrs BP) followed by a gradual decline in the lake size and water column during late Holocene (Saxena et al. 2011: 149).

Besides ostracod and gastropod proxies, oxygen isotopic fingerprints of bovid tooth enamel from Ganga plain have also been studied to understand its palaeoenvironmental history. Oxygen isotope analysis of teeth enamel was performed at the archaeological sites of Kalli Pachchhim, Dadupur and Charda in Ganga Plain. Oxygen isotope analysis of M3 teeth of *Bos indicus* collected from these sites show that the bulk $^{18}O$ values of M3 teeth from different archaeological horizons reflect climatic shifts over large time scales. Samples from around 3600 cal yr BP indicate humid conditions, which change to drier conditions around 2800 cal yr BP. From 2500 to 1500 cal yr BP, there is a trend of increasing humidity. Around 1300 cal yr BP, climatic conditions again became less humid or dry. The bulk $^{18}O$ values of M3 teeth from different archaeological horizons also reflect climatic shifts over large time scales. The $^{18}O$ values of tooth samples from Charda (high annual rainfall area) are lower in comparison to $^{18}O$ values of samples from Kalli Pachchhim (lower annual rainfall area).

However, $^{18}O$ values of samples from the same archaeological period from the two sites show a similar seasonal variation. It appears that although the amount of annual rainfall varied significantly in different parts of the Ganga plain, the seasonal pattern remained the same everywhere (Sharma et al. 2004: 27).

Another significant proxy data from animal bones was gathered from Kalpi, Uttar Pradesh. The present climate of Kalpi is semi-arid. However, the fluorine-phosphorus ratio of animal bones recovered from Event II strata indicated that it was deposited during humid climate event of 33-28 ka (Singh et al. 1999: 1024).

**Macro Faunal Direct Data:** Compared to micro faunal proxy data, there is plenty of evidence for the usage of macrofauna for palaeoenvironmental studies in the Middle Ganga Plain and Vindhyas (Pal 2013: 1). Sathe (2017) holds that reconstruction of the palaeoenvironment on the basis of macrofaunal remains can be best attained, especially when the assemblage is multi-species, reflecting the existence of a wider range of habitats. This is true with regard to thousands of fossils representing a diverse range of faunal species recovered from Pleistocene alluvial contexts at numerous localities in the Son and Belan river valley and Gangetic horseshoe lake sites. The coarse member of Baghor formation in Son valley was highly fossiliferous and revealed a corpus of faunal remains such as *Bos, Equus*, hippopotamus, crocodile, antelope, elephant, tortoise, stag, deer, etc. in well-preserved conditions (Misra 2007: 5). A large proportion of bovid, equid and rhino indicates substantial tracts of relatively open grassland, while good representation of Cervidae indicates presence of sufficient woodland and bushes. Swampy areas with plenty of water bodies are indicated by hippo, crocodile and mollusc presence (Blumenschine and Chattopadhyaya 1983: 283). Taxonomic composition of this assemblage from Baghor formation is consistent with the geological evidence of a humid climate in Son valley during the terminal Pleistocene. Investigations of the depositional sequence and the associated faunal remains at Belan valley also have helped to understand the prehistoric environments of the region, and on the basis of artefacts obtained from these deposits; the reconstructed climatic phases have been correlated with those of prehistoric cultures (Pal et al. 2004: 51). From cemented gravel III (Upper Palaeolithic Period) of Belan valley, remains of cattle, sheep, goat, antelope, bison, elephant and hippo were documented. The occurrence of bison with cattle indicates that the terrain had a thick forest cover along with grass. Presence of elephant and hippo indicate wetter climatic conditions (Alur 1990: 240).

It has been fairly established by several other sources that the Holocene environment in Middle Ganga plain during the Mesolithic period was humid. Supporting evidence for the same was gleamed from the faunal remains at Damdama. At Damdama, faunal remains of thirty species of mammals, fish, birds, reptiles and molluscs were identified. The principal species identified at Mesolithic sites were Chital, hog deer, stag, wild boar, antelope, wild buffalo, wild cattle, bison, *nilgai*, elephant, rhino, porcupine, gaur and pig. A large number of bones of birds, fishes and tortoise were also found. As is evident, many of these species are found in humid habitats. So, it can be inferred that the environment at the time of Damdama Mesolithic habitation must have been humid. Similar correlation of the presence of animals with humid climate was attempted at Kalpi in Uttar Pradesh, where studies relating to the Pleistocene environment were carried out. Scattered in the succession of Event II at Kalpi, where the remains of many vertebrates, namely, *Bos, Equus, Elephas,* hippopotamus, crocodiles and turtles. Scholars studying the faunal collection concluded that this rich fauna would have required a swampy region with humid climate to flourish (Singh et al. 1999: 1024).

Besides animal bones, some idea about the palaeoenvironment can be envisioned by the faunal depictions in Mesolithic rock art. The pictorial content of rock paintings by Vindhyan Mesolithic hunters document a fauna that could only exist in a climatic condition very similar to the current one (Neumayer 1993: 20). Rock paintings at Gochara, Kerwa, Kauva Koh, Ghormanagar, Panchmukhi, Soraho in Mirzapur document the presence of one-horned Rhino in the paintings of earlier phases. Tewari also documented 55 depictions of elephant from rock painted shelters in Mirzapur (Tewari 1990:13). This once again attests to the humid conditions in the area since preferred habitats of rhino and elephant are regions with wet and humid climate.

## Discussion

It appears that the use of archaeozoological assemblages as palaeoenvironmental proxies can be fraught except in general terms. Though archaeozoological records can also reflect specific environmental transformations such as local extirpations and extinctions but such a case was not seen in the area under study. Zooarchaeologists also refer to difficulties encountered while eliciting subtle palaeoenvironmental change based on assemblages of terrestrial fauna because of potential anthropic influences on the assemblage composition, including changing relative importance of subsistence strategies, changes in cultural preferences and resource depletion, to name a few (Denham 2012: 315). They postulate that the reconstruction of the palaeoenvironment can be best attained, especially when the assemblage is multi-species, reflecting the existence of a wider range of habitats. Luckily for us, from most of the sites in the current area taken up for palaeoenvironmental studies, faunal assemblage is multi-species.

It is important to note here that most of the palaeoenvironmental reconstruction in the area of study is done on the basis of fossil remains of big vertebrate animals like *Bos, Elephas*, Hippo, etc. Sathe opines that since the mobility of micro vertebrates is generally confined to the restricted area during their entire life span and some of them are sensitive to climatic changes, their occurrence provides higher resolution in interpretations of palaeoenvironment and formation of palaeo communities. In this context, rodents represent a specific type with the potential to provide palaeoenvironmental information not attainable from other animal groups. The usefulness of rodents as a source of such information appears to have been overlooked in the context of Indian Archaeology in general and in the area of study in particular (Sathe 2017: 6).

All methods and approaches used for the reconstruction of palaeoenvironmental information have inherent shortcomings, limitations, and problems. It is suggested that a combination of different, independent techniques and proxies should be used, not only to overcome the shortcomings, limitations and problems associated with the application of individual methods, but also to combine the advantages of individual methods. Such an integrated analysis of different proxies can lead to more reliable information about palaeoenvironmental conditions and improve our knowledge about the comparability and applicability of these methods (Uhl 2006: 87).

## Conclusion

With the growth in environmental and ecological studies in archaeological pursuits, the role of archaeo-faunal materials has changed drastically. Archaeo-faunal studies have come a long way from the time when they were concerned with mere identification at the species level. Today, it reflects greater interest in the issues like animal utilization trends, selective choices with regard to animal exploitation, human-animal relationships, cultural preferences and beliefs associated with animals and ecological reconstruction, to name a few. Therefore, it can be concluded that in corroborations with the other proxy records such as chronology, palynology, and stable isotopic records, archaeo-faunal direct and proxy data can be used as an excellent tool to gain information pertaining to the regional scenario of palaeoenvironment (Saxena et al. 2011: 34). Thus, it can be concluded that a glimpse into the palaeoenvironment can be achieved by the integration of data from multiple proxies, including archaeo-faunal proxy and direct data.

## References

Blumenschine, R.J. and U.C. Chattopadhyaya 1983. A preliminary report on the terminal Pleistocene fauna of the Middle Son Valley, in *Palaeoenvironments and Prehistory in the Middle Son Valley* (G.R. Sharma and J.D. Clark Eds.), pp. 281-284. Allahabad: Abinash Prakashan.

Bradley, R.S. 1985. *Quarternary Palaeoclimatology Methods of Paleoclimatic Reconstruction.* Boston: Allen & Unwin.

Butzer, Karl 1982. *Archaeology as human ecology*. Cambridge: Cambridge University Press.

Denham, Tim 2012. Environmental Change and Archaeological Evidence, in *The SAGE Handbook of Environmental Change Vol. I Approaches, Evidences and Causes* (John A. Matthews Ed.), pp. 305-319. London, California, New Delhi, Singapore: SAGE.

Dincauze, Dena F. 1987. Strategies for Palaeoenvironmental reconstruction in Archaeology, in *Advances in Archaeological Methods and Theory* Vol.11. (M.B. Schiffer Ed.), pp. 255-336. California: Academic Press.

Gornitz, Vivien 2008. Paleoclimate Proxies, An Introduction, in *Encyclopedia of Palaeoclimatology and Ancient Environments* Encyclopedia of Earth Sciences Series (V. Gornitz Ed.), pp. 716-720. Doedrecht: Springer.

Harding, Anthony (Ed.) 1982. *Climatic change in Prehistory*. Edinburgh: Edinburgh University Press.

Jochim, A. Michael 1979. Breaking down the system: Recent Ecological approaches in Archaeology, in *Advances in Archaeological Methods and Theory* Vol. 2 (M.B. Schiffer Ed.), pp. 77-119. California: Academic Press.

Lyman, R. Lee 2017. Paleoenvironmental Reconstruction from Faunal Remains: Ecological Basics and Analytical Assumptions, *Journal of Archaeological Research* 25: 315-371.

Misra, V.D. 2007. Stone Age Cultures, their Chronology and Beginning of Agriculture in North-Central India, *Man and Environment* XXXII (1): 1-14.

Neumayer, Erwin 1993. *Lines on stone The Prehistoric Rock Art of India.* New Delhi: Munshiram Manoharlal Publications.

Pal, J.N. 2013. New Researches in the Prehistoric Archaeology of the Vindhyas, *Puratattva* 43: 1-10.

Pal, J.N., M.A.J. Williams, M. Jaiswal and A.K. Singhvi 2004. Infra Red Stimulated Luminescence Ages for Prehistoric Cultures in the Son and Belan valleys, North Central India, *Journal of Interdisciplinary Studies in History and Archaeology* 1(2): 51-62.

Reitz, Elizabeth J. and Elisabeth S. Wing 2008. *Zooarchaeology*. Cambridge Manuals in Archaeology. Cambridge: Cambridge University Press.

Sathe, V. 2017. Smaller but not Secondary: Evidence of Rodents in Archaeological Context in India, *Ancient Asia* 8: 1-20.

Saxena, A., I.B. Singh and P.N. Agarwal 2011. Palaeoecological implication of ostracod and gastropod assemblages of the Holocene lake records from the Ganga Plain, *Journal of the Palaeontological Society of India* 56 (2): 23-37.

Sharma, G.R. 1973. Stone Age in the Vindhyas and the Ganga valley, in *Radiocarbon and Indian Archaeology* (D.P. Agarwal and A. Ghosh Eds.), pp. 106-110. Bombay: Tata Institute of Fundamental Research.

Sharma, S., M. M. Joachimiski, H. J. Tobschall, I.B. Singh, D.P. Tewari and R. Tewari, 2004. Oxygen isotopes of bovid teeth as archive of palaeoclimate variations in archaeological deposits of Ganga Plain, India, *Quaternary Research* 62: 19–28.

Singh, I.B. 2005. Quartenary Palaeoenvironments of the Ganga Plain and Anthropogenic Activity, *Man and Environment* XXX(1): 1-35.

Singh, Indra Bir, Shikha Sharma, Maneesh Sharma, Pradeep Srivastava, and Govindaraja Rajagopalan 1999. Evidence of human occupation and humid climate of 30 ka in the alluvium of south Ganga Plain, *Current Science* 76: 1022-1026.

Tewari, A.R. 1971. *Geography of Uttar Pradesh.* New Delhi: *Book Trust of India.*

Uhl, D. 2006. Fossil plants as palaeoenvironmental proxies – some remarks on selected approaches, *Acta Palaeobotanica* 46(2): 87–100.

Wadia, D.N. 1973. *Geology of India.* New Delhi: Tata McGraw Hill Publishing Co.