DISCOVERY OF A FOSSIL BONE BED IN THE MANJRA VALLEY, DISTRICT LATUR, MAHARASHTRA

VIJAY SATHE

Introduction

The discovery of a large number of fossilised cranial and skeletal elements of tiger, horse, rhinoceros, hippopotami, elephants, cattle, buffaloes, blackbuck, deer, tortoise and several fresh water molluscs in the Late Pleistocene fossiferous gravels near Harwadi, Latur District, Maharashtra has generated a new set of data for broader palaeoenvironmental interpretations with special reference to upper Manjra valley. Tiger from Harwadi is only the second occurrence of this species in Peninsular India after its presence in the Hunsgi-Baichbal valley. Rhinoceros elsewhere is found only at the Kurnool caves (A.P.) and Ghataprabha valley in Karnataka. Morphologically, they are in close to their extant representatives. The occurrence of fossils in an excellent state of preservation provides a point of reference to address the complex issues concerning the formation of a fossil record especially with respect to fluvial settings.

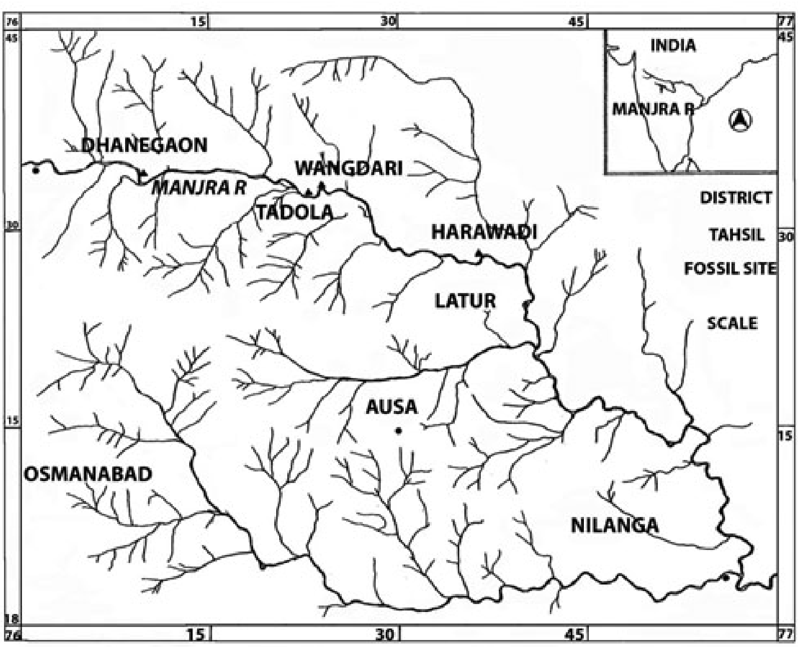

Fig. 1 a : Locality Map of Manjra Valley

Table – 1 : Site wise Occurrence of Pleistocene vertebrate fauna in Manjra Valley

Taxa	Common names	Dhanegaon	Wangdari	Tadola	Ganjur	Harwadi
Hystrix c.f. crassidens	Porcupine	-	✓	-	-	-
Pantheratigris	Bengal tiger	-	-	-	-	✓
Canid	Carnivore	-	✓	✓	-	-
Rhinoceros unicornis	Indian Great One-horned rhinoceros	-	-	-	-	✓
Equus namadicus	Horse	-	✓	-	✓	✓
Stegodon insignis ganesa	Primitive elephant	✓	✓	✓	-	?
Elephas namadicus	Elephant	✓	✓	-	-	✓
Elephas hysudricus	Elephant	✓	✓	-	-	?
Hexaprotodonspp.	Six incisored hippopotamus	-	✓	✓	-	✓
Bos namadicus	Cattle	✓	✓	✓	✓	✓
Bubaluspalaeindicus	Buffalo	✓	✓	✓	✓	✓
Axis axis	Spotted deer	-	✓	✓	-	✓
Cervusduvauceli	Swamp deer	-	✓	-	-	✓
Cervus sp.	Deer	-	✓	✓	-	✓
Antilopecervicapra	Blackbuck	-	✓	-	-	✓
Crocodylusp alaeindicus	Crocodile	-	-	✓	-	-
Trionyx c.f. gangeticus	Turtle	-	✓	✓	✓	✓

The present paper is an account of fossil discoveries with reference to their role in palaeoenvironment reconstruction of the region.

The Manjra valley has emerged as one of the areas rich in Pleistocene vertebrate fossils in recent years (Joshi *et al*. 1981, Badam *et al.* 1984, Sathe 1989, 2004 & 2009). The faunal diversity and its sedimentological context have enabled a better resolution of the palaeoenvironment (Sathe 2005, 2014, Kulkarni and Sathe *submitted*). The fossil sites known in the area are within 60 km of each other, on the main channel of Manjra in the Districts of Latur and Beed (Fig. 1a). The faunal record comes from a sandy pebbly gravel which is the sole fossil horizon resting on the Deccan Trap (Fig. 2). However, the discovery of a new fossil site on the left bank of river Manjra near the village of Harwadi, Latur District, Maharashtra has brought to light a

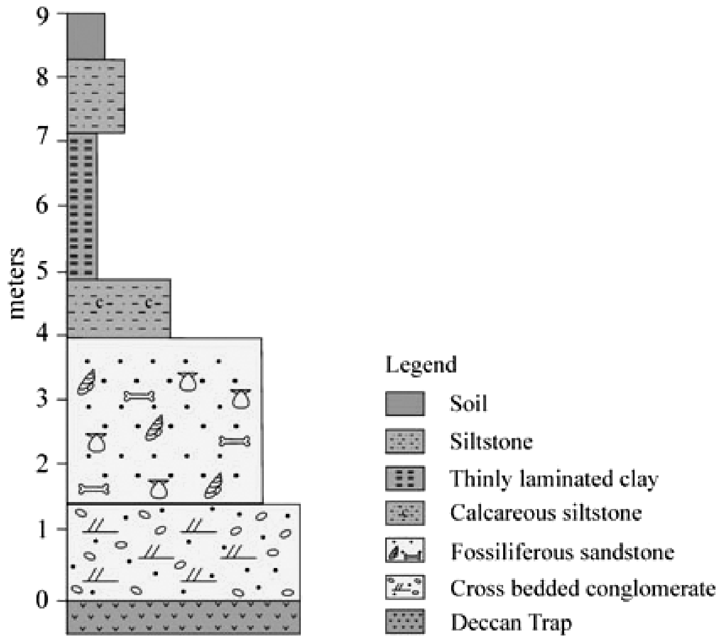

Fig. 1 b : Lithostratigraphy of the fossil bearing site of Harwadi

large number of complete cranial and skeletal elements with a higher species diversity, forming an undisturbed bone bed that is being presented here. It has come to represent the type site of large mammalian fluvial taphonomy for Peninsular India (Sathe 2005).

Four year's consecutive field explorations in the Manjra valley and three seasons of excavations at Harwadi have brought to light at a single site faunal diversity of thirteen large to small vertebrate taxa (Table–1). A couple of trenches and sections exposed along the left bank of the Manjra yielded this multi species scatter, 90% of which is in an excellent state of preservation. It is predominantly a hippo and elephant yielding site with the majority of their remains being complete and often still articulated. Bovids are represented by postcranials and a couple of crania while a single complete cranium of an equid is a rarity.

The fossil locality and sedimentary context

The site of Harwadi (18º 27' 40" N: 76º 35' 38" E) is situated on the left bank of Manjra. Quaternary formations in the area have a lateral extension of a kilometre and are confined to broad and shallow valleys cut into lower pediplained surfaces. Alluvial deposits are characterised by cut and fill types with thickness ranging from 9 to 10 m. The Older alluvium represents cemented and cross-bedded sandy pebbly gravel and calcareous yellowish brown sandy silt being the representative litho unit. The occurrence of a fossil record within a single lithological unit and spread to the lateral extension of a couple of hundred meters qualifies it to be a bone bed. General stratigraphy of this region is given in Figure 1b.

Fossil Assemblage and taphonomic history

The occurrence of well preserved and diverse fossil record within a single sedimentary stratum and spread to the lateral extension of a few hundred meters qualifies it to be a bone bed (Beherensmeyer 2007). Undoubtedly it has a great amount of information regarding the history of deposition. Investigations into the supposed proximity of the fossil record to its original place of burial and 'subsequent means of preservation' are central to the theme of this paper. From the scatter pattern of the assemblage, it is being examined using sedimentological, isotope, trace element and bone histological methods as to what information might have been lost to time and to what extent it is a 'disturbed assemblage' (Sathe in *prep*).

A total of over one hundred and fifty specimens (NISP) were collected, of which, approximately seventy per cent came from the excavations. In the vicinity of about 60 km of this region, Older Alluvium in the Manjra has also preserved some of the well preserved sections yielding the fossils of similar species of similar antiquity. At the site of Harwadi, horizontal and vertical step trenches yielded a multi species scatter which included animals like tiger, rhinoceros, horse, elephant, hippopotamus, large bovines, deer, black buck, and turtle, 90% of which is in a pristine condition (Table –1). A large number of fresh water molluscs belonging to six species of gastropods and bivalves, the majority of which were sampled from underneath the hippopotamus skeletal scatter. Within the reach of a few tens of meters in the similar sedimentary horizon, complete fore and hind limb bones of large bovines are found embedded together in a sandy-silty matrix (Fig 2). In a predominantly hippo yielding trench the mandibular symphysis was found

Fig. 2 : Occurrence of bovine ling bones in the section along gravelly bed, Harwadi

Fig. 3 : Multi species fossil scatter with predominant finds of hippopotamus exposed in a trench

upside down while the cranium had E-W polarity. Next to the skull a complete femur with a similar polarity was found and between the jaws the scapulae occurred. The scatter has a mixed assemblage of bones and animals and above all a combination of each of Voorhies' representatives (Fig. 3). The field observations to examine the extent of fluvial dispersal included polarity, orientation, shape of fossils and the shape index. The second part (laboratory) of investigations consist of detailed examination of surface conditions of the fossils for factors like fragmentation, abrasion and weathering and microscopic examinations for surface taphonomy as well as the bone histology for mineral impregnation.

Ever since Voorhies (1969) pioneered the studies of mechanical dispersal processes in fluvial transport which was further corroborated by several other scholars (Benhrensmeyer 1975, and 2007; Behrensmeyer1991; Lyman 1994 and Allison&Bottjer2011), the study of the history of modifications has become a meaningful endeavour. In the context of the site of Harwadi, their observations offer useful clues, especially while dealing with a mixed assemblage. Bone shape, size, their densities are some of the most inherent features that determine the preservation potential (Shipman 1981, Lyman 1994). The shape exerts a strong influence on the possibilities of its fluvial transportation. The length, width and thickness of the fossils point to sphere, blade, disc and rod. The ratio between blade and disc, and sphere and rod shapes was calculated. Well preserved presence of rod and sphere shapes in spite of being less in number yet again recommends a low key effect of fluvial disturbance.

Discussion and Conclusions

Faunal analyses in the context of field taphonomic documentation suggest that the depositional setting of the site of Harwadi can be assessed while keeping in view the presence of certain skeletal elements in the assemblage, its completeness with respect to the animals found, orientation, weathering and abrasion.

The mammalian skeletal elements, grouped on the basis of susceptibility to fluvial transport (Voohries 1969) indicate ribs, vertebra and sacrum as the prone elements that move immediately or float. Interface of his Group I and II include scapula, phalanges and ulna. Interestingly, preserved with remarkable completeness, the bones like ribs, vertebrae (atlas, axis, cervical, thoracic, and lumbar) and synsacrum are a testimony to the weak currents. The deposit was not winnowed and sorted at any time by stronger fluvial activity. The ribs and vertebrae were found in a very close cluster and on top on one another. The appearance resembled the cluster noticed in the minimally disturbed carcasses which yet again confirms their proximity to the death assemblage.

Additional evidence suggesting a low-energy current, that influenced the Harwadi assemblage, comes from the initial stages of bone abrasion seen in the specimens. Most of the elements are fresh except those (50%) bearing abrasion stages 1 and 2 after the proposed parameters of abrasion by Fiorillo (1988). These stages show moderate to slight amount of abrasion on edges and corners of the type that might be expected in a low-energy environment. Teeth and vertebra ratio being an indication as to how much winnowing took place and resulted into preferential removal of vertebrae fails to satisfy present circumstances. However, it needs to be re-examined whether the absence of 'desired' skeletal elements and the taxon is an artifact of field investigations or an absence of the evidence all together.

The presence of all the Voohries' Groups in an excellent state of preservation at the site of Harwadi reiterates the inadequacy of the current velocities (at the site of deposition) that could not displace the bones of all size and taxa. It should be accepted here that removal of some of the susceptible elements has occurred and hence the assemblage lacks skeletal completeness. Loosing this precious data to a prolonged state of burial and re-exposure may not be ruled out. According to Behrensmeyer (1975) removal of bones of largest animals like hippos and elephants require flood velocities and if that is accepted, the bones cannot be expected in a state of preservation that the present assemblage projects. The inherent palaeoecological information that this assemblage provides cannot be negated.

Palaeoenvironments

The checklist of animals that have been identified include tiger, rhinoceros, horse, hippopotamus, stegodonts, elephants, spotted deer, swamp deer, sambar, cattle, buffaloes, antelope, tortoises and six genera of gastropods (Tables 1, 2 &3). The total MNI

Table–2 : Molluscs at Harwadi

No.	Genus/species	NISP
1	Corbicula peninsularis	57
2	Parreysia corrugatana gpoorensis	19
3	bellamyabengalensis	40
4	Digoniostomata sp.	32
5	Thiara((Melanoides)tuberculata	14
6	Lamellidens marginalis	25

Table–3 : Skeletal element distribution of the Harwadi mammalian species:
(NISP = number of identified specimens, MNI = minimum number of individuals, MNE = minimum number of elements).

Animal species	Skeletal elements	NISP	MNE	MNI	Total
Buffalo (*Bubalus palaeindicus*)	Skull	3	3	3	5
	Radius	1	1	1	
	Pelvic gridle	2	1	1	
Cattle (*Bos namadicus*)	Maxillae	5	2	1	9
	Mandibles	6	3	1	
	Humeri	3	2	1	
	Radii	2	1	1	
	Femora	1	1	1	
	Metacarpals	2	2	1	
	Metatarsals	4	2	1	
	Synsacrum	4	2	2	
Cattle/buffalo	Cuenciform	2	2	1	11
	Teeth	4	1	1	
	Humerus	1	1	1	
	Radi	6	1	1	
	Femora	2	1	1	
	Pelvic girdle,	1	1	1	
	pectoral girdles	1	1	1	
	Cervical,	4	1	1	
	thoracic,	2	1	1	1
	lumbar	1	1	1	
	Ribs	10	1	1	
Antelope (*Antilope cervicapra*)	Horncores	3	2	2	4
	Humerus	5	1	1	
	Radius		1	1	1
Deer (*Cervus spp.*, *Axis axis*)	Antler	4	3	2	2
Turtle (*Trionyx sp.*)	Carapace	5	2	2	3
	plastron	3	2	1	

of each of the taxons represent the life assemblage of Late Pleistocene Harwadi whose death, burial and fossilisation forms the central theme of the project. The megafaunal fossil record highlights their role in reconstructing the palaeoenvironments of megafauna-bearing sites from Pleistocene Peninsular India and to describe general environmental changes in the region. Medium- and large-bodied mammals are the most frequently recovered mammals at most of the sites along Manjra including that of Harwadi (Table–4). The reconstructions may help in identifying the region bearing significant areas of mixed habitats, and that the widespread distribution of forest

Table–4 : Present day body size (weight in Kg) of animals whose fossilised remains have been found at Harwadi and other localities in the Manjra Valley

Elephant	Extremely large	3000-4000	Horse	Large	500-700
Hippopotamus	Extremely large	1000-3500	Tiger	Medium	100-250
Rhinoceros	Extremely large	1000-2500	Deer and small bovid	Medium to small	40-200
Bovids (cattle & buffaloes)	Large	500-1000	Antelope	Medium	34-45
Nilgai	Large	100-288	Porcupine	Small	11-18

patches. Reconstruction of habitat types of the Pleistocene fossil sites through a synecological (community-based) method considers medium- and large-bodied mammals, and ecovariables that could be directly assessed from species lists. Eventually the methods allow the reconstruction of fossil sites as closed (continuous tree cover), mixed (heterogeneous tree cover) and open (very limited to no tree cover) through discriminant functions analysis of community guild structure (Louys and Meijaard 2010). In this context detailed analysis of palaeo-community structure envisages a perennial vegetational continuum and pollen evidence offers meaningful insights into it (Chauhan et al. *in prep* & Table–5).

Table–5 : Categorization of plant taxa recovered in the sediment profile

Arboreals		**Non-arboreals**	**others**
Trees	**Shrubs**	**Grasses**	
Moist elements: (av. rainfall > 1200mm) *syzygiumcumini, symplocosracemosa, Terminalia,* sp., *Madhuca-indica, Moringaoleifera, Ailanthus excels.* **Dry elements:** (av. rainfall < 1000mm) *Acacia nilotica, Holopteleaintegrifolia, Aegle marmelos, Holarrhena*sp, *Emblicaofficinalis, Bombaxceiba*	*Acanthus* sp., *Adhatodavasica, Ziziphus*sp., *combretum* sp., Fabaceae.	Poaceae. **Culture/ruderal taxa:** Cerealia, Chenopodiaceae/ Amaranthaceae (Cheno/Am), Brassicaceae, *Artemisia* sp., Caryophyllaceae, *Cannabis sativa. Alternria,* **Heathland taxa:** Asteraceae (Tubuliflorae & Liguliflorae), *Xanthium strumarium, Justiciasimplex, Tinosporacordifolia.* **Wetland taxa:** Cyperaceae, *Solanum* sp. **Aquatic taxa:** *Typhalatifolia,Lemna*sp.	**Ferns:** Ferns producing monolete spores, Frens producing trilete spores. **Fungal remains:** *Nigrospora,* *Curvularia, Glomus,* Ascospores. **Algal remains:** *Pseudoschizea, Zygnema*zygospoes. **Drifted:** *Pinus* sp.

The taxonomically rich and diverse assemblage of the Pleistocene mammalian fauna attests to the presence of suitable habitats that supported the ancient wildlife in the Manjra valley, with special reference to the site of Harwadi (Figs. 4-10). Among

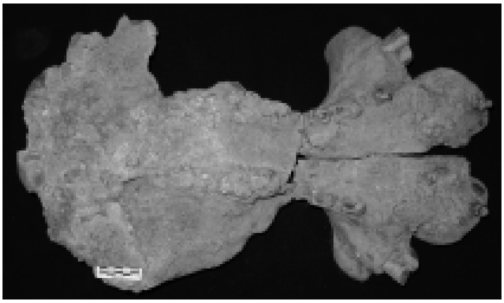

Fig. 4 : Skull, jaws and other elements of hexaprotodont

Fig. 5 : In situ cranium of Equus namadicus at Harwadi

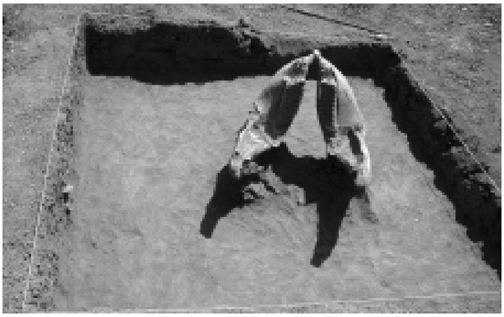

Fig. 6 : In situ mandibular symphysis and hip girdle of Elephas namadicus

Fig. 7 : In situ cranium of Bubaluspa-laeindicus 100m se of the trench

Fig. 8 : Right jaw with mandibular symphysis of Rhinoceros c.f. unicornis in a trench along Manjra at Harwadi

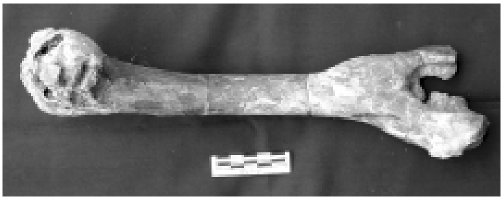

Fig. 9

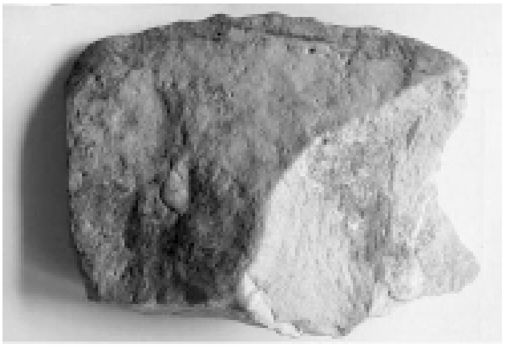

Fig. 10 (a)

Fig. 10 (b)

Fig. 10 (c)

all the large mammals, hippopotamus is climatically a most sensitive taxon whose physiological attributes deserve a special mention here in the face of the general notion that large mammals may not necessarily be reliable indicators of palaeo-environment. Ecology of hippo-potamus explains that the survival of hippopotamus is essentially depending upon the perennial presence of water bodies or even the mud swamps with proximity to aquatic source. Most superficial layer of skin stratum corneum is thin and smooth and dense and permits a higher rate of transepidermal loss of water, highest in mammals. The water loss is directly through the skin as hippos lack sweat glands. High rate of transepidermal water loss facilitates evaporative cooling necessary to counter animal's heat loss (Luck & Wright 1964, Olivier 1975). Eventually it is the physiology and dermal anatomy that makes them amphibious, lazy and economical with energy (Rowan 2005). Remaining all the day in water and nocturnal feeding are the characteristic habits of this large herbivore. Since the evaporation of water from skin is very high compared to other mammals and temperature control is not achieved through any mechanism similar to sweating unless red secretion acts as sweat. With prolonged exposure skin develops severe and unbearable cracks, heats up and the excessive water loss pulls them back to the water. It has also been observed that the water bodies do not necessarily have to be a swamp or flowing water as long as the skin is kept wet by mud in wallows (Eltringham 1999). These animals weigh between 650 to 3500 kg which leads to excessive pressure on the ground, forming compaction of soils. This renders a runoff of excessive water during rains and gives rise to sheet erosion besides depriving the soil from further absorption of water. Moving out of water for foraging on routine trails forms shallow trenches which may turn into a gully or even carry water to form a water logged zone over the longer period of time. In short even in marshy conditions their trails may also contribute to serving as an important function of drainage channels. The hippos are nocturnal feeders and spend 8 to 9 hours grazing as far as 8 to even 10 km away from the water bodies. To support a school or even a larger herd of hippos the landscape in the vicinity is expected to maintain adequate amount of grasses and this balance is often maintained by the elephants by destroying the tress and converting woodlands into grasslands (Eltrigham 1999). The habitat preferences and behavioural biology of living hippos is a useful reference to understand as to what it needed to support the survival of these mega mammals and helps in portraying the community structure in the Manjra valley, especially with reference to the site of Harwadi.

The fossilised skeletal elements of hippo, cattle, and elephant indicate Voorhies' (1969) lag elements which are generally last to be transported on account of being resistant to hydraulic pressures. The orientation data in addition to the polarity of long ends and 0-1 degree of abrasion of bones yet again advocate moderate fluvial dispersal which was unable to move an original skeletal assemblage. Large numbers of complete gastropods along with these bones point to undisturbed conditions of burial. In the light of ecological data of living hippos, the occurrence of their skeletal remains may permit us to reconstruct the 'palaeo-habitat' of these animals and palaeoenvironment around Harwadi. The activity area of these animals or their foot prints are significant clues which have been lost to the fluvial processes. The presence of 'wetland soil' and the association of a large molluscan assemblage points to shallow water bodies, providing adequate subsoil moisture which may have helped maintaining vast expanse of grasslands. The bone bed suggests a semi-autochthonous assemblage of animals which were supported by the perennial grasslands and a galleria forest in the vicinity.

Undisturbed status of the sediments that bore the fossil material and its ecological interpretations with reference to hippos are further attested by a large body of molluscan shell remains found at Harwadiin association with hippopotamus skeletal scatter. The molluscan assemblage includes *Corbicula peninsularis, Parreysia corrugata nagpoorensis, bellamya bengalensis, Digoniostomata* sp., *Thiara((Melanoides) tuberculate and Lamellidens marginalis.* Most of the specimens are excellently preserved without much of post mortem wear and tear. In a sizeable number of bivalve shells both the valves are intact and conjoined. Even pieces of ligament are preserved in some of the specimens. All these observations suggest that these fossils were deposited in the sediment not far from the place where they lived, if not autochthonous. Therefore, the body of water in which this molluscan fauna thrived was a lake and not a river (Kulkarni and Sathe *in press*).

The section exposed on the left bank of Manjra at the hippo-rich fossil site of Harwadi was subject to careful sampling to see if any palynological evidence could be documented. Over a dozen and half samples of soil were collected and analysed for the pollen identification at the Birbal Sahni Institute of Palaobotany, Luckow by M.S. Chauhan. The samples in accordance with the successive stratigraphy were divided into I to V units and pollen potential was calculated, which brings to light vegetation diversity throughout the Late Pleistocene and early Holocene period (Table 5). The layer in contact with the fossil horizon, i.e. 'Pollen zone I' reveals the open mixed deciduous forests under a regime of warm and less-humid climate than that prevailed today. The diversity of grass types including sedges and aquatic flora is also witnessed which corresponds to aquatic water bodies that were the lifeline of hippopotamus and several other large mammals whose primary diet source is supplied by the type of grasses growing on the landscape. However, the successive layers witness the presence of mixed deciduous forests turned varied and dense with the expansion of trees and may be attributed to the onset of a warm and humid climate in response to increased monsoon precipitation. The region had some lakes/ water bodies as indicated by the sedges and aquatic flora (Chauhan et al. *in prep*). A detailed discussion on the palaeovegetation based on the pollen profile of Harwadi (Chaunah et al *In prep*) helps to envision the vegetal diversity during and even up till the beginning of Holocene at the site of Harwadi.

Dating of fossils and fossil bed

Based on the geomorphological, palaeontological records and available carbon 14 dates, the fossil assemblage has been assigned to the Late Pleistocene with a time bracket of 22 to 60 thousand years. Fluorine uptake in bones as an established method of relative dating has been commonly employed to assess the relative dating of bones and it has offered a general time frame for Quaternary fauna in India (Joshi and Kshirsagar 1986, Kshirsagar 1993, Joshi and Sathe 2007). In order to check stratigraphic integrity and antiquity of bones, a set of ten fossilised bones, sampled from excavations at Harwadi and a set of ten from excavations in an upstream site of Tadola on River Manjra were examined in the Archaeological Chemistry Laboratory of Deccan College. Since the fossils had a definite stratigraphic control, it gave us an opportunity to see if any discrepancy or comparability in the fluorine values could help in looking at the single and/ or multiple events of burial or an extensive reworking that had probably brought the fossils to rest where they were sampled by an excavator. Interestingly, as regards Harwadi, the fluorine ratio has values well within 5 to 6 while those of samples from Tadola tell a different story. Specimen nos. 1 to 6 come from a stratified context where the ascending values (of fluorine) do not necessarily match with depth at which they were collected. For example, samples from the lower most fossil yielding level gives the values 3.86 and 3.81, which are half of the ones 6.19 on sample no. 4 obtained on bones from upper levels. The lack of uniformity between the values and depth suggests post-burial disturbances resulting in the mixing of fauna that perhaps coincided with the beginning of the process of fossilisation. The fluvial origin and taphonomic assessment of the fauna makes this a plausible explanation. This contrasts with Harwadi where the values support geomorphological and taphonomic interpretations of the assemblage probably being a result of a single event of burial. A single higher value of 6.19 at Tadola is an exception against the cluster of much lower values within the range of 3 to 4. This higher value (6.19) pushes for a higher range comparable with fossils of late Middle Pleistocene assemblages from Peninsular India. It may be summarised that fluorine dating eventually corroborates taphonomic interpretations at Harwadi and Tadola. On one hand, the average of 5.35 at Harwadi, compliments observations regarding a single event of burial, while the range of fluorine/ phosphate ratio at Tadola clearly suggests a mixing of faunal assemblages (multiple burial events) which can be termed as allochthonous (Joshi and Sathe 2007).

Conclusions

Regardless of the fact that the study is based on a small collection and the faunal analyses is preliminary, several conclusions can be drawn regarding its mode of occurrence, skeletal representation and animal taxa. At the outset it demonstrates a set of specific information regarding climatic, biological and depositional environments that governed the sustenance of life assemblage, death and subsequent burial. In fact the first ever occurrence of artefacts on basalt such as flakes, blade and a knife from the Acheulian character occur. (Pers com. Prof K Paddayya) The immediate question that arises here is what was the cause of death and how did the bones come to rest without any further deterioration? The mode of death determines the 'future' of the death assemblage and if the cause of death and subsequent dispersal is looked into (Sathe 2004), the enigma of hippo's extinction could also be explained meaningfully, especially in the light of the fact that hippos in no circumstances can live without sufficient and perennial water sources (Eltringham 1999, Jablonski 2004, Dennel 2005). If the assemblage is an outcome of a snapshot of locked ecosystem of Late Pleistocene, what circumstances were conducive for fossilisation in time?It necessitates looking for the reasons for absence of vertebrates < 10kg in the region for a holistic approach to palaeoecology. However, recent discovery of a porcupine fossil 50 km further upstreams of Harwadi once again opens up the possibility of finding more of a smaller fauna which is otherwise generally under-represented in the floodplain deposits. It is possible that Harwadi fauna is an assemblage of a catastrophic death which probably escaped carnivore activity and exposures were a matter of a short time (may be a few weeks to months), skipping majority of information loss. As the taphonomic attributes related to drought like situations as cause of death (Shipman 1975) were found in the fossil assemblage from Wangdari-Tadula and Ganjur (cluster of sites 60 km upstreams of Harwadi) (Sathe 2004), it is likely that taphonomic models from sites in southern Europe (e.g. Mazza & Ventra 2011) may help in precise identification of origin, preservation biases and paleobiological significance of the fossil assemblage from the Manjra valley which represents an important benchmark in vertebrate taphonomy of peninsular India. The Palaeobiochemistry and bone histology with reference to major, minor and trace elements for palaeoenvironmental clues and detailed taphonomic assessment from the available data are under progress (Chakraborty and Sathe 2014, Sathe 2014 and Sathe & Kelkar-Mane 2014 & 2015) and expected to shed important light on the present state of understanding of the site formation process at Harwadi.

Acknowledgements

The expenses for all the field seasons in the Manjra valley were entirely supported by the Individual Research Grant of the University. Author is grateful to Dr K. Paddayya and Dr V.P. Bhatta, Former Directors of Deccan College Postgraduate and Research Institute, Pune for sanction of the financial assistance from Individual Research Grant. Molluscs discovered from the excavations at Harwadiwere analysed by Dr (Mrs.) Kantimati Kulkarni, Senior Ichnologist and Invertebrate Palaeontologist from the Palaeobiology Group of Agharkar Research Institute, Pune while the pollen analyses were carried out by Dr. M.S. Chauhan, Scientist E (retired) of the BirbalSahni Inistitute of Palaeobotany, Lucknow. Author is thankful to both of them for analysing the biological materials and providing an important set of reports, which have proved crucial in palaeoenvironmental reconstruction of the Manjra fauna.

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