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V

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Preface

When I participated in the IVth International Conference of ASWA, held in the summer of 1998 in Paris, I was gratified to learn that the Scientific committee had unanimously agreed to hold the next meeting in Jordan. Thus, on 2 April 2000, the Vth International Conference of the Archaeozoology of Southwest Asia and Adjacent Areas was held for the first time within the region at Yarmouk University in Irbid, Jordan after being held on the past four occasions in Europe.

The themes of this conference were divided into five areas including:

- Paleo-environment and biogeography
- Domestication and animal management
- Ancient subsistence economies
- Man/animal interactions in the past
- Ongoing research projects in the field and related areas

I wish to thank all those who helped make this conference such a success. In particular, I would like to express my appreciation to the Director of the Institute of Archaeology and anthropology at Yarmouk University Special thanks are due to his excellency, the President of Yarmouk University, Professor Khasawneh, who gave his full support and encouragement to the convening of this conference at Yarmouk University and to all those who contributed the working papers which made the conference possible.

I also wish to thank members of the organizing committee who worked very hard for many months in preparing the venue for this conference.

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Note from the editors:
The editors wish to thank Dr. László Bartosiewicz for his excellent assistance in preparing and checking the contributions to this volume.

Participants at the 5th ASWA Conference, held at theYarmouk University in Irbid, Jordan, 2000

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Preface

COMMUNITY STRUCTURE CHANGES THROUGH TIME: ‘UBEIDIYA AS A CASE STUDY

Miriam Belmaker[1]

Abstract

The site of ‘Ubeidiya has been chosen in order to compare different methods of palaeoecological reconstruction. This analysis is based upon a published faunal list from Tchernov (1986), on five levels comprising 100 specimens. The results of ecomorphological diversity suggest that 1: the levels can not be allocated to any of Andrew’s ecosystems, 2: No change can be evidenced within the levels. This is in contradiction with climatic changes evidenced by the frequencies of faunal indicators and by the method of cenograms. However, the frequencies of faunal indicators and the cenogram analyses are tributary of different palaeoecological reconstructions. In the case of ‘Ubeidiya, the two analyses (for the cenograms as well as the method of ecomorphological diversity) have been processed on the basis of data from the African biomes. Our hypothesis is that this geographic region should be rather considered as a proper entity than as an ecological reflection of Africa and/or Europe. We propose the necessity of a new model based upon the Mediterranean fauna.

Résumé

Le site d’Oubeidiyeh a été choisi afin de comparer différentes méthodes de reconstruction paléoécologique. Cette analyse s'appuie sur la liste faunique publiée par Tchernov (1986), sur 5 couches comprenant plus de 100 spécimens. Les résultats de la diversité écomorphologique indiquent que 1: Les couches ne peuvent être attribuées à aucun des cinq écosystèmes de Andrews. 2: Aucun changement ne peut être mis en évidence entre chaque couche. Ceci contredit les changements climatiques mis en évidence par les fréquences des indicateurs fauniques et par les méthodes de cénogrames. Cependant, les fréquences des indicateurs fauniques et les analyses de cénogrames sont tributaires des différentes reconstitutions paléoécologiques. Pour Oubeidiyeh, les deux analyses (pour les cénogrames ainsi que pour les méthodes de diversité écomorphologique) ont été effectuées à partir de données sur les biomes africains. Notre hypothèse est que cette région géographique doit être considérée comme ayant une entité propre plutôt que comme le reflet écologique de l'Afrique et/ou de l'Europe. Nous préconisons le besoin d'un nouveau modèle s'appuyant sur la faune méditerranéenne.

Key Words: Environment reconstruction, Ecomorphology, African fauna, Pliocene, Pleistocene

Mots Clés: Reconstitution environnementale, Ecomorphology, Faune africaine, Pliocène, Pleistocène

Introduction

Ecosystems comprise many taxa and individuals, but there is also the higher organizational level of the community. In this study, a community is defined as "a group of species which are often found living together" (Fager 1963) and is equivalent to the concept of an assemblage used by other authors (Kauffman and Scott 1976). This study will concern itself with the mammalian community and the interactions within such a community. While ecological research focuses on the spatial distribution of communities and the inter and intra community relationships, the incorporation of community level analysis into paleontology allows for modeling on large temporal scales that are not discernible within the framework of the ecological time span. Hence, the study of paleoecology answers both geological questions pertaining to palaeoenvironmental reconstructions and ecological hypotheses in the temporal dimension (Olson 1985).

Evolutionary processes have resulted in morphological adaptations of mammals to their habitats. The presence of an indicator species of mammals and its relative abundance has been used as evidence for climatic change.

For example, the presence of reindeer, today living in northern latitudes, in the southern latitudes of Europe served to indicate the limits of glaciations during the Pleistocene (Delpech and Heintz 1976). The main premise underlying this method is the unique niche requirements of the species. Despite being widely used, this method has several shortcomings (Andrews 1995a). First, relative species frequencies are highly sensitive to taphonomic bias. They may be concerned with time and space averaging, depositional milieu, differential preservation, random effects or anthropogenic preferences

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(Andrews 1995b; Behrensmeyer 1984, 1987; Lyman 1994; Voorhies 1969). It has been shown in mollusk assemblages that qualitative attributes i.e. presence and absence, deduced from a fossil assemblage accurately represent the living population, while quantitative attributes i.e. relative abundance, do not (MacDonald 1976). Second, when using single species adaptations there is a strong dependency on precise taxonomic identification, the association of the species to an ecomorphological characteristic and hence habitat. The habitat associated with extinct species is usually based on similarities to extant related species. This premise, of resemblance in palaeo and modern habitats between phylogenetically close species, although probably true for most cases, should not be taken as an *a priori* assumption (Andrews 1995a).

To overcome these problems, several "taxon free" or "phylogeny free" methods have been developed. The first, ecomorphological diversity, was developed by Andrews (Andrews *et al*. 1979). This method associates different ecomorphological characteristics with a species regardless of its taxonomic identification. This allows for comparison of assemblages that differ in species composition because of spatial and temporal distances, but have similar ecomorphological diversities. Andrews (Andrews *et al*. 1979) compared four modern communities from various localities: lowland forest, montane forest, floodplain and woodland-bushland. Taxonomy at the ordinal level, size, locomotion and diet distributions were found to differ significantly among these environments (Andrews *et al*. 1979). Moreover, when fossil assemblages were studied, they could be assigned to modern communities in a similar manner. Such analyses have since been carried out for many Neogene and Quaternary sites (Andrews 1992, 1995a; Andrews *et al*. 1979; Andrews and Nesbit Evans 1978; Andrews 1989; Cerling *et al*. 1992; Evans *et al*. 1981; Fernandez-Jalvo *et al*. 1998; Gagnon 1997; Gunnell 1995; Kay and Madden 1997; Nesbit Evans *et al*. 1981; Reed 1996; Reed 1995; Reed, 1998).

The second method is the cenogram developed by Legendre (Legendre 1986, 1987; Valverde 1967). This graph correlates the mammalian species (all species except chiroptera and carnivora) ranked by size against log body weight. The slopes produced can be correlated with open *vs*. closed and humid *vs*. dry environments. This method has been applied to paleontological sites worldwide (Aguilar *et al*. 1998; Gunnell 1990; Legendre *et al*. 1991; Montuire 1994; Montuire 1998, 1999; Montuire and Desclaux 1997; Montuire and Girard 1998; Morgan *et al*. 1995; Spencer 1991; Wilf *et al*. 1998).

The aim of this study is to compare results from the three methods described: Indicative species abundance, cenogram graphs and ecomorphological diversity. The methods will be compared using the site of ’Ubeidiya as a case study. The comparison will concentrate on two aspects. 1. Can change be discerned in the temporal scale for each of the methods? 2. What palaeoenvironmental reconstruction for each of the strata is produced by the different methods?

The site

The site of ’Ubeidiya is situated in the Jordan Valley, Israel (Fig. 1). The site revealed a large lithic assemblage as well as a rich faunal one. It has been biochronologically dated to ca. 1.4 million years and has been correlated with the European Villanfrachian fauna (Stekelis *et al*. 1960; Tchernov 1989). Unfortunately, no radiometric dates are as yet available. The lithic assemblage has been described as similar to Olduvai Upper Bed II (Bar-Yosef and Goren-Inbar 1993). The geomorphology indicates a series of lakes with alternating fluvial and lucustrine deposits throughout the sequence (Picard and Baida 1966a, 1966b).

Palaeoenvironmental analyses at the site have concentrated on geomorphology and the geo-chemical affinities of the ‘Ubeidiya lake series (Picard and Baida 1966a, 1966b). Diatom studies indicated fluctuating salinity levels for the lake (Siman-Tov *et al*. 1993) and the relative abundance of mollusks was used to interpret the depth of the lake (Tchernov 1973). A single pollen spectrum was extracted from stratum III-12 and indicated a *Quercus* dominated woodland (Bar-Yosef and Tchernov 1972). The mammalian fauna was comprised of a mixed assemblage with Eurasian (e.g. *Dicerorhinus etruscus*) and African elements (e.g. *Pelorovis oldowayensis*) (Tchernov 1986).

The choice of ‘Ubeidiya as a case study stems from the unique geological formation of the site. Post depositional tectonic events have caused the sediments to fold in a syncline and to fault.

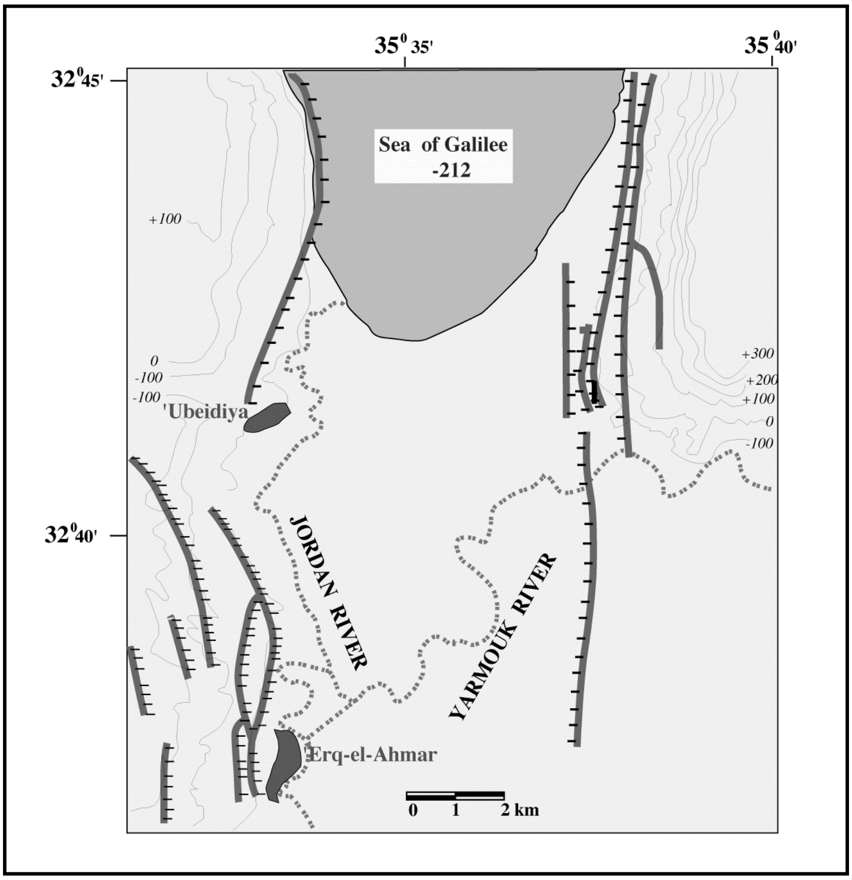


Fig. 1. Location of the site of ‘Ubeidiya. Map published with the kind permission of Eitan Tchernov.

This allows for relatively easy access to large temporal scales that are not present in more common "horizontal" sites. Moreover, the faunal assemblage at the site appears to be palaeontological rather than archaeological. The presence of the rich lithic assemblage at the site raises the question of human involvement in bone accumulation processes. Preliminary data by Gaudzinski (Gaudzinski in Tchernov and Bosinski 1997; Tchernov and Bosinski 1999; Tchernov *et al*. 1998) have indicated a low percent of cut marks and absence of bone marrow extraction breakage patterns. This suggests that while humans scavenged the remains at the site it is doubtful whether they were the active agents in the accumulation of the faunal assemblage. This has recently been supported by analysis of the lithic abrasion patterns (Shea 1999).

To date, no faunal turnover has been described at the site despite changes in both lake level and salinity resulting from changing levels of precipitation (Tchernov 1986). Moreover, the original lithic analysis suggested a change of culture throughout the sequence (Stekelis 1966; Stekelis *et al*. 1969) but this has been since refuted by later studies (Bar-Yosef and Goren-Inbar 1993). Hence, the question of whether the mammalian community of ’Ubeidiya underwent change throughout the sequence may shed light on our understanding of the role of hominids within the mammalian community and its implication for both biological and cultural evolution.

Methods

All analyses were performed on the 1986 published faunal list (Tchernov 1986). Five strata (III-12, II 23-24, II 25–27, I 15-16 and II 36) with over 100 identified specimens (NISP) and a minimum of 20 species were chosen (Table 1).

Ecomorphological distributions were compared for each pair of strata using the Kolmogorov-Smirnoff two-sample test. Individual pairwise comparisons for each category were done using the chi-square goodness of fit test. Ecomorphological characteristics of order, size, diet and locomotion were assigned to each species using literature references and similarities to related extant species (Table 2). Since the aim of this study was to evaluate the method described by Andrews (Andrews *et al.* 1979), morphological assignments followed his distinctions. It is important to stress that such assignment to species is questionable when extinct species are concerned. Also, within each ecomorphological characteristic, the category assigned may not be mutually exclusive and many mammals can be assigned to more than one category e.g. baboons which are most commonly terrestrial, may climb trees to escape predators and may therefore also be categorized as arboreal (Barton *et al.* 1992). When an animal could be assigned to one of several categories within a given characteristic, the choice of category was based on the ecomorphological adaptation most commonly used.

Table 1. Excavation parameters for selected ‘Ubeidiya strata.

	III 12	II 23- 24	II 25-27	I 15-16	II 36
Cycle	**LI**	**FI**	**FI**	**FI**	**FI**
Exposure M^2	20	216	89	250	13
Thickness M	1	2.7	3	0.85	0.4
Estimated volume M^3	20	583.2	267	212.5	5.2
Total artifacts	18	360	1161	1126	500
NISP	272	7572	100	337	696
N species	20	56	21	25	32

- Exposure, thickness and total artifacts from Bar-Yosef and Goren-Inbar 1993.
- NISP and N species from Tchernov 1986.
- Estimated volume per stratum calculated by Exposure * Thickness.

Results

The strata were compared using the Jaccard similarity index (Fig. 2). This index compares similarities between the taxonomic composition of two assemblages. A value of 0 indicates no common taxa while a value of 1 indicates complete similarity. The average index between ’Ubeidiya strata was 0.42. One would expect consecutive strata to be more similar and hence have a higher similarity index than strata further apart on the temporal scale. No correlation was found between the Jaccard similarity index and the temporal distance of ’Ubeidiya strata.

Results for ecomorphological diversity characteristics of order, size, diet and locomotion are presented in Figs. 3 – 6. The results of Kolmogoro-Smirnoff two-sample tests for all strata showed insignificant differences between the strata for distributions of all four characteristics. Pairwise comparison for each of the individual categories within the four characteristics using chi-square goodness of fit was insignificant for all categories except for carnivores which showed significant differences between strata both in the taxonomy and the dietary preference characteristics (Figs. 7- 8).

Carnivores are highly susceptible to taphonomic bias and are usually under-represented in a thanatocoenosis, comprising only ca. 40% of species richness compared to the bicoenosis (Behrensmeyer and Hill 1980). Excavation volume is a good proxy for sample size and the relationship between species richness and sample size may be described by a logarithmic equation (Grayson 1991). Hence, one can describe a positive correlation between species richness and excavation volume that reaches an asymptote with large sample sizes. Thus, if differences in carnivore species richness are a product of excavation volume as opposed to a reflection of ecological change, we would expect an increase in number of species in general and carnivore species in particular with an increase in volume of excavation. Unfortunately, exact volumes of excavations were not available for the strata studied. The nearest estimate is the calculation of volume by multiplication of area exposed and the average depth of the stratum (Table 1).

Table 2. ‘Ubeidiya species list and assigned ecomorphological characteristics

Species	Order	Body size	Locomotion	Diet
Macaca sylvana	Primates	C	Arboreal	Frugivore
Homo cf. *erectus*	Primates	EF	LGM	Omnivore
Ursus etruscus	Carnivora	GH	LGM	Omnivore
Canis cf. *arnensis*	Carnivora	D	LGM	Carnivore
Canis sp. *(size falconeri)*	Carnivora	D	LGM	Carnivore
Vulpes sp.	Carnivora	C	LGM	Carnivore
Lutra sp.	Carnivora	C	Aquatic	Carnivore
Pannonictis ardea	Carnivora	C	LGM	Carnivore
Vormela cf. peregusna	Carnivora	AB	SGM	Carnivore
Megantereon cf. culridens	Carnivora	EF	LGM	Carnivore
Panthera gombaszoegensis	Carnivora	EF	LGM	Carnivore
Lynx sp.	Carnivora	D	LGM	Carnivore
Felis sp. *(size chaus)*	Carnivora	D	LGM	Carnivore
Crocuta crocuta	Carnivora	D	LGM	Carnivore
Herpestes sp.	Carnivora	C	LGM	Carnivore
Kolpochoerus olduvaiensis	Artiodactyla	EF	LGM	Omnivore
Sus strozzii	Artiodactyla	EF	LGM	Omnivore
Premegaceros verticornis	Artiodactyla	GH	LGM	Browser
Cervidae gen. indet.	Artiodactyla	EF	LGM	Browser
Pelorovis olduwayensis	Artiodactyla	GH	LGM	Grazer
Bos sp.	Artiodactyla	GH	LGM	Grazer
Oryx sp.	Artiodactyla	EF	LGM	Grazer
Gazella cf. *gazella*	Artiodactyla	D	LGM	Grazer
Gazellospira torticornis	Artiodactyla	EF	LGM	Grazer
Equus cf. *tabeti*	Others	GH	LGM	Grazer
Equus cf. *caballus*	Others	GH	LGM	Grazer
Mammuthus merdionalis	Others	GH	Aquatic	Grazer
Hippopotamus behemoth	Artiodactyla	GH	Aquatic	Grazer
Hippopotamus gorgops	Artiodactyla	GH	LGM	Grazer
Camelus sp.	Artiodactyla	GH	LGM	Grazer
Giraffidae gen. indet.	Artiodactyla	GH	LGM	Grazer
Dicerorhinus etruscus	Others	GH	LGM	Browser
Crocidura russula	Insectivora	AB	SGM	Insectivore
Crocidura cf. *leucodon*	Insectivora	AB	SGM	Insectivore
Erinaceus cf. *europaeus*	Insectivora	AB	SGM	Insectivore
Hystrix indica	Rodentia	D	LGM	Frugivore
Cricetus cricetus	Rodentia	AB	SGM	Frugivore
Mesocricetus primitivus	Rodentia	AB	SGM	Frugivore
Allocricetus bursae	Rodentia	AB	SGM	Frugivore
Occitanomys haasi	Rodentia	AB	SGM	Frugivore
Parapodemus jordanicus	Rodentia	AB	SGM	Frugivore
Apodemus sylvaticus	Rodentia	AB	Scansorial	Frugivore
Apodemus flavicollis	Rodentia	AB	Scansorial	Frugivore
Apodemus mystacinus	Rodentia	AB	Scansorial	Frugivore
Praomys galilensis	Rodentia	AB	SGM	Omnivore
Praomys levantinus	Rodentia	AB	SGM	Omnivore
Arvicanthis ectos	Rodentia	AB	SGM	Frugivore
Mus musculus	Rodentia	AB	SGM	Omnivore
Gerbillinus dasyurus	Rodentia	AB	SGM	Frugivore
Parameriones obeidiensis	Rodentia	AB	SGM	Frugivore
Spalax ehrenbergi	Rodentia	AB	SGM	Frugivore
Lagurodon arankae	Rodentia	AB	SGM	Grazer
Arvicola jordanica	Rodentia	AB	Aquatic	Grazer
Allactaga euphratica	Rodentia	AB	SGM	Frugivore
Myomimus roachi	Rodentia	AB	SGM	Frugivore
Hypolagus brachygnathus	Others	C	SGM	Grazer

Body size distribution: AB < 1kg, C 1-10 kg, D 10- 45 kg, EF 45-180 kg, GH >180 kg, Locomotion: LGM - Large terrestrial mammals, SGM - Small terrestrial mammals

Fig. 2. Jaccard similarity index values for pairs of selected ‘Ubeidiya strata

III 12	1.00							
II 23	0.39	1.00						
II 24	0.51	0.68	1.00					
II 25-27	0.22	0.40	0.41	1.00				
I 15-16	0.41	0.47	0.56	0.31	1.00			
II 28	0.41	0.38	0.46	0.48	0.32	1.00		
II 34-35	0.36	0.31	0.38	0.28	0.35	0.34	1.00	
II 36	0.3	0.5	0.6	0.4	0.5	0.5	0.3	1.00
	III 12	II 23	II 24	II 25-27	I 15-16	II 28	II 34-35	II 36

Correlation of number of carnivore species as function of volume of excavation does not result in any correlation. Since volumes of excavation were only roughly calculated, this may have masked any such relationship and hence, another variable should be considered. As a second proxy for excavation volume, I applied total species richness based on the aforementioned logarithmic correlation. To evaluate the source of the difference between strata in the percent of carnivores, I compared carnivore species richness and total species richness (Fig. 9). The positive correlation suggests that the difference in carnivore ratio between ‘Ubeidiya strata reflects a taphonomic bias produced by excavation volume rather than ecological factords.

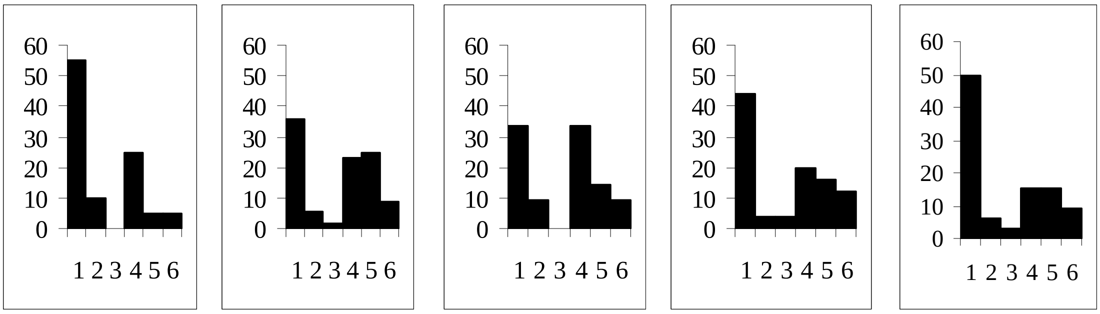
In order to compare the ecomorphological distribution in ‘Ubeidiya with those of modern biomes, I used the modern data presented by Andrews and compared the distributions using the chi-square goodness of fit test (Andrews *et al*. 1979). The model proposed by Andrews (Andrews *et al*. 1979), predicts that a paleontological assemblage can be ascribed to one of the four modern biomes. Moreover, the results should be consistent among all four characteristics, i.e. if an assemblage can be ascribed to woodland-bushland on the basis of taxonomy distribution it should also be ascribed to woodland-bushland, size, diet and locomotion distributions. The results of the ’Ubeidiya analysis (Table 3) do not indicate a clear-cut picture. Different ecomorphological characteristics produced different reconstructions. For example, based on the taxonomy characteristic, stratum III 12 can be classified as both lowland and montane forest as well as woodland-bushland but it does differ from flood plain. In the size and locomotion characteristics it can be classified as any of the biomes and for the diet characteristic it cannot be classified as any of the biomes. Similar discrepancies are found for other strata.

In summary, when the five ’Ubeidiya strata were compared in an attempt to identify community structure changes through time, no changes could be discerned in any of the ecomorphological characteristics described by Andrews (Andrews *et al*. 1979). Moreover, comparing the selected strata to modern habitats using different ecomorphological parameters, the assemblage could not be uniquely ascribed to any of Andrews’ four ecosystems.

Discussion

These conclusions contradict two other reconstructions that have been published. Using the relative indicator species frequency, Tchernov (Tchernov 1986) observed a climatic shift throughout the ’Ubeidiya sequence. Stratum III 12 was identified as a closed woodland environment based upon a high percent of arboreal species such as *Apodemus* sp. Stratum II 23-24 was identified as an open savanna with an increase in xeric species and stratum II 36 was identified as closed woodland with an increase in *Apodemus* sp. again.

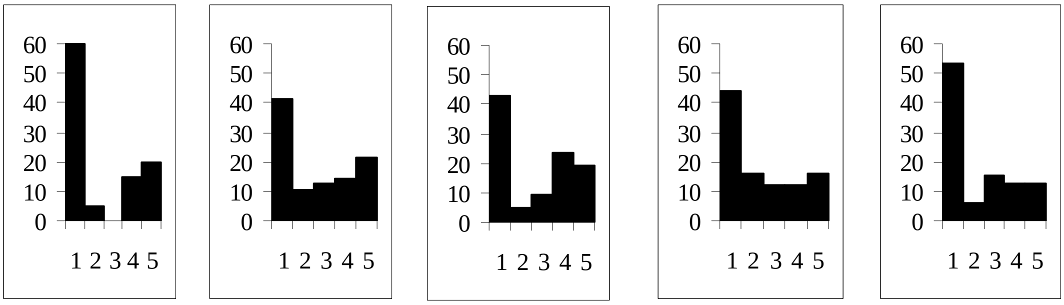
Sophie Montuire applied the cenogram to the same faunal list published by Tchernov (Montuire 1994; Montuire and Girard 1998). Her results indicate that stratum III 12 was an open environment followed by a wooded environment in stratum II 23-24. Stratum II 36 was indicative of an open environment again.



III 12 II 23 - 24 II 25 - 27 I 15 - 16 II 36

Fig. 3. Taxonomy at the order level distribution for selected ‘Ubeidiya strata

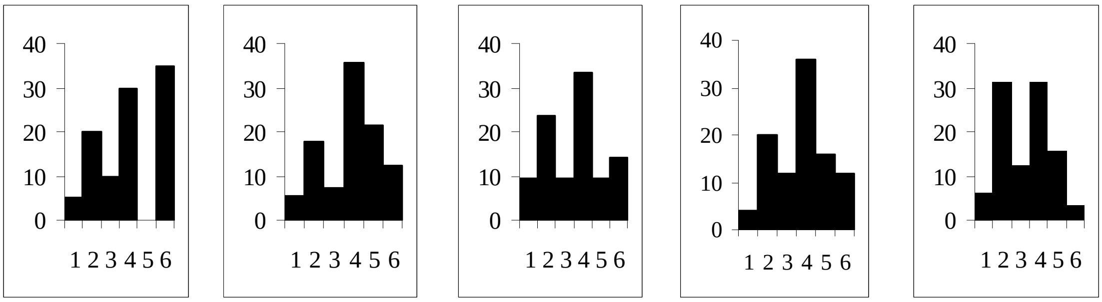
Each box represents the distribution within a single stratum. Categories on the x axis:
1. Rodentia 2. Insectivora 3. Primates 4. Artiodactyla 5. Carnivora 6. Others
The y-axis represents percent of species.



III 12 II 23 - 24 II 25 - 27 I 15 - 16 II 36

Fig. 4. Body size distribution for selected ‘Ubeidiya strata

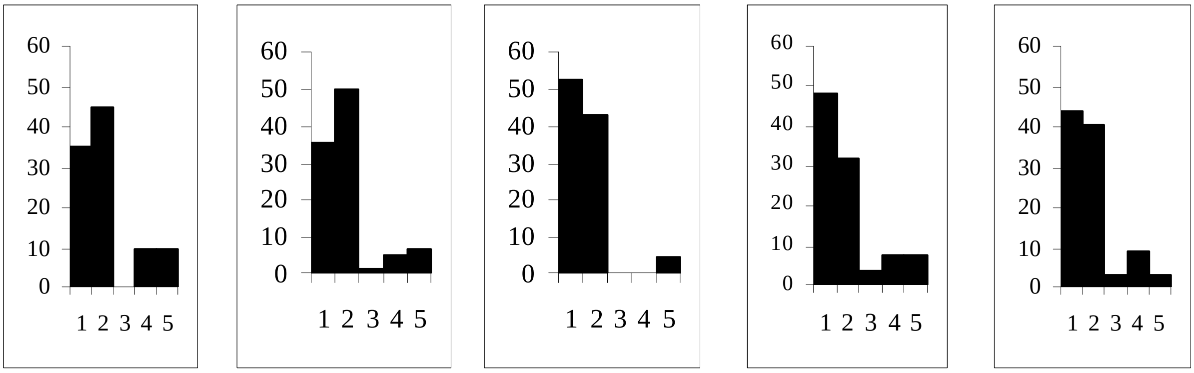
Each box represents the distribution within a single stratum. Categories on the x axis:
1. <1 kg, 2. 1-10 kg, 3. 10-45 kg, 4. 45-100 kg, 5. 100-180 kg. 6, >180 kg.
The y-axis represents percent of species.



III 12 II 23 - 24 II 25 - 27 I 15 - 16 II 36

Fig. 5. Dietary preference distribution for selected ‘Ubeidiya strata

Each box represents the distribution within a single stratum. Categories on the x axis:
1. Insectivora 2. Frugivora 3. Browsers 4. Grazers 5. Carnivora 6. Omnivora
The y-axis represents percent of species.



III 12 II 23 - 24 II 25 - 27 I 15 - 16 II 36

Fig. 6. Locomotor adaptation distribution for selected ‘Ubeidiya strata

Each box represents the distribution within a single stratum. Categories on the x axis:
1. Large terrestrial quadrupeds 2. Small terrestrial quadrupeds 3. Arboreal 4. Scansorial 5. Aquatic
The y-axis represents percent of species.

III 12	***				
II 23-24	<0.01	***			
II 25-27	n.s	<0.01	***		
I 15-16	n.d	<0.05	n.s	***	
II 36	n.d	<0.05	n.d	n.s	***
	III 12	II 23-24	II 25-27	I 15-16	II 36

n.s. - not significant
n.d. - no data, chi-square could not be performed due to small sample size

Fig. 7. P-values of chi-square goodness of fit test for pairwise comparison of the carnivore category in the taxonomy at the order level characteristics between selected ‘Ubeidiya strata

III 12	***				
II 23-24	<0.05	***			
II 25-27	n.s	n.s	***		
I 15-16	<0.1	n.s	n.s	***	
II 36	<0.05	n.s	n.s	n.s	***
	III 12	II 23-24	II 25-27	I 15-16	II 36

n.s. - not significant
n.d. - no data, chi-square could not be performed due to small sample size

Fig. 8. P-values of chi-square goodness of fit test for pairwise comparison of the carnivores category in dietary preference characteristics between selected ‘Ubeidiya strata

Montuire explained the discrepancy in the results by a lag in the biological response of species and communities to a given environmental change (Montuire and Girard 1998). I believe that the reason lies in the models themselves. Despite being published as global models, both the cenogram graph and ecomorphological diversity methods were developed using data primarily from African biomes (Andrews *et al*. 1979; Legendre 1986). During the Pleistocene, ’Ubeidiya was already situated in the Mediterranean region, as it is today (Suc 1987). I hypothesize that this region should be viewed as an entity of its own rather than the ecological fringe of Africa and/or Europe. This would suggest the need for development of a new model based on Mediterranean fauna.

Similarities are found between Late Pliocene-Early Pleistocene faunal assemblages in the Mediterranean region such as Dmanisi (Dzaparidze *et al*. 1992; Gabunia *et al*. 2000; Vekua 1995), Venta Micena (Agusti 1987), ‘Ein Hanech (Sahnouni and de Heinzelin 1998), Oum el Ouglham (Alemseged and Geraads 1998; Geraads 1995, 1997) and ‘Ubeidiya (Tchernov 1986). Such similarities support the hypothesis put forth that the Mediterranean region should be analyzed as a unique biome. Other studies have found a higher percent of African fauna in Eurasian sites than has been previously estimated (Arribas and Plamqvist 1999; Martinez-Navarro and Palmqvist 1996). The relatively high fraction of African fauna in ‘Ubeidiya (Martinez-Navarro 1999; Tchernov 1986) was seen to indicate that hominin presence at the site should not be viewed as an expansion but rather as part of the greater African milieu (Klein 2000). Thus, the association of ’Ubeidiya with a Mediterranean ecosystem as opposed to an African or European ecological fringe area is of importance to our understanding of the hominin dispersal.

Conclusions

Several models have been published to date that use the mammalian community as a paleoenvironmental indicator. These models have been published and used as global models despite their intrinsic association with African habitats. When applied to a non-African assemblage, the results differ in their environmental reconstruction and in their ability to detect changes in a mammalian community through time. Hence, application of models for paleoenviron-mental reconstructions should not be *a priori* applied to assemblages without due consideration to the general biome in which the assemblage is situated.

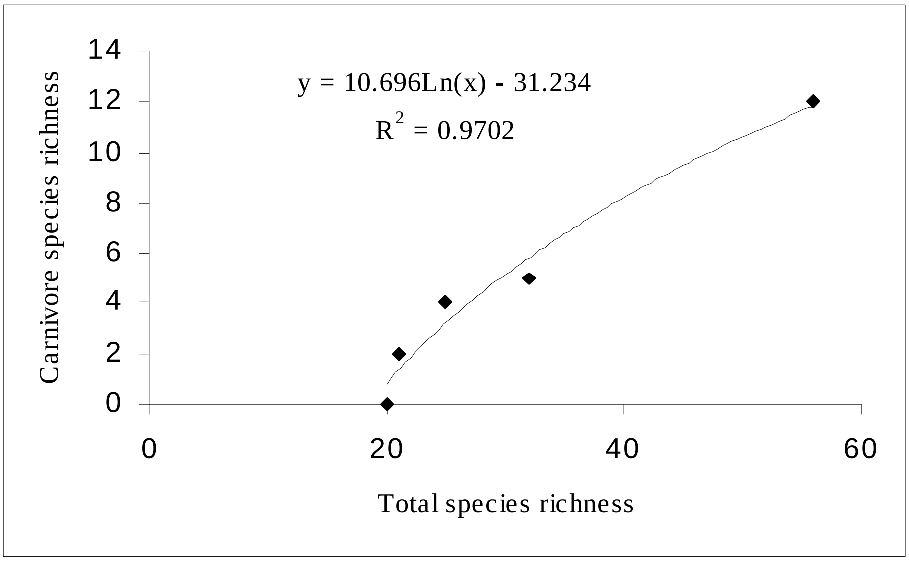


Fig. 9. Carnivore species richness as a function of total species richness for selected ‘Ubeidiya strata

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