ARCHAEOZOOLOGY OF THE NEAR EAST IV A

Proceedings of the fourth international symposium on the archaeozoology of southwestern Asia and adjacent areas

edited by

M. Mashkour, A.M. Choyke, H. Buitenhuıs and F. Poplin

ARC - Publicatie 32
Groningen, The Netherlands, 2000
Cover illustration:
Przewalski from Susa (nacre – mother of pearl)
Dated to 2500 – 2000 BC, identified by F. Poplin

Copyright:
Centre for Archeological Research and Consultancy
Groningen Institute for Archaeology
Rijksuniversiteit Groningen The Netherlands

Printing: RCG -Groningen

Parts of this publication can be used if source is clearly stated.
Information: Centre for Archeological Research and Consultancy
Poststraat 6, 9712 ER Groningen, The Netherlands

NUGI 644 - 134
Contents

VOLUME A

Preface A

Deborah Bakken 11
Hunting strategies of Late Pleistocene Zarzian populations from Palegawra Cave, Iraq and Warwasi rock shelter, Iran

Daniella Zampetti, Lucia Caloi, S. Chilardi and M.R. Palombo 18
Le peuplement de la Sicile pendant le Pléistocène: L’homme et les faunes

Sarah E. Whitcher, Joel C. Janetski, and Richard H. Meadow 39
Animal bones from Wadi Mafhah (Petra Basin, Jordan): The initial analysis

Liora Kolska Horwitz and Eitan Tchernov 49
Climatic change and faunal diversity in Epipalaeolithic and Early Neolithic sites from the Lower Jordan valley

Paul Y. Sondaar and Sandra A.E. van der Geer 67
Mesolithic environment and animal exploitation on Cyprus and Sardinia/Corsica

Pierre Ducos 74
The introduction of animals by man in Cyprus: An alternative to the Noah’s Ark model

Jean-Denis Vigne, Isabelle Carrère, Jean-François Saliège, Alain Person, Hervé Bocherens, Jean Guillaume and François Briois 83
Predomestic cattle, sheep, goat and pig during the late 9th and the 8th millennium cal. BC on Cyprus: Preliminary results of Shillourokambos (Parekklisha, Limassol)

Norbert Benecke 107
Mesolithic hunters of the Crimean Mountains: The fauna from the rock shelter of Shpan’-koba

Hitomi Hongo and Richard H. Meadow 121
Faunal remains from Prepottery Neolithic levels at Çayönü, Southeastern Turkey: A preliminary report focusing on pigs (Sus sp.)

Gulcin Ilgezdi 141
Zooarchaeology at Çayönü: a preliminary assessment of the red deer bones

Banu Oksuz 154
Analysis of the cattle bones of the Prepottery Neolithic settlement of Çayönü

Nerissa Russell and Louise Martin 163
Neolithic Çatalhöyük: preliminary zooarchaeological results from the renewed excavations

Alice M. Choyke 170
Bronze Age bone and antler manufacturing at Arslantepe (Anatolia)

Ofer Bar-Yosef 184
The context of animal domestication in Southwestern Asia

Cornelia Becker 195
Bone and species distribution in late PPNB Basta (Jordan) - Rethinking the anthropogenic factor

Justin Lev-Tov 207
Late prehistoric faunal remains from new excavations at Tel Ali (Northern Israel)

Daniella E. Bar-Yosef Mayer 217
The economic importance of molluscs in the Levant

Daniel Helmer 227
Les gazelles de la Shamiyya du nord et de la Djézireh, du Natoufien récent au PPNB: Implications environnementales

Maria Saña Seguí 241
Animal resource management and the process of animal domestication at Tell Halula (Euphrates Valley-Sria) from 8800 bp to 7800 bp
## Contents

**VOLUME B**

Chiara Cavallo, Peter M.M.G. Akkermans and Hans Koen
  Hunting with bow and arrow at Tell Sabi Abyad  
  
**Caroline Grigson**
  The secondary products revolution? Changes in animal management from the fourth to the fifth millennium, at Arjoune, Syria  
  
**Barbara Wilkens**
  Faunal remains from Tell Afis (Syria)  
  
**Margarethe Uerpmann and Hans-Peter Uerpmann**
  Faunal remains of Al-Buhais 18: an Aceramic Neolithic site in the Emirate of Sharjah (SE-Arabia) - excavations 1995-1998  
  
**Angela von den Driesch and Henriette Manhart**
  Fish bones from Al Markh, Bahrain  
  
**Mark Beech**
  Preliminary report on the faunal remains from an 'Ubaid settlement on Dalma Island, United Arab Emirates  
  
**Jean Desse and Nathalie Desse-Berset**
  Julfar (Ras al Khaimah, Emirats Arabes Unis), ville portuaire du golfe arabo-persique (VII^e-VII^e siècles): exploitation des mammifères et des poissons  
  
**Chris Mosseri-Marlio**
  Sea turtle and dolphin remains from Ra’s al-Hadd, Oman  
  
**Hervé Bocherens, Daniel Billiou, Vincent Charpentier and Marjan Mashkour**
  Palaeoenvironmental and archaeological implications of bone and tooth isotopic biogeochemistry (13C 15N) in southwestern Asia  
  
**Sándor Bökönyi † and László Bartosiewicz**
  A review of animal remains from Shahr-i Sokhta (Eastern Iran)  
  
**Ann Forsten**
  A note on the equid from Anau, Turkestan, *Equus caballus pumpeii* Duerst  
  
**Alex K. Kasparov**
  Zoomorphological statuettes from Eneolithic layers at Ilgynly-depe and Altn depe in South Turkmeniya  
  
**László Bartosiewicz**
  Cattle offering from the temple of Montuhotep, Sankhkara (Thebes, Egypt)  
  
**Louis Chaix**
  A hyksos horse from Tell Heboua (Sinaï, Egypt)  
  
**Liliane Karali**
  Evolution actuelle de l’archéozoologie en Grèce dans le Néolithique et l’Age du Bronze  
  
**Emmanuella Vila**
  Bone remains from sacrificial places: the temples of Athena Alea at Tegea and of Asea on Agios Elias (The Peloponnese, Greece)  
  
**Wim Van Neer, Ruud Wildekamp, Marc Waelkens, Allan Arndt and Filip Volckaert**
  Fish as indicators of trade relationships in Roman times: the example of Sagalassos, Turkey  
  
**Ingrid Beuls, Bea De Cupere, Paul Van Mele, Marleen Vermeere, Marc Waelkens**
  Present-day traditional ovicaprine herding as a reconstrucional aid for understanding herding at Roman Sagalassos  

**Address List ASWA**
HUNTING STRATEGIES OF LATE PLEISTOCENE ZARZIAN POPULATIONS FROM PALEGAWRA CAVE, IRAQ AND WARWASI ROCK SHELTER, IRAN

Deborah Bakken

Abstract

Palegawra Cave and Warwasi rock shelter are late Pleistocene, Zarzian occupation sites excavated by Braidwood, Howe, and Reed as part of the Iraq-Jarmo Project. Both sites have abundant lithic components, and both are high in faunal remains. The initial analysis by Turnbull and Reed demonstrated a faunal suite indicative of dry grassland regimes similar to those seen today in this area. Taxonomically, the majority of identified elements in both caves belong to the onager, Equus hemionus. Turnbull and Reed argued that the onagers were the result of human hunting, but they did not examine the type of hunting strategy favored by the Zarzian occupants of the caves. All equids were under some degree of hunting pressure at the end of the Pleistocene as they were highly prized food sources, and they are common components of archaeological site faunas. Both Palegawra and Warwasi document the exploitation of local equids; by integrating mortality data available from dental remains with behavioral evidence drawn from modern onager populations, hunting strategies at use during the formation of both sites are reconstructed. These are examined in light of behavioral differences between onagers and the more familiar horses found at other sites documenting equid exploitation such as Solutré in France and Dereivka in the Ukraine.

Résumé

La grotte de Palegawra et l’abri sous roche de Warwasi sont des sites d’occupations de la fin du Pléistocène, zarziens fouillés par Braidwood, Howe et Reed faisant partie du projet Iraq-Jarmo. Les deux sites contiennent d’abondants objets lithiques et tous deux ont fourni de nombreux vestiges fauniques. L’analyse initiale par Turnbull et Reed a révélé un assemblage faunique indicateur de la présence d’une prairie de type aride proche de celle visible actuellement dans la zone d’étude. Sur le plan taxinomique la majorité des éléments identifiés dans les deux grottes appartiennent à l’onagre. Turnbull et Reed ont avancé que les restes d’onagre résultaient de la chasse par l’homme, mais ils n’ont pas examiné le type de stratégie de chasse choisi par les occupants zarziens des deux sites. Tous les équidés étaient à un certain degré sous pression de la chasse à la fin du Pléistocène du fait qu’ils étaient des sources de nourriture très prises et qu’ils sont des composants courants des faunes archéologiques. Palegawra et Warwasi documentent l’exploitation locale des équidés : en intégrant les données sur la mortalité à partir des restes dentaires et les données comportementales des populations actuelles d’onagres, les stratégies de chasse en vigueur durant la formation des deux sites sont reconstituées. Celles-ci sont examinées au vu des différences comportementales entre l’onagre et le cheval, rencontrés plus couramment dans d’autres sites qui nous renseignent sur l’exploitation des équidés comme Solutré en France et Dereivka en Ukraine.

Key Words: Palegawra Cave, Warwasi Rock Shelter, Equids, Mortality Profiles

Mots Clés: Grotte de Palegawra, Abri sous roche de Warwasi, Equidés, Courbes d’abattage

Introduction

Humans had become efficient hunters of large animals at least by the Upper Paleolithic. That large game were highly prized in temperate grassland and woodland environments is attested to by their continued and selective presence in archaeological faunas. Not only did large game provide food, they also yielded useful products such as skins, bone, antler, and sinew for tools and other material goods.

1 Office of Sponsored Programs, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL, 60605-2496 USA.
Equids were an important component of the large game faunas that humans favored. All equids, in fact, were under some degree of hunting pressure at the end of the Pleistocene. They are commonly found at archaeological sites of this period, and in some sites they dominate the fauna (Clutton-Brock 1992; Levine 1979; Olsen 1989). This is the pattern seen at two late Pleistocene sites from the Near East, Paleagawra Cave and Warwasi rock shelter. How were such high quality prey collected? What sort of hunting strategy was employed? In this paper I use dental wear and attrition data to generate age class frequencies that may be used to interpret the probable hunting strategy used at Paleagawra and Warwasi.

Site Background

The archaeological site of Warwasi rock shelter lies in Kurdistan province in west central Iran. It was excavated by Robert Braidwood, in the 1960s. Warwasi yielded blade industries ranging from Mousterian, through Baradostian and Zarzian at different depths within the deposits. The earliest level dates to 40,000 BP, and the latest level dates to 10,000 BP. Priscilla Turnbull conducted the faunal analysis (Turnbull 1967, 1975). She described a small suite, consisting of onager, sheep, goat, rodents, and lagomorphs. This material will be discussed later in this paper.

The site of Paleagawra Cave lies further east, in northeastern Iraq. It was excavated during the 1950s as part of the Iraq-Jarmo project, under the general direction of Robert Braidwood and Bruce Howe (Braidwood et al. 1960). Paleagawra is a late Pleistocene aged site dated to between 12,000 and 14,000 BP based on radiocarbon dates (Turnbull and Reed 1974). It is situated in a small cave in the Baranand Dagh, the foothills of the Zagros Mountains. The cave is located about 70 meters above the valley floor, at an elevation of 990 meters above sea level. Abundant stone tools were recovered from Paleagawra; the assemblage is microlithic, and characteristic of Zarzian toolkits (Turnbull 1967).

The faunal analysis at Paleagawra was conducted by Priscilla Turnbull along with Charles Reed (1974). They described a modern fauna representative of similar environmental conditions as those currently in effect. Most taxa occur in the region today, or at least were known to occur within historic times. The climate at Paleagawra was broadly similar to that seen today, but very likely cooler and drier. This area saw extensive local glaciation at the last glacial maximum, and abatement of that extreme climate was well underway by 18 to 16,000 years ago. Pollen samples are indicative of a relatively dry, sagebrush or Artemisia steppe environment.

Turnbull and Reed (1974) identified a diverse assemblage consisting of 26 genera of mammals (see also Turnbull 1986 for a discussion of equid species identification). Notable among the specimens was a canid mandible that Reed argued was evidence of the first domesticated dog yet found. For a time, this made Paleagawra the earliest animal domestication site identified in the archaeological record. Paleagawra has since been surpassed by an earlier specimen, and the domestic nature of the canid mandible has also been questioned (Olsen 1985).

Onagers are especially common at both Paleagawra and Warwasi, constituting the majority of faunal elements at both sites (Table 1). The onager, Equus hemionus, also known as the half-ass, is one of several species of Asiatic wild ass. It is closely related to the kulan, the gor-khar, and the Syrian ass. It is distinguished by its long metapodials and renowned for being a strong and graceful runner with a great deal of stamina. Onagers, like all equids, are grazers that subsist primarily on grasses though they will consume other kinds of vegetation as well (Groves 1974; Willoughby 1974).

Table 1. Numbers of identified specimens and minimum numbers of individuals for selected taxa from Paleagawra Cave (FMNH paleontology collections)

<table>
<thead>
<tr>
<th>Taxon</th>
<th>NISP</th>
<th>MNJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equus hemionus (onager)</td>
<td>1121</td>
<td>27</td>
</tr>
<tr>
<td>Cervus elaphus (red deer)</td>
<td>456</td>
<td>12</td>
</tr>
<tr>
<td>Ovis orientalis (sheep)</td>
<td>134</td>
<td>10</td>
</tr>
<tr>
<td>Capra hircus (goat)</td>
<td>97</td>
<td>8</td>
</tr>
<tr>
<td>Gazella subgutturosa (gazelle)</td>
<td>95</td>
<td>7</td>
</tr>
<tr>
<td>Sus scrofa (pig)</td>
<td>68</td>
<td>3</td>
</tr>
<tr>
<td>Bos primigenius (cattle)</td>
<td>19</td>
<td>2</td>
</tr>
</tbody>
</table>

Though other species of equids were under population pressure at the end of the Pleistocene, onagers living in the arid and semi-desert country of the Near East were apparently stable during that period. The warming of global climates at the end of the last glaciation contributed to habitat loss as grasslands were replaced with forest cover.
Equids in North and South America were extinct by 10,000 years ago, and the European wild horse had become rare by 7,000 years ago (Clutton-Brock 1992: 24). Onager populations at Paedawra and Warwasi may have been stable between 14,000 and 10,000 years ago, due to overall stability in climatic conditions and persistence of grassland vegetation (Turnbull and Reed 1974).

Behaviorally, onagers differ from the pattern shown by the more familiar horses, in which territories are not defended but stallions instead maintain and defend harems of females with associated foals (Type 1 behavior of Klingel 1974; Berger 1986). Onagers exhibit Type 2 behavior as do the kiang, the African wild ass, Grevy’s zebra, and the domestic donkey, (Clutton-Brock 1992: 23; Klingel 1974; Berger 1986). The males are territorial, and may defend territories successfully for over ten years. Females range across several male territories, and they do not form harem groups connected with a particular male. Females will only mate with males that maintain territories, and they may mate with each male in the several territories that constitute their range. Young males unable to defend a territory form bachelor groups, and they do not mate. Group size tends to be fluid; seasonal concentrations of individuals in large groups may occur in early to mid-summer when foals are about to be born. Clutton-Brock (1992: 23) and others have argued that this is a behavior pattern that is adapted to resources that are predictable but specialized, such as those found in arid and semi-desert regions.

Onagers were kept and bred in later sites within this region, however, it is likely that onagers were never truly domesticated. Modern West Asian domestic donkeys produce fertile offspring with the African wild ass, Equus africanus, but they produce infertile offspring with onagers (Clutton-Brock 1992: 37). That they were kept and used as draught animals is apparent from a number of sites such as Ur (2,500 BC; Olsen 1988). The earliest site for the possible domestication of any equids is Dereivka, Ukraine, dated to ca. 4,000 BC (Bökényi 1984; Levine 1990). This site has been re-analyzed by Levine (1990), and she argues that the remains do not represent domestication but rather the exploitation by hunting of prime age adults, between 5-8 years of age, from wild populations.

That onagers were clearly a highly valued resource is evident by their abundance within the Paleagwra assemblage (Table I). Turnbull and Reed (1974) and Turnbull (1967) argued that the fauna was accumulated as the result of human hunting, and I would agree based on my own observations of the faunal remains.

In order to look more closely at the hunting strategy practiced at Paleagwra, I generated mortality profiles to examine the represented ages of the individual onagers present in the assemblage. A population rich in prime age adults is indicated in Turnbull and Reed’s analysis (1974). I concur, but base our estimates on slightly different criteria.

**Mortality profiles**

Mortality profiles have been used extensively to look at the nature of a death assemblage (Kurtén 1955; Lyman 1994; Voorhies 1969). Two common patterns have been identified, with certain forms of variation within each type. A catastrophic or living-structure assemblage is characterized by

---

Fig. 1. Theoretically derived living structure or catastrophic mortality profile (Klein 1982; Stiner 1994).

Fig. 2. Theoretically derived attritional or U-shaped mortality profile (Klein 1982; Stiner 1994).
large numbers of young and juveniles succeeded by progressively smaller categories of prime age adults and old individuals (Hillson 1986; Klein 1982; Lyman 1994; Stiner 1994). This is the profile demonstrated by a living group of gregarious mammals (Fig. 1). Catastrophic assemblages may result from any event that kills all the members of a living group, such as a flood. Attritional or U-shaped profiles are composed of an essentially bimodal distribution of very young and very old animals with relatively few prime age adults (Hillson 1986; Klein 1982; Lyman 1994; Stiner 1994). These assemblages may reflect any event that selects those animals that are easiest to remove from a living population, such as the young, old, and weak (Fig. 2). Attritional profiles are commonly produced through hunting or scavenging from a living group, although it is worth remembering that a series of phenomena, such as accidents and disease, may contribute to an attritional pattern from an archaeofauna.

Construction of a mortality profile begins with the identification of some element that changes progressively throughout the life of the animal. Within the high-crowned ungulates a variety of methods are available based on incremental growth and wear in the dentition. Common methods include eruption and wear stages of tooth rows (e.g. Lowe 1967), and the quadratic crown height method (e.g. Klein 1982). All are based on the observation that teeth are continuously worn away through use.

Equid tooth eruption and wear are processes that are not as tightly constrained as in some other ungulate taxa. Tooth eruption and wear have, however, been successfully used by researchers to reconstruct seasonality and mortality characteristics in populations of equids (Levine 1983; Stiner 1994). Dental eruption sequences are complex for equids due to the high number of teeth and the ever-growing nature of the permanent teeth, which continue to erupt until late in life (Clutton-Brock 1992: 20). Equine teeth are in flux in the mouth from birth to five years, at which time the full adult complement of teeth (36 of them) are present in the mouth (Levine 1983). The roots of the permanent teeth are not fully developed until five years (Clutton-Brock 1992: 20). All teeth at five years are also completely mineralized and have ceased growing (Levine, 1983). Teeth only become fully rooted later in life.

The quadratic crown height method is based on an algebraic transformation of a formula that predicts that hypsodont teeth are worn as a square root function of preceding height (see Klein and Cruz-Uribe 1984 for formulas, and Lyman 1994 for discussion). Measurement of the remaining crown heights generates data indicating the amount of occlusal wear in the sample. Quadratic regression formulae may then be applied to the data to reconstruct age classes (Klein and Cruz-Uribe 1984; Kurtén 1953). The number of cases within each class determines the shape of the mortality profile.

Two kinds of teeth are required; one must be a deciduous tooth, ideally one already erupted at birth, and one must be a permanent tooth that erupts before the deciduous tooth is shed. For this sample, the deciduous fourth premolar and second molar were chosen for analysis. The permanent second molar erupts at 24 months while the deciduous fourth premolar is not shed until 36 months (Groves 1974; Klingel and Klingel 1966). Crown height was taken as the measurement of the distance from the base of the crown to the occlusal surface of the tooth. In addition, for the quadratic crown height regression, an estimate of the potential ecological longevity in wild populations must be drawn from the wildlife biology literature. For this study an estimated potential longevity of 25 years is used based on studies of several species of wild equids.

The resulting mortality profile age estimates are finally clustered into age classes, typically in one year or ten percent of lifespan increments. They may also, however, be reproduced as frequencies that demarcate the three major stages within the life cycle (Tables 2 and 3). These are juveniles, prime age adults, and old individuals. Juvenile describes the interval between birth and the loss of the deciduous fourth premolar; prime age adult describes the interval between loss of the deciduous fourth premolar and roughly 61-65%
Table 3. Frequencies of juvenile prime age and old individuals of onager. Wear class data based on incisor rows and on mandibular tooth rows (Klingel and Klingel 1966; Levine 1983). For the regression formula juvenile is based on duration of the deciduous premolar. Prime age is loss of the deciduous premolar until 60% of potential longevity. Old age is 61% of potential longevity or greater (Stiner 1994). Data for Dereivka from Levine (1990), data for Mt. St. Helens from Lyman (1987). Other frequencies from Stiner (1994: 295-303).

<table>
<thead>
<tr>
<th></th>
<th>Juvenile</th>
<th>Prime</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palegawra incisor wear n=10</td>
<td>0.20</td>
<td>0.70</td>
<td>0.10</td>
</tr>
<tr>
<td>Palegawra molar wear n=28</td>
<td>0.21</td>
<td>0.64</td>
<td>0.14</td>
</tr>
<tr>
<td>Palegawra quadratic n=32</td>
<td>0.23</td>
<td>0.77</td>
<td>0.00</td>
</tr>
<tr>
<td>Warwas quadratic n=9</td>
<td>0.45</td>
<td>0.55</td>
<td>0.00</td>
</tr>
<tr>
<td>Hunted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dereivka *</td>
<td>0.07</td>
<td>0.82</td>
<td>0.11</td>
</tr>
<tr>
<td>Mass death (volcano)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mt. St. Helens n=86</td>
<td>0.38</td>
<td>0.57</td>
<td>0.05</td>
</tr>
<tr>
<td>Living structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>†Lyman 1987 n=55</td>
<td>0.34</td>
<td>0.45</td>
<td>0.21</td>
</tr>
<tr>
<td>Non-predated U-shaped</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>†Stiner 1994 –</td>
<td>0.59</td>
<td>0.22</td>
<td>0.19</td>
</tr>
<tr>
<td>fallow deer n=170</td>
<td>0.68</td>
<td>0.15</td>
<td>0.18</td>
</tr>
<tr>
<td>Predated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tiger on chital n=98</td>
<td>0.18</td>
<td>0.45</td>
<td>0.36</td>
</tr>
<tr>
<td>tiger on sambar n=56</td>
<td>0.13</td>
<td>0.38</td>
<td>0.48</td>
</tr>
<tr>
<td>hyena on zebra n=26</td>
<td>0.19</td>
<td>0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>

* my estimate
† modeled population

of potential ecological longevity or crown reduction such that somewhat more than half of the permanent tooth crown is worn away. Old adult describes the interval between 61-65% potential ecological longevity and maximum potential longevity, or permanent crown worn to zero height. Using these three stages focuses on life cycle divisions that are meaningful at the population level, and lessens the potential for errors in assignment (see Stiner 1994 for discussion).

As the quadratic crown height method is known to slightly overestimate the youngest age classes, I employed two additional age estimation methods for the onagers. Both methods are based on visible wear stages of groups of associated teeth. Equids have long been aged while on the hoof by examination of the amount of wear to the incisors; Klingel and Klingel’s (1966) work with zebra populations is used here (Table 3). While isolated incisors are not common components of the Palegawra fauna, there are several examples of symphyseal fragments that contained the incisors together as a group. In addition, mandibular tooth rows containing the cheek teeth are relatively common at Palegawra. These have been aged based on wear stages developed by Levine (1982; Table 3).

Differential preservation can skew the fossil record against the recovery of immature teeth. While this is certainly true, it is unclear that attempts to correct for poor preservation significantly increase the accuracy of results based only on the existing data set. In the following study there is no attempt to normalize or reconstruct missing data. This is partly warranted by general caution over attempts to reconstruct missing data. Also, bone preservation in the Palegawra sample, while not great, is certainly good, and the quality of tooth preservation is such that immature teeth should not be under especial preservation disadvantage. In addition, both unfused and partly fused epiphyses may be found among the bony elements; this is an indication that even though their bones are not as dense as in the adults, the remains of immature individuals are indeed a part of the sample.
Results

Table 3 displays the results for the quadratic crown height regressions, incisor age estimation, and mandibular tooth row estimation. They indicate a population rich in young and prime age adults, with few old individuals. The three methods employed to age the dental sample correspond well with each other, and I would argue that the incisor estimation is the most accurate representation of the population. This is an artifact of preservation in that the wear stages on the incisors are slightly more distinguishable than on the molar series.

Warwasi is also rich in juvenile and prime age adults, but the sample from the upper level at Warwasi is very small. I do not, therefore, have as much confidence that these frequencies adequately represent the site. Also, due to the small sample size of the Warwasi fauna, there was no way to compare the earlier Mousterian level with the later Zarzian level.

In contrast, the living structure or catastrophic profiles shown in Table 3 (Mt. St. Helens, Lyman model living structure) display higher frequencies of juveniles and lower frequencies of prime adults. In addition, various taxa of ambush and cursorial predators also may be seen to generate different frequencies in prey populations; old animals are more common in these samples than in either the Paleagwra and Warwasi samples or the living structure and catastrophic samples. Paleagwra and Warwasi are, however, similar in structure to the pattern seen at Dereivka (these frequencies are my estimates based on data from Levine 1990). Earlier sites with an abundant equid fauna, such as Solutre (not listed in Table 3; Olsen 1989) also document a sample rich in prime adult animals.

The inhabitants of Paleagwra, and probably of Warwasi as well, were clearly able to selectively target prime age adult onagers. The position of the site above the valley floor provided a vantage point from which to watch for seasonal movements and aggregations of onagers. Groups of onagers would generally have been of two types; either groups of females with associated young, or bachelor groups of males yet unable to successfully hold a territory. The presence of juveniles argues against exclusive selection of bachelor group males, however, as they would be composed of prime age adults and older individuals.

Exploitation of prime adult individuals from local equid populations is a broadly similar strategy as that seen at earlier sites such as Solutre (Olsen 1989) and later sites such as Dereivka (Levine 1990). Levine argues that the Dereivka sample does not contain many individuals less than four years of age, or many greater than eight to ten years old. The assemblage instead is rich in prime adults between five and eight years old. These individuals represent an extremely high quality resource that was both valuable and useful to the local inhabitants.

Additional information comes from a look at frequencies of elements. Limb elements are common in the sample, but axial elements such as ribs and vertebrae are rare (Turnbull and Reed 1974; Turnbull 1975). Turnbull and Reed argued that this indicated that carcases were partially dressed in the field, and only certain parts of the body brought back to the cave. They also noted that while mandibles are common, skulls are rare. This is true, however, maxillary teeth, and to some extent maxillary tooth rows are common, indicating that head parts were a component of the assemblage.

In sum, Paleagwra most likely represents a residence site rather than a kill site, and it is one which was used intensively by local Zarzian period hunters. Warwasi may represent the same kind of occupation, but one of much shorter duration. Local hunting practices at the end of the Pleistocene favored organized and targeted exploitation of large-bodied, high quality resources.

References


