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Re-analysis of Faunal Assemblages from the Haua Fteah and other Late Quaternary Archaeological Sites in Cyrenaican Libya

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In preliminary reports based on approximately 5000 identified bones from the Haua Fteah, Cyrenaica, E. S. Higgs concluded that changes in the abundance of bovines versus Barbary sheep reflected climatic change from drier (=last interglaciation) to wetter (=last glaciation) and back to drier (=present interglaciation). Higgs also reported the earliest occurrence of domestic caprines in Africa, in Haua Fteah "Neolithic" layers dated to about 6800 bp. A new analysis, based on roughly 9000 identified specimens, supports the broad pattern of faunal change that Higgs found, but suggests that it reflects wetter when Higgs proposed drier and vice versa. The new analysis failed to confirm the early date for domestic caprines, mainly because of uncertainty concerning the stratigraphic provenience of key specimens. Finally, the new analysis produced some additions to the species list (most notably eland) and provided previously unavailable information on skeletal part representation and on the ages of animals at time of death. With respect to skeletal parts, smaller ungulates tend to be represented by a wider variety than larger ones, a contrast that is almost universal in Stone Age sites. With regard to age profiles, the largest and most reliable one (for Barbary sheep from the "Neolithic" layers) implies the animals were captured by driving over cliffs or into other traps. Restudy of small additional samples from the Cyrenaican sites of Hagfet et Tera, Hagfet ed Dabba, and Sidi el Hajj Creiem fully supports taxonomic and paleoenvironmental conclusions drawn earlier by Higgs and Bate.

Keywords: HAUA FTEAH, ED DABBA, ET TERA, SIDI EL HAJJ CREIEM, WADI DERNA, CYRENAICAN STONE AGE, ANIMAL DOMESTICATION, LATE QUATERNARY CLIMATIC CHANGE.

Historical Backgrounds

Between 1947 and 1955, Charles McBurney directed Cambridge University excavations at four important Stone Age sites in Cyrenaican Libya (McBurney & Hey, 1955; McBurney, 1960, 1967, 1977). These included three caves (the Hagfet ed Dabba, Hagfet et Tera, and Haua Fteah) and one open-air site (Sidi el Hajj Creiem, also known as Wadi Derna)

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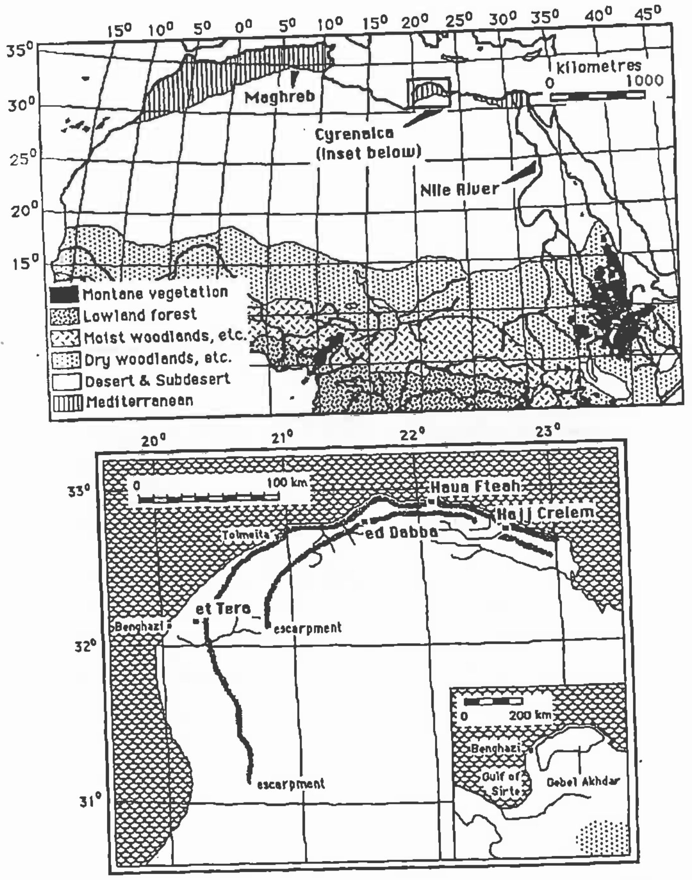

Figure 1. Top, Africa north of the Equator (modified after Clark, 1967: Map 12). Bottom, Approximate locations of the Cyrenaican sites mentioned in the text (modifed after McBurney & Hey, 1955: fig. 2).

(Figure 1). Animal bones identifiable to skeletal part from all four sites were taken to England, where those from et Tera, ed Dabba, and Hajj Creiem were described by Bate (1955), and the ones from the Haua Fteah by Higgs (1967*a*, *b*, *c*). From a modern perspective, Bate's and Higgs' descriptions were preliminary and lacked many numerical data necessary for reliable intersample comparisons of taxonomic abundance, skeletal part representation, ages of animals at time of death, and other aspects that inform on past environments and on the behavior of ancient bone collectors. To obtain a wider range of numerical data and to increase the archeological and paleoenvironmental value of the four bone samples, we renalysed them in 1985.

Excavation and Stratigraphy of the Haua Fteah

Among the four sites, the Haua Fteah (or "Great Cave") is by far the most important, both for its great depth of deposits and for the large quantities of artifacts and bones it provided. McBurney tested the Haua Fteah in 1951 and returned for more substantial excavations in 1952 and especially in 1955. He exposed the top 2·4 m of deposit over an area of approximately 10·6 × 9·1 m, the next 5·2 m over an area of 4·5 × 6·1 m, and the final 5·3 m over an area of roughly 1·8 × 2·4 m. The excavation reached a depth of almost 13 m, without encountering bedrock.

In all three seasons, the excavation was conducted according to arbitrary horizontal layers or "spits". However, in the upper 7·6 m of the profile McBurney (1967) recognized 35 natural layers (I–XXXV from top to bottom), distinguished primarily by sediment color and texture. He referred to the bottommost 5·3 m simply as the "Deep Sounding". After the excavations were completed, he related the spits to the natural stratigraphy, recognizing that, in most instances, individual spits cut across two or more natural layers and, in some cases, even across culture-stratigraphic boundaries. As a result, it is impossible to determine exactly where major artifactual and faunal changes occur within the Haua Fteah profile, and some significant changes may have been totally obscured. This is particularly likely in the lower part of the sequence (layers XX and below), which provided so little material that even minor mixture could mask significant differences between stratigraphically adjacent artifact and bone assemblages.

Paleoclimatic Implications and Dating of the Haua Fteah Deposits

The paleoclimatic implications of the Haua Fteah sediments were never explored in detail, though McBurney (1967) drew some broad inferences from field observations and from a granulometric study of sediment samples by Sampson (1967). On granulometry, McBurney divided the profile into four basic parts: (1) layers I–XI, in which the matrix is mainly silt with little or no coarse debris; (2) layers XII–XXI in which unweathered, sharp limestone fragments are abundant; (3) layers XXII–XXV in which silt again dominates, though with bands of coarse debris (and also stalagmite); and (4) below XXXV (the "Deep Sounding") in which the deposits are as homogeneously silty as in layers I–XI. McBurney believed that the coarse, unweathered debris of layers XII–XXI accumulated partly by frost-fracturing under very cold conditions at the end of the last glaciation. The overlying silts of layers I–XI would then belong to the present interglaciation (Holocene) and the analogous silts from below layer XXXV to the last interglaciation. The silts with bands of coarse debris in layers XXII–XXXV would reflect the intermediate and variable climatic conditions of the early and middle parts of the last glaciation.

McBurney's interpretation is supported by radiocarbon dates that place layers XI to I between 10,500 bp and the present and that bracket layers XX–XII between 33,000 (or before) and 10,500 bp (Vogel & Waterbolk, 1963; Callow *et al.*, 1963; McBurney, 1967). Layers XXI and below are probably all at or beyond the range of conventional radiocarbon dating; a date of approximately 47,000 bp on layer XXVIII should probably be read as ⩾47,000 bp.

The oxygen-isotope composition of marine shells from the Haua Fteah further corroborates McBurney's paleoclimatic interpretation. The shells were probably introduced by Stone Age people who collected them for food on the coast, presently about 1 km to the north. Shells from the "Deep Sounding" and from layers above X have very similar $^{18}O/^{16}O$ ratios which differ sharply from the ratios in shells from layers between XXXV and X (Emiliani *et al.*, 1963; McBurney, 1967). The differences suggest that offshore waters were generally much cooler when layers XXXV–X accumulated, in keeping with their assignment to the last glaciation. In addition, shells are relatively rare in layers XXXV–X, probably in part because the lower sea levels of the last glaciation displaced the coastline seawards.

McBurney (1967) proposed detailed correlations between specific Haua Fteah layers and last interglaciation/last glaciation climatic events. It now seems best to abandon these correlations, in part because they were based on very speculative dates for the lower third

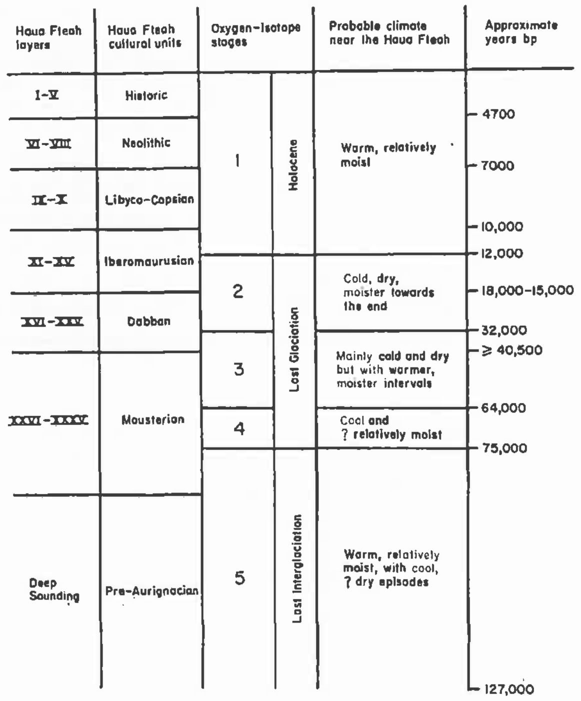

Figure 2. Suggested correlations between the Haua Fteah sequence and the global marine oxygen-isotope stratigraphy.

of the profile and on minimum (non-finite) radiocarbon dates for the middle third. In addition, the global climate stratigraphy with which McBurney attempted correlations was significantly revised in the 1970s.

In terms of the now widely accepted marine oxygen-isotope stratigraphy (Shackleton & Opdyke, 1973, 1976), the available Haua Fteah data suggest that the base of the excavation (the "Deep Sounding") dates from one of the warmer substages of isotope stage 5 (= the last interglaciation *sensu lato*). Layers XXII–XXXV, all of which are clearly at or beyond the range of conventional radiocarbon dating, may belong in part to stage 5 (to one or more of its colder substages) and in part to stages 4 and 3 (the early and middle parts of the last glaciation). Based on the available radiocarbon dates, layers XI–XXI correspond largely, if not entirely, to isotope stage 2 (the later part of the last glaciation), while layers X and above clearly belong to stage 1 (the present interglaciation or Holocene). The suggested correlations are tabulated in Figure 2. They could be significantly refined by new excavations to recover sediment samples, shells, and other pertinent materials according to the natural stratigraphy.

Cultural Stratigraphy of the Haua Fteah

McBurney (1967) recognized seven basic culture-stratigraphic units at the Haua Fteah, some of which he subdivided into phases. The stratigraphic interfaces between these units often lay within arbitrary spits and could not be defined as precisely as the layer assignments below suggest. From top to bottom, the cultural units are as follows:

(1) *Historic*: Layers I–V. Marked by the occurrence of wheel-made pottery and metal artifacts. Greco-Roman potsherds occur *in situ* in layers I and II, sherds left by the "historic Libyans of Pharaonic Age" in layers III, IV, and V.

(2) *Neolithic*: Layers VI–VIII. Distinguished by the first occurrence of potsherds, pressure-flaked stone artifacts, rough hoe-shaped limestone implements, and "certain specialized forms of grinding equipment". Pottery similar to that found in the "Neolithic of Capsian Tradition" of the Maghreb. Bracketed between roughly 7000 and 4700 bp by radiocarbon dates on charcoal from layers VI and VIII.

(3) *Libyco-Capsian*: Layers IX and X. Marked by backed bladelets, numerous true microliths, occasional notched and strangulated blades, and bone and ostrich eggshell artifacts. Likened by McBurney to the well-known Capsian of the Maghreb (Camps, 1974; Lubell *et al.*, 1984), but in fact far more similar to the local (Eastern) Iberomaurusian underlying it (Close, 1977, and *in litt.* 5 May 1986). Placed between roughly 10,000 and 7000 bp partly by radiocarbon dates from the Haua Fteah and partly by presumed analogy with the Maghreb.

(4) *Iberomaurusian*: Layers XI–XV. Distinguished by the abundance of well-made, very thin, backed bladelets and the rarity of other stone tools. Originally referred to by McBurney as "Eastern Oranian", but essentially indistinguishable from the Oranian of the Maghreb, now generally known as the Iberomaurusian (Camps, 1974; Lubell *et al.*, 1984). Divided at the Haua Fteah between an Early phase (layers XIV and XV) in which "reverse-trimmed" backed bladelets are relatively rare and a Late phase (layers XIII, XII, and X) in which they abound. Contains the oldest formal bone artifacts to be found at the Haua Fteah. Dated by McBurney between roughly 15,000 and 10,000 bp on limited radiocarbon dates from the Haua Fteah, and thus broadly coeval with the Iberomaurusian of the Maghreb (Camps, 1974, 1975).

(5) *Dabban*: Layers XVI–XXVI. Distinguished by the earliest appearance of "punched" or "true" blades in the Haua Fteah sequence. The principal tool types are backed blades, chamfered blades, well-made angle and polyhedral burins, and small, somewhat variable, but well-made end-scrapers. No formal bone tools at the Haua Fteah, but the Dabban bone sample is very small, and bone artifacts do accompany very similar, broadly contemporaneous stone artifacts at the name site of Hagfet ed Dabba, approximately 60 km to the southwest (Figure 1). Divided by McBurney into an Early phase (layers XXV–XXE) and a Late phase (layers XXD–XVI) on changes in tool type frequencies that may not be significant, given the small samples involved. Radiocarbon-dated at ed Dabba to at least 40–5000 bp and lasting until perhaps 15,000 bp at the Haua Fteah. Saxon *et al.*, (1974) suggest that some late Dabban dates from the Haua Fteah may actually pertain to the early Iberomaurusian, in which case the Dabban may have terminated at 20,000–18,000 bp. Apart from a blade assemblage radiocarbon-dated to approximately 31,500 bp at Nazlet Khater 4 in the Nile Valley of Upper Egypt (Vermeersch *et al.*, 1982), the Dabban is the only well-documented industry between *c.* 18,000–20,000 and 40,000 bp in all of northern Africa. It is also among the earliest true blade-and-burin ("Upper Paleolithic") industries in the world.

(6) *Mousterian*: Layers XXXV–XXVI. A series of flake assemblages subdivided by McBurney into an "Evolved Hybrid Mousterian" (layers XXXV and XXXIV), an early Levalloiso-Mousterian (layer XXXIII), a possible Aterian (layers XXXII and XXXI), and a later Levalloiso-Mousterian (layers XXX–XXVI). The possible Aterian is distinguished by "traces of an incipient tanged form", and the remaining phases by differences in the frequencies of points, side-scrapers, end-scrapers, and crude burins. The entire Mousterian sequence is probably beyond the 40,000 bp limit of conventional radiocarbon dating and perhaps began within the later part of the last interglaciation or early part of the last glaciation.

(7) *Pre-Aurignacian*: Deep Sounding. Distinguished by an abundance of crude angle burins and by scrapers and other tools often made on elongated flakes or flake-blades. Likened by McBurney to the "Amudian" of the Levant. Precise age uncertain, but probably dating from the last interglaciation.

McBurney believed that occupation of the Haua Fteah was essentially continuous from the Pre-Aurignacian of the last interglaciation to the present. However, he did record some depositional non-sequences (disconformities), some of which may represent long gaps, particularly in the lower half of the profile. Further, from his description, it is clear that the density of cultural debris (artifacts and bones) varied greatly throughout the sequence, and mainly sterile zones apparently separated the Pre-Aurignacian from the overlying Mousterian and the Mousterian from the Dabban.

Finally, McBurney emphasized the low density of finds in the Mousterian and especially in the Dabban layers. This suggests the Haua Fteah was occupied only ephemerally, probably because, like the remainder of North Africa, Cyrenaica was exceptionally dry during much of the last glaciation. Very low archeological visibility due to hyperaridity may explain why compelling traces of human occupation dated between 18,000–20,000 and ⩾40,000 bp have not yet been found in the Maghreb. Broadly contemporaneous hyperaridity is probably responsible for occupation gaps or near-gaps at similar latitudes in southern Africa, as discussed by H. J. Deacon & Thackeray (1984) or Klein (1983*a*).

The stratification of the "Libyco-Capsian" directly above the Iberomaurusian at the Haua Fteah deserves special note, since the Capsian and Iberomaurusian rarely occur at the same sites or even in the same regions in the Maghreb (Camps, 1974; Lubell, 1984; Lubell *et al*., 1984). Instead, Iberomaurusian sites tend to be located near the coast, while Capsian ones occur inland. At most Iberomaurusian sites, there is a gap of several thousand years between the Iberomaurusian levels and succeeding Neolithic ones, while there is rarely any pre-Capsian occupation at Capsian sites. A broadly similar pattern has been observed in southern Africa, where some regions seem to have been occupied throughout the Holocene, while others were largely abandoned for several thousand years in the early to middle part (J. Deacon, 1984). In southern Africa the reason for the difference is probably climate (very arid in areas that were abandoned). It is not clear what factors were responsible in the Maghreb, but if the dating of the "Libyco-Capsian" has been properly assessed, they obviously did not pertain to the Haua Fteah.

Invertebrate Remains from the Haua Fteah

Like ourselves, previous writers on the Haua Fteah have emphasized the vertebrate remains. However, we observed five fragments of crab pincers (chelipeds) among the bones (two from the Libyco-Capsian layers and three from the Neolithic). Much more importantly, McBurney reported numerous marine and terrestrial invertebrate shells. The marine shells came mainly from the limpet, *Patella coerulea*, and the top shell, *Trochus turbinatus*, and were concentrated in the pre-Aurignacian levels below layer XXXV and in the Iberomaurusian, Libyo-Capsian, and Neolithic levels above layer XIII. As we noted above, the rarity of marine shells in the intervening Mousterian and Dabban layers probably in part reflects seaward displacement of the coastline during the last glaciation. It may also reflect sparse human occupation under very arid conditions.

The Pre-Aurignacian shells rank among the oldest evidence in the world for human use of coastal resources. Shells perhaps collected by broadly contemporaneous people also occur at the Aterian sites of Smugglers' Cave (Témara) (Roche & Texier, 1976), Zouhrah Cave (Débénath & Sbihi-Alaoui, 1979), and Mugharet el 'Aliya (Howe, 1967), all in Morocco; at the Aterian site of Bérard in Algeria (F.-E. Roubet, 1969); and at Devil's Tower and other Mousterian cave sites on the Rock of Gibraltar (Garrod *et al*., 1928).

Both shells and marine vertebrate remains that are broadly coeval with the Pre-Aurignacian ones have also been found in Middle Stone Age coastal sites in southern Africa (Volman, 1978: Singer & Wymer, 1982; Voigt, 1982; Klein, 1983*a*).

The terrestrial shells from the Haua Fteah come from tiny snails that were probably introduced accidentally on vegetation or that actually lived in the cave, as well as from large edible snails that probably represent human food debris (Hey, 1967). Large terrestrial shells were found sporadically throughout the sequence, but were concentrated in the Pre-Aurignacian layers at the bottom and especially in the Iberomaurusian, Capsian, and Neolithic layers (XIV–V) near the top. The shells of edible snails are also common at Iberomaurusian, Capsian, and Neolithic sites in the eastern Magreb, where there are veritable snail middens, particularly in Capsian sites (Camps, 1974; Lubell *et al*., 1976; Lubell, 1984).

Human Remains from the Haua Fteah

Two partial human mandibles, one adult and one juvenile, were associated with Early Levalloiso-Mousterian artifacts near the interface between layers XXXII and XXXIII. As described and illustrated by McBurney *et al*. (1953*a*, *b*), Trevor & Wells (1967), and Tobias (1967), the adult mandible (Haua Fteah I) comprises the left ascending ramus and a part of the horizontal branch with M_2 and M_3 in place. The juvenile mandible (Haua Fteah II) comprises the left ascending ramus only, with unerupted M_3 still present in its crypt. Although both mandibles have been called "Neandertaloid," they differ from typical European and southwest Asian Neanderthal mandibles and approach fully modern ones in some important respects, especially in the absence of a retromolar space (demonstrable on the adult mandible; inferrable for the immature).

Together with mandibles and other cranial remains from the Aterian levels of Dar es Soltan 2, Zouhrah Cave, and Smugglers Cave (Témara), and from perhaps slightly earlier deposits at Mugharet el 'Aliya and Jebel Irhoud, all in Atlantic Morocco (Débénath, 1980; Débénath *et al*., 1982), the Haua Fteah mandibles probably sample a distinctive early Upper Pleistocene, North African population that was neither Neanderthal nor fully modern. It appears to bridge the morphological gap between archaic and fully modern *Homo sapiens* better than any other known fossil sample (Stringer *et al*., 1984). Together with sub-Saharan human fossils discussed by Rightmire (1984) and Bräuer (1984), the North African ones imply that the roots of fully modern people may lie in Africa.

Other Vertebrate Remains from the Haua Fteah

McBurney states that the Haua Fteah excavations produced tens of thousands of bones, most of which were highly fragmented. Approximately 12,000 were judged "identifiable" and were removed to Cambridge. Of this number, Higgs was able to identify about 5000 to skeletal part and taxon. These formed the basis for his preliminary report. In our reanalysis we examined the entire Cambridge sample and identified 9068 bones to part and taxon. 8003 of these were from mammals, 425 from birds, 619 from tortoises, 3 from snakes, and 18 from fish.

Table 1 shows the number of bones in each category and major cultural unit. Relative to bones of other creatures, particularly mammals, tortoise bones are much more abundant in the Mousterian and Dabban levels than in the overlying ones, which may be a further indication of hyperaridity during Mousterian and Dabban times. We lacked the experience and comparative material to identify the non-mammals to genus or species, which precludes further interpretation here. However, the bird bones from the Neolithic layers might prove especially interesting if, as we suspect, some come from domestic species.

Table 2 shows the number of bones (NISP) and the minimum number of individuals (MNI) by which each mammalian taxon is represented in major cultural subdivisions. We

Table 1. The number of mammal, bird, tortoise, snake and fish bones in the principal cultural units at the Haua Fteah

	Historic	*Neolithic*	*Libyco-Capsian*	*Ibero-Maurusian*	*Dabban*	*Mousterian*	*Pre-Aurignacian*	*No unit*	*Totals*
Mammal	139	3084	1475	2580	269	168	85	203	8003
Bird	2	190	96	63	15	31	22	6	425
Tortoise									
Carapace & plastron	0	145	74	136	72	119	39	13	598
Other bones	2	2	2	2	11	1	0	1	21
Snake	0	1	2	0	0	0	0	0	3
Fish	1	7	0	0	0	0	1	9	16
Totals	144	3429	1649	2781	367	319	147	232	9068

Table 2. The number of identifiable specimens/the minimum number of individuals by which various mammalian taxa are represented in successive cultural units at the Haua Fteah. There is a single horn-core of dorcas gazelle from a late Iberomaurusian layer, but other gazelle bones cannot be identified to species. Other problematic identifications are discussed in the text

	Historic	*Neolithic*	*Libyco-Capsian*	*Late Ibero-Maurusian*	*Early Ibero-Maurusian*	*Late Dabban*	*Early Dabban*	*Levalloiso-Mousterian*	*Aterian*	*Evolved Levalloiso-Mousterian*	*Hybrid Mousterian*	*Pre-Aurignacian*
Cape hare	—	—	3/1	3/1	—	—	—	—	—	—	—	—
European rabbit	—	—	—	—	1/1	—	—	—	—	—	—	—
Lagomorphs (gen.)	—	2/1	3/1	3/1	1/1	1/1	1/1	1/1	1/1	—	—	—
Crested porcupine	—	17/4	1/1	—	—	—	—	—	—	—	—	1/1
çf. bear	—	1/1	—	—	—	—	—	—	—	—	—	—
Domestic dog	5/2	4/2	1/1	—	—	—	—	—	—	—	—	—
Red fox	—	4/1	4/1	5/1	2/1	—	—	—	—	1/1	—	—
Small mustelid	—	—	—	—	1/1	—	—	—	—	—	—	1/1
Spotted hyena	—	—	3/1	—	—	1/1	—	—	—	—	—	—
Hyena(s) (gen.)	—	—	3/1	2/1	—	1/1	—	1/1	—	—	—	—
Wildcat	—	2/1	—	—	1/1	—	—	—	—	—	—	—
African elephant	—	—	—	1/1	—	—	—	—	—	—	—	2/1
Kirchberg's rhinoceros	—	—	—	—	—	1/1	1/1	—	3/1	1/1	5/1	3/1
White rhinoceros	—	—	—	—	—	—	—	1/1	—	—	—	—
Rhinoceros (gen.)	—	—	—	—	—	2/1	1/1	3/1	3/1	1/1	5/1	3/1
Equid	1/1	2/1	—	1/1	8/1	5/1	5/1	—	—	—	—	—
Boar	4/1	1/1	—	—	—	—	—	—	—	—	—	—
Eland	—	—	—	1/1	—	—	—	—	—	—	—	—
Hartebeest	—	35/2	33/2	121/6	47/4	4/1	2/1	—	8/1	5/1	1/1	3/1
Gazelle	4/1	56/7	41/3	127/5	65/3	11/1	12/2	4/1	4/2	5/1	2/1	29/2
Barbary sheep	35/2	2349/41	1140/41	1295/52	659/25	148/13	29/5	1/1	5/1	62/4	2/1	33/1
Domestic goat	78/8	421/19	1/1	—	—	—	—	—	—	—	—	—
?Domestic sheep	2/1	124/8	4/1	12/5	—	—	—	—	—	—	—	—
Cattle/aurochs	7/1	38/3	228/13	189/7	30/2	25/4	20/2	4/2	4/1	4/1	36/2	13/4

had initially planned to present these numbers on a layer-by-layer basis. However, like Higgs, we eventually opted for presentation by cultural unit, because the individual layers generally contain too few identifiable bones for meaningful analysis. This is especially so because a true layer-by-layer presentation would exclude most of the bones in the sample, since they come from spits that overlap two or more layers. Even presentation by cultural unit forced us to exclude 203 bones, and there are many others we included on the arguable assumption that they came mainly from one cultural unit rather than another. The problem is particularly acute for the Mousterian and Dabban units, where the overall sample sizes are small and even slight admixture could mask important differences between the bone assemblages.

Pre-Excavation Damage to the Haua Fteah Bones and the Question of the Bone Collector

Abundant artifacts, hearths (noted especially in the Mousterian layers), and traces of artificially dug depressions (in the Dabban and Iberomaurusian layers) clearly suggest that people introduced many, if not most of the animal bones found at the Haua Fteah. Other possible accumulators include hyenas and porcupines, both of which are represented by bones in various levels (Table 2). We also encountered a fragmentary coprolite, probably from hyena, in a Pre-Aurignacian spit. In the hope of determining what role various bone accumulators may have played, we inspected each bone for characteristic damage.

Table 3 shows that our examination revealed very few bones with obvious damage of any kind, whether from people, carnivores, or rodents. Higgs (1967*a*) also commented on the rarity of surficial damage, though he provided no numbers. Some damage marks may have been lost or obscured when the bones were fragmented, especially as a result of leaching and profile compaction after burial. It is also possible that the proportion of damaged pieces would be higher if the sample included the thousands of "unidentifiable" bone fragments that were not brought to Cambridge. However, given the size of the available sample, we think that the rarity of damage probably reflects reality at the Haua Fteah, and the essential question is how to interpret it. Above all, does a low frequency of cut marks mean that people may not have played a major role in accumulating the bones?

We know of no research that points to a direct relationship between human involvement in collecting bones and the frequency of cut marks, and we think it is unlikely such a relationship exists. In fact, it is difficult to cut bone with stone tools and, to the extent that they could, Stone Age butchers probably avoided contact with bone. Thus we do not think the rarity of cut marks means that people accumulated relatively few of the Haua Fteah bones, while the abundance of cultural debris and the near absence of evidence for carnivore or porcupine activity suggests they accumulated the great majority.

Mammalian Species in the Haua Fteah Fauna

In our re-examination, we identified basically the same species as Higgs, with some interesting additions. These are domestic dog (in Libyco-Capsian and later layers), a large carnivore, possibly bear (in a Neolithic layer), elephant (in Pre-Aurignacian and late Iberomaurusian layers), and eland (in a late Iberomaurusian layer). We also positively identified domestic goat (in Libyco-Capsian and later layers) and less surely domestic sheep (in late Iberomaurusian and later layers). Higgs had simply referred to "domestic caprines" in the Neolithic and Historic layers, without distinguishing goat or sheep, except for one goat horn-core.

Our identification of domestic dog is based on dentitions that seemed to be morphologically distinct from comparative and fossil golden jackal ones. However, it can be very

Table 3. Burnt, cut, weathered, carnivore-chewed, rodent-gnawed, and acid-dissolved bones from the Haua Fteah

	Historic	*Neolithic*	*Libyco-Capsian*	*Late Ibero-Maurusian*	*Early Ibero-Maurusian*	*Late Dabban*	*Early Dabban*	*Pre-Mousterian*	*Aurignacian*	*Total altered bones*	*Total bones*
Burnt											
Golden jackal	0	1	0	0	0	0	0	0	0	1	65
Equid	0	1	0	0	0	0	0	0	0	1	22
Gazelle	0	0	0	1	2	0	0	0	0	3	360
Barbary sheep	0	2	1	11	0	0	4	0	0	18	5758
Cattle/aurochs	0	0	0	0	0	1	0	0	0	1	596
Cut											
Hartebeest	0	0	0	0	1	0	0	0	0	1	259
Cattle/aurochs	0	0	0	0	0	0	0	1	0	1	596
Weathered											
Cattle/aurochs	0	0	0	1	0	2	0	1	0	4	596
Carnivore-chewed											
Hartebeest	0	1	0	0	0	0	0	0	0	1	259
Cattle/aurochs	0	0	0	1	0	0	0	0	0	1	596
Rodent-gnawed											
Barbary sheep	0	2	0	0	0	0	0	0	0	2	5758

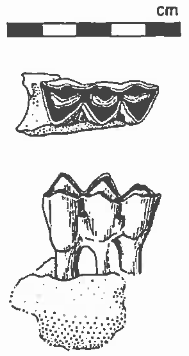

Figure 3. A large tragelaphine right dP_4 from the Iberomaurusian deposits of the Haua Fteah (HFT 52/7–8).

difficult to distinguish golden jackal from similarly sized dogs, and the identification should be checked by someone with more experience.

Our identification of elephant is based on unmistakable fragments of molar plates and is secure. Similarly, our identification of eland is based on a dP_4 which is unmistakably tragelaphine (Figure 3). On size, it is almost certainly eland, though there is an outside possibility that it came from greater kudu. Eland has been recorded at several late Quaternary sites in the Maghreb, while kudu has been found at one (Thomas, 1979). Whether it is eland or kudu, the Haua Fteah tragelaphine, from a "late" Iberomaurusian layer, is probably the most recent so far found in North Africa.

To separate domestic goat and sheep we relied primarily on postcranial criteria described by Boessneck (1969), supplemented by dental criteria presented by Payne (1985). On this basis, we are certain that we identified most goat bones correctly. We are less certain about domestic sheep bones, which we found more difficult to distinguish from those of Barbary sheep, the wild caprine which is superabundant in the Haua Fteah sample. In particular, it is conceivable that the supposed domestic sheep bones we found in the Iberomaurusian and Libyco-Capsian layers represent exceptionally small Barbary sheep.

Higgs believed that the bovine bones from the Haua Fteah belonged mainly to aurochs, though he suggested that some of the Paleolithic bones might come from a long-horned buffalo, while some or all the Neolithic and Historic bones might come from domestic cattle. In our examination we found no Paleolithic bovine bones that clearly fall outside the range of aurochs, and we saw no clear differences between bovine bones in the Paleolithic layers and ones in the Neolithic layers. We believe that long-horned buffalo is either rare or absent, but we are much less certain about domestic cattle. As Higgs noted, the Haua Fteah aurochs is small by European standards, and it may be indistinguishable from like-sized domestic cattle without more complete bones than the ones we saw. We add that the numbers of bovine bones from different layers are small, precluding truly detailed comparisons. Domestic cattle may well be present, at least in the Neolithic and Historic layers.

The Haua Fteah equid bones that are intact enough for diagnosis closely match homologous bones of Burchell's zebra, which is well-represented at other late Quaternary archeological sites in northern Africa (Vaufrey, 1955; Camps, 1974). However, it is possible that some of the highly fragmented Haua Fteah bones came from ass or (near the top of the sequence) even domestic horse. We have therefore referred all the bones to a generalized equid category.

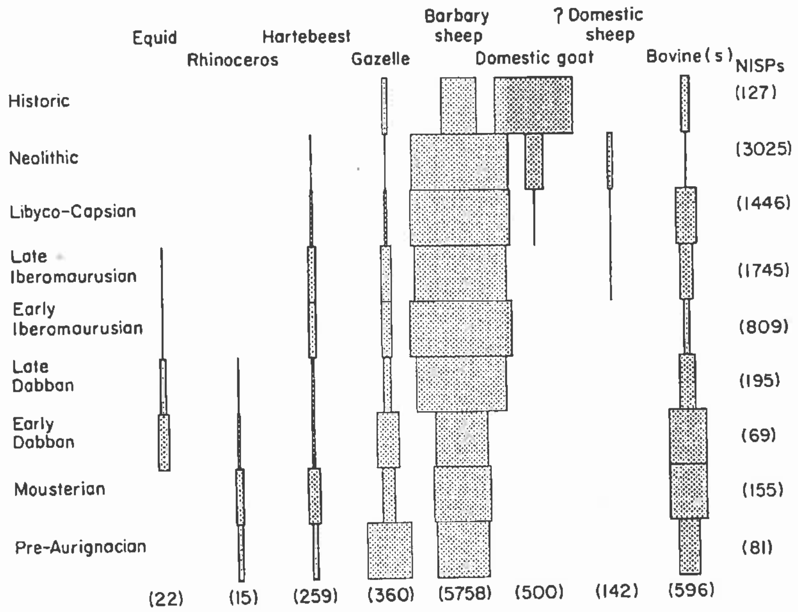

Figure 4. The relative abundance of equids, rhinoceroses and bovids at the Haua Fteah. For each cultural unit, the bars are proportional to the NISP for each species divided by the total NISP for equids, rhinoceroses and bovids.

Finally, our identification of boar is secure, but we were unable to determine if the species was wild or domesticated. This potentially important question might be resolved by a larger (and more precisely excavated) sample.

Mammalian Species Abundance at the Haua Fteah

The NISPs of the main mammalian species in each Haua Fteah cultural unit are shown graphically in Figures 4 & 5. For the equids, rhinoceroses, and bovids (Figure 4), the bars are proportional to the NISP of each species divided by the total NISP for equids, rhinoceroses, and bovids. For the remaining species (Figure 5), the bars are proportional to the NISP of each species divided by the total NISP for all species. We emphasize that the numbers are only approximate, especially since bones from adjacent cultural units were certainly mixed during the excavation. Perhaps most important, given the small numbers involved, imprecise excavation could easily account for the record of domestic goat and ?domestic sheep bones in pre-Neolithic cultural units.

Figures 4 & 5 clearly corroborate Higgs' finding that Barbary sheep dominate throughout. It was probably also the most common wild species nearby historically. The figures further support Higgs' conclusion that Barbary sheep were somewhat less important in the bottommost units (the Pre-Aurignacian, Mousterian, and early Dabban levels), where gazelle and especially aurochs tend to be relatively more common. Relative to Barbary sheep, aurochs also tends to increase in the Late Iberomaurusian and Libyco-Capsian layers. Higgs suggested that the greater abundance of aurochs near the bottom and top of the sequence reflected relatively dry, interglacial conditions, while the increased frequency of Barbary sheep in the middle was due to a relatively moist, glacial climate.

At the time Higgs wrote, it was widely believed that interglacial intervals were dry in low and lower-middle latitudes, while glacial ones were wet. Abundant evidence now indicates

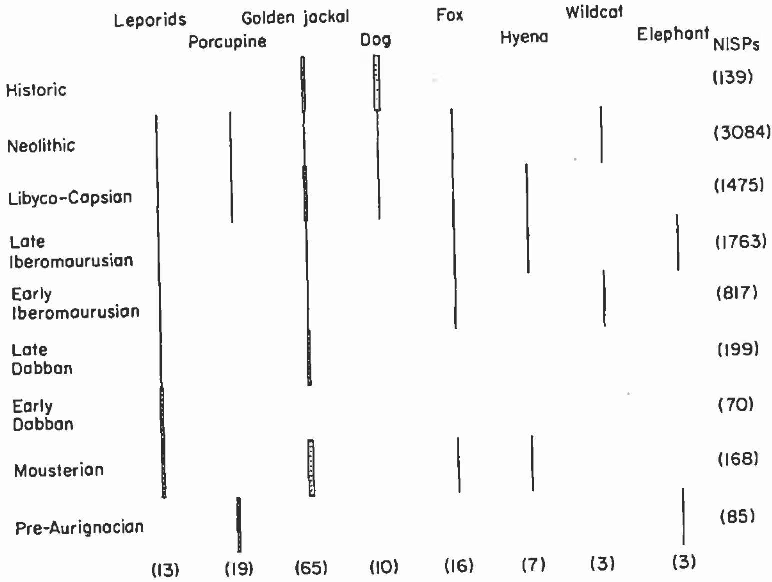

Figure 5. The relative abundance of elephant and the principal non-ungulates at the Haua Fteah. For each cultural unit, the bars are proportional to the NISP for each species divided by the NISP for all species.

precisely the opposite (Butzer, 1971, 1978, 1984). Further, with regard to the Haua Fteah, relative to aurochs, an increase in Barbary sheep is far more likely to indicate dry conditions than wet ones, since Barbary sheep tolerate aridity far better than bovines do, if only because they can meet their moisture requirements almost entirely from vegetation, whereas bovines must drink regularly (Dorst & Dandelot, 1970; Haltenorth & Diller, 1980). In this regard, it is certainly pertinent that an increase in wild bovine(s) is correlated with indications of moister climate at archeological sites in the Maghreb (Lubell, 1984) and also in southernmost Africa (Klein, 1983*b*), where the overall pattern of late Quaternary climatic change closely paralleled that in northern Africa.

In sum, it seems reasonable to assume that Haua Fteah levels richest in aurochs versus Barbary sheep reflect moister conditions near the site, keeping in mind that the overall pattern may have been partially blurred by the excavation method. In particular, the apparently high proportion of aurochs bones in the Early Dabban may be due to mixture with the underlying Mousterian, complicated by small sample size.

In addition to fluctuations in indigenous species, Figure 4 illustrates the appearance and importance of domestic caprines (goat and less certainly sheep) near the top of the sequence. Higgs believed that the first appearance of domestic caprines coincided closely with the first appearance of pottery and other "Neolithic" artifacts at the Haua Fteah, dated to roughly 6800 bp. Accepting this date, at the time Higgs wrote the Haua Fteah domestic caprines were the oldest ones known in Africa. Even today, only those from Capelletti Cave, northern Algeria, dated to *c.* 6500 bp (C. Roubet, 1979), and from Nabta Playa in the western desert of Egypt, dated to *c.* 7000 bp (Gautier, 1980), would be comparable in age. Unfortunately, however, we feel that the actual time when domestic caprines appeared near the Haua Fteah is not well fixed. A more secure date would require fresh excavations that tied both bones and radiocarbon dates more closely to the natural stratigraphy. New excavations might also demonstrate the presence of domestic cattle from the beginning of the local Neolithic or before. Cattle were certainly present in the Sahara to the south by 6000 bp (Smith, 1984) and possibly 2000–3000 years earlier (Gautier, 1980, 1984*a*). The earlier date depends on fragmentary bones that have been only tentatively assigned to domestic (as opposed to wild) bovines.

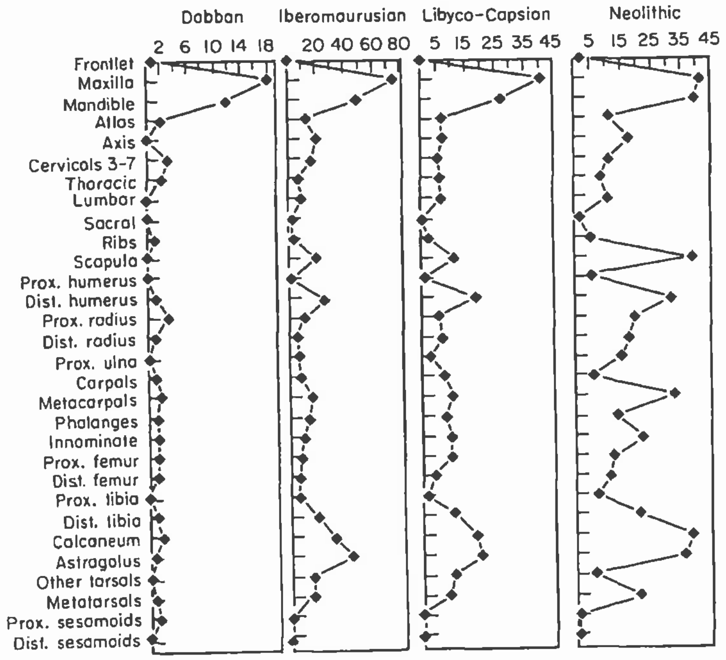

Figure 6. The minimum number of Barbary sheep represented by various skeletal parts in the Dabban, Iberomaurusian, Libyco-Capsian, and Neolithic cultural units at the Haua Fteah.

Figure 5 shows that elephant, carnivores, and other non-ungulates are rare in the Haua Fteah deposit. Elephant bones have rarely been found in Stone Age camp sites, probably because people usually did not bring very large bones home. Carnivore bones also tend to be infrequent. An abundance of carnivore bones has in fact been taken to indicate that carnivores, rather than people, accumulated most bones at a site (Klein, 1975; Brain, 1981). Unfortunately, the rarity of carnivore bones need not demonstrate the opposite. The number of carnivores in a carnivore-accumulated assemblage may depend on the carnivore species doing the collecting and also perhaps on environmental factors, particularly the amount of competition among carnivores. The nature of a site may also play a role. Higgs (1967*a*) suggested that the Haua Fteah was far too light and open to serve as a true carnivore lair, though carnivores may have shaded or rested there occasionally.

Skeletal Part Representation at the Haua Fteah

Only Barbary sheep, domestic caprines, and aurochs/cattle are numerous enough for an analysis of skeletal part representation, and then, only in some culture-stratigraphic units. Figures 6 & 7 show the pattern of skeletal part representation for Barbary sheep and aurochs/cattle in the Dabban, Iberomaurusian, Libyco-Capsian, and Neolithic layers,

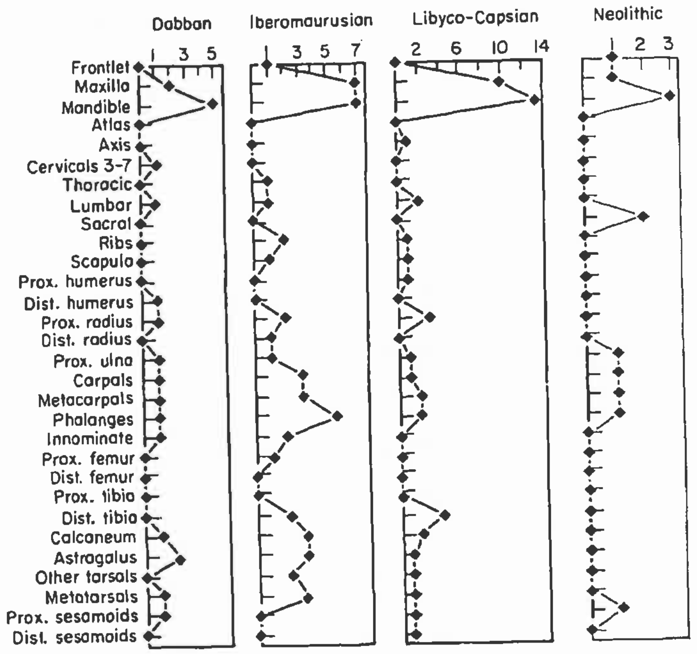

Figure 7. The minimum number of aurochs/cattle represented by various skeletal parts in the Dabban, Iberomaurusian, Libyco-Capsian, and Neolithic cultural units at the Haua Fteah.

while Figure 8 shows the pattern for Barbary sheep, domestic caprines, and aurochs/cattle in the site as a whole. In each case, the abundance of a skeletal part is represented by the minimum number of individuals (MNI) necessary to account for it. The MNIs were calculated using the computer program described by Cruz-Uribe & Klein (1986), treating each cultural unit (Figures 6 & 7) and the entire site (Figure 8) as if they contain only one layer, that is as if bones from anywhere within a unit (or the site) could come from the same individuals represented anywhere else within the unit.

The figures show that, regardless of taxon, in each stratigraphic unit the most abundant skeletal parts tend to be the hardest, most compact bones, including especially the teeth, distal humerus, calcaneum, and astragalus. The same elements are common in most fossil faunas, reflecting their durability. As at other sites, softer, less compact bones like the proximal humerus, sacrum, and proximal tibia tend to be rare at the Haua Fteah. Relatively small, inconspicuous bones like Barbary sheep sesamoids and smaller tarsals and carpals are also uncommon, probably because they were overlooked during excavation and sieving. Similar recovery bias probably accounts for the rarity of these and other small bones in many fossil faunas. Together, differential durability and excavation bias certainly explain much of the skeletal part frequency variation in Figures 6–8.

Durability factors perhaps also explain some of the differences in skeletal part representation among cultural units. Thus, with regard to Barbary sheep, softer skeletal parts are more common in the Neolithic layers than in the underlying ones (Figure 6), probably because the Neolithic bones suffered less from leaching and profile compaction. They are conspicuously less fragmented and better preserved.

There are also differences in skeletal part representation that probably reflect collector behavior. The most obvious one is the contrast between Barbary sheep and domestic caprines on the one hand and aurochs/cattle on the other (Figure 8). Dentitions and foot bones tend to dominate in all three cases, but other bones are especially rare in aurochs/cattle. In short, the smaller animals tend to be better represented by a wider range of skeletal parts. The same contrast between smaller and larger ungulates characterizes most Stone Age sites and was especially emphasized by Perkins & Daly (1968) in their analysis of the fauna from the early Holocene hunter–gatherer site of Suberde in Turkey. They explained it by the "schlepp effect", whereby people often brought smaller animals to a site intact, but butchered larger ones where they died and only brought back selected skeletal parts.

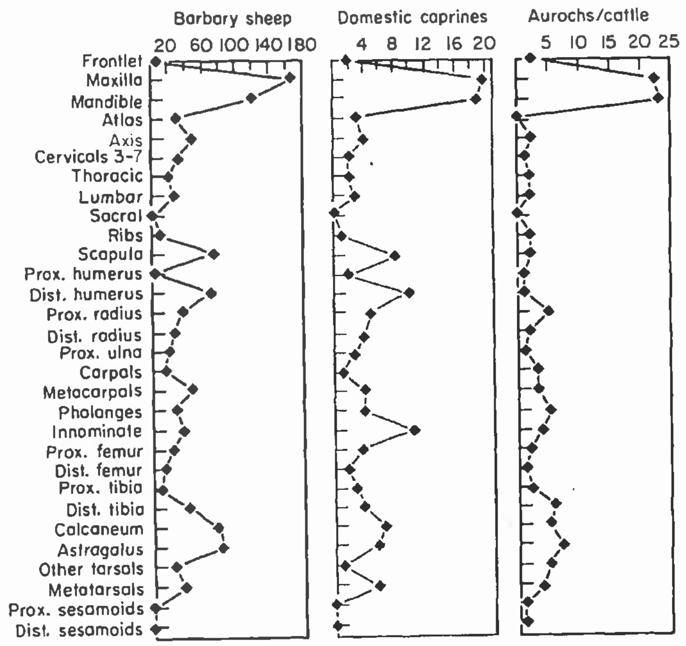

Figure 8. The minimum number of Barbary sheep, domestic caprines, and aurochs/cattle represented by various skeletal parts at the Haua Fteah.

Binford (1984) argues that the "schlepp effect" has been overworked and that the contrast in skeletal part representation between different-sized animals implies that people obtained them in different ways. In his opinion, the wide range of well-represented skeletal parts that tends to characterize smaller bovids implies active human hunting, while the disproportionately high number of skull and foot bones that characterizes larger bovids implies scavenging. Skull and foot bones have relatively little nutritional or other value and would thus often be left at carcasses on which non-human predators had already fed.

Perhaps the principal difficulty with Binford's hypothesis is that the pattern is so widespread. It characterizes not only the majority of stone age sites, but also a broad range of later sites, such as Iron Age ones in sub-Saharan Africa (Voigt, 1983). In these sites too, compared to smaller bovids, large ones are disproportionately represented by head and foot bones. However, the smaller bovids are primarily domestic sheep and goats, which were certainly not hunted, and the larger ones are domestic cattle, which were almost certainly not scavenged. We have no compelling explanation for why the pattern is so common, but we don't think that a "schlepp effect", broadly defined, can be entirely ruled out. In addition, like Voigt (1983), we think the pattern may partly reflect greater fragmentation of large bones during butchering and food preparation, combined with leaching, profile compaction, and other post-depositional destructive pressures that tend to remove fragmented bones first (or that make them hard to identify).

Mortality Profiles at the Haua Fteah

Only the Barbary sheep is sufficiently abundant for a potentially meaningful analysis of age and sex composition. We estimated age from dP_4 and M_3 crown heights, using the procedure described by Klein & Cruz-Uribe (1984). For the initial (unworn) dP_4 and M_3 crown heights that this procedure requires, we used 15·6 and 47·0 mm, the maximum unworn heights observed in the Haua Fteah sample. Although much has been published on Barbary sheep biology (bibliography in Gray & Simpson, 1980), we were unable to find secure ages for dP_4 shedding and M_3 eruption and used 26 months and 30 months respectively. These figures were inferred from the limited dental eruption data for Barbary sheep in Ogren (1965) and are close to ones for Dall sheep and bighorn sheep (Taber, 1971). They almost certainly approximate the true Barbary sheep numbers very closely. Finally, for maximum possible individual age ("potential ecological longevity") in Barbary sheep, we took 192 months (16 years), based on information in Mentis (1972) and Rode (1943). 192 months also characterizes other Barbary sheep-size bovids for which information is available (Mentis, 1972).

Figure 9 shows the Barbary sheep age (=mortality) profiles for the Haua Fteah subsamples in which sheep teeth are most common and also for the Dabban levels of the Hagfet ed Dabba. For comparative purposes, the figure includes a similarly constructed profile for domestic goat in the Haua Fteah Neolithic and Historic layers. There are several factors that complicate interpretation of the age profiles. Most important, many teeth were broken or destroyed during and after deposition, mainly by trampling, leaching, and crushing as the deposits settled. Many dP_4s probably disappeared altogether, and a large number of M_3s became unmeasurable. For Barbary sheep, these include 10 of 44 M_3s from the Dabban levels at Ed Dabba, 18 of 47 from the Iberomaurusian, 15 of 38 from the Libyco-Capsian, and 22 of 65 from the Neolithic layers at the Haua Fteah.

Most of the unmeasurable M_3s are well worn, and their exclusion might therefore bias the age profiles towards younger individuals. However, it is possible that many less worn (=more fragile) teeth have disappeared completely, producing an even more serious bias in the opposite direction. At the same time, subjective examination suggests that the age distribution of the unmeasurable teeth is about the same in each cultural unit, except perhaps in the Neolithic. This in turn suggests that exclusion of the unmeasurable teeth probably did not cause differences among the age profiles, except perhaps for differences between the Neolithic profile(s) and the rest.

A second problem derives from the fact that, in caprines, M_3 usually erupts after dP_4 is shed. This means that an age profile based on dP_4 and M_3 crown heights will automatically exclude those individuals who have neither dP_4 nor M_3. The resultant bias will be mainly against individuals in the second 10% of lifespan. This problem could be avoided by using M_1 or M_2 in place of M_3, but unlike M_3, M_1 and M_2 are often difficult to distinguish, especially in the Haua Fteah sample where so many teeth are broken.

A final important problem is the relatively small size of the dental samples for most of the cultural units, which increases the possibility that the differences among age profiles could be due to chance. Small sample size also makes it difficult to compare the profiles to the idealized "catastrophic" and "attritional" mortality profiles on which paleobiologists often base interpretations.

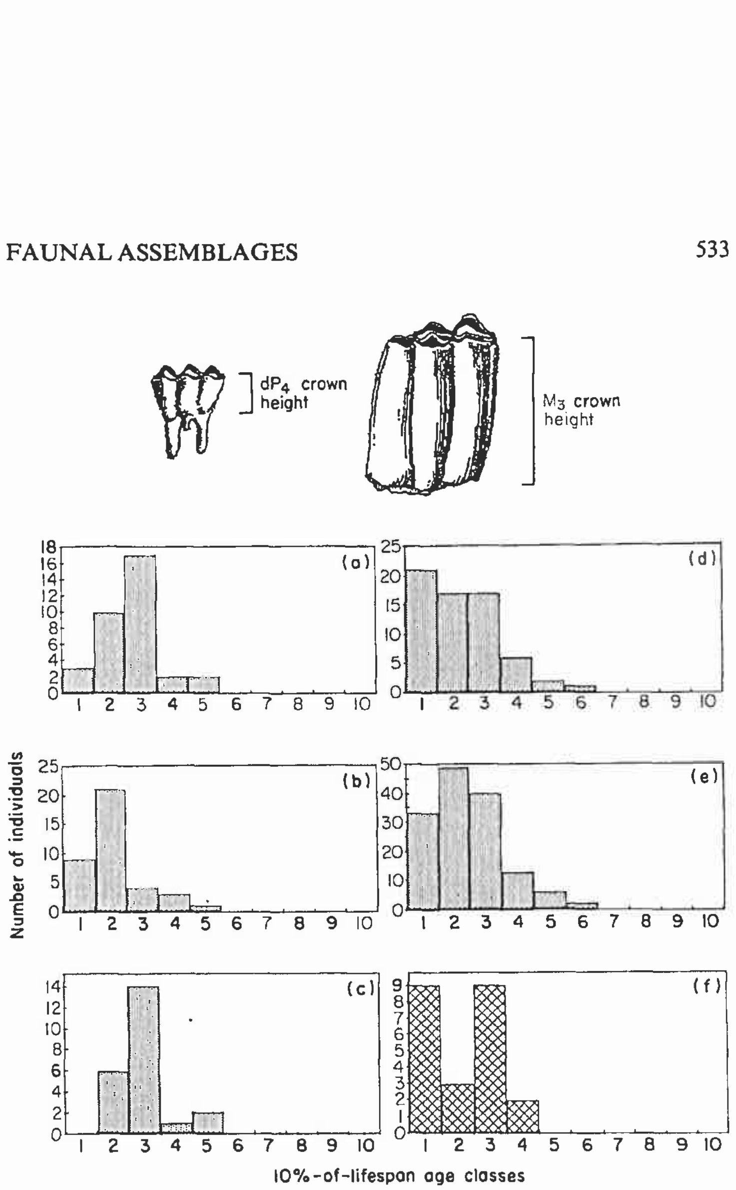

Figure 9. Top, The crown height dimension used to estimate individual age, illustrated on the first lobes of a Barbary sheep dP_4 and M_3. Bottom, Age (mortality) profiles of Barbary sheep (a–e) and domestic goat (f) from the Hagfet ed Dabba and the Haua Fteah. (a) Ed Dabba, Dabban. (b) Haua Fteah, Iberomaurusian. (c) Haua Fteah, Libyco-Capsian. (d) Haua Fteah, Neolithic. (e) Haua Fteah, all. (f) Domestic goat, Haua Fteah, Neolithic. Each age class represents 10% of potential life span, from youngest (1) to oldest (10).

With thse caveats in mind, it is clearly impossible to draw definitive conclusions from the age profiles in Figure 9. The first age class in the Dabban, Iberomaurusian, and Libyco-Capsian Barbary sheep profiles may have been depressed by especially great post-depositional destruction of very young teeth. The second age class in the Dabban and Libyco-Capsian sheep and in the Neolithic/Historic goats may be artificially low because dP_4 and M_3 were used to construct the age profiles. Chance (sampling error) could explain the larger number in the second age class of Iberomaurusian sheep.

All problems considered, based on size and quality of preservation, perhaps the most reliable profile for interpretation is the one for Neolithic Barbary sheep from the Haua Fteah. Remembering that the first age class is probably seriously under-represented because of the fragility of the dP_4s on which it is based and the second because of the ageing method, this profile exhibits the characteristic shape of a "catastrophic" profile, in

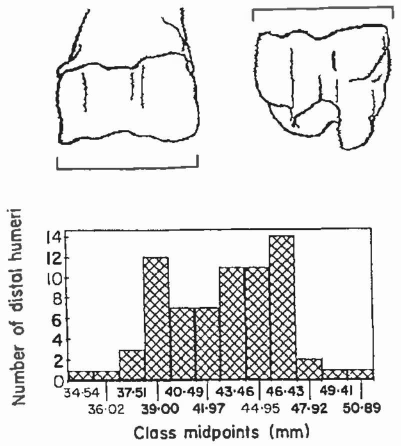

Figure 10. Mediolateral diameter of Barbary sheep distal humeri in the Iberomaurusian, Libyco-Capsian, and Neolithic layers of the Haua Fteah. The bimodality probably reflects sexual dimorphism.

which successive age categories contain progressively fewer individuals. In the context of the Haua Fteah, the "catastrophe" most likely to have struck Barbary sheep was human driving of small groups over cliffs or into traps where all individuals died, regardless of their age. In fact, trapping of Barbary sheep that might produce catastrophic profiles is depicted in probably Neolithic rock paintings in the 'Uweinat highland, southeastern Libya (Winkler, 1939).

In theory, the best skeletal parts for estimating the sex ratio in fossil Barbary sheep would be pelves or horn-cores, but both elements are rare in the Haua Fteah sample. Next best are long bone epiphyses that reflect the greater weight of males, particularly over the forequarters. Figure 10 presents the mediolateral diameters of the most abundant epiphysis in the sample, the distal humerus. To avoid potential confusion between young male and adult female humeri, the figure includes only fused specimens, that is ones that had reached adult size. In Barbary sheep, as in other similar-sized bovids, the distal humerus probably fuses at 10–12 months, and a sex profile based on the distal humerus will thus exclude younger animals. Unfused ("young") epiphyses are in any case very rare at the Haua Fteah, probably because they often failed to survive post-depositional leaching and profile compaction.

The distribution in the figure is clearly bimodal; the left-hand mode probably represents females and the right-hand one males. More detailed interpretation is hindered both by small sample size and by the fact that the figure includes all measurable humeri, regardless of their stratigraphic origin. It might thus mask important differences among cultural units. Assuming that there are no such differences, the figure suggests a sex ratio near 1:1 or perhaps one slightly in favor of males. Unfortunately, there are no comparative data for free-ranging Barbary sheep in North Africa today from which it might be possible to determine if the apparent sex ratio is consistent with driving.

Barbary sheep abound at many other Stone Age sites in northern Africa, but in most cases there is no information on sample age and sex composition. The most prominent exception is in the Iberomaurusian layers of Tamar Hat Cave, eastern Algeria, where Saxon established an age/sex profile from fused and unfused epiphyses (Saxon *et al.*, 1974). He concluded that the Tamar Hat sheep were mainly young (1–2 years old) males and fully adult females, and that deliberate flock management (herding and culling) rather than hunting produced this pattern.

Saxon's hypothesis is intriguing, but we agree with Lubell (1984) that his sex determinations are not compelling. There is also the possibility that the age profile was seriously biased by selective pre- and post-depositional removal of unfused epiphyses. Selective destruction would act especially against very young epiphyses, whose rarity or absence at Tamar Hat Saxon is regarded as particularly strong evidence for systematic culling and against hunting. If very young epiphyses are rare at Tamar Hat because of their fragility, Saxon's epiphyseal age profile need not differ from that of a live Barbary sheep population. In this event, which could be checked by dental ageing, driving (hunting) rather than herding might be implied.

The Faunas from Hajj Creiem, Ed Dabba, and Et Tera

At Sidi el Hajj Creiem, Levalloiso-Mousterian artifacts and animal bones occurred *in situ* at the base of a series of lacustrine marls and silts near the margin of a now-dry pool on the floor of the Wadi Gahham, a tributary of the Wadi Derna. McBurney excavated approximately 40 m^2 in 1947 and 1948, recovering 1500 artifacts and a large quantity of animal bones. The geological age of the occurrence has not been fixed, but deposition probably occurred during a relatively moist interval in the last interglaciation or in the early part of the last glaciation.

The Hagfet ed Dabba is a cave containing nearly 2 m of deposits excavated by McBurney in 1947–8. He identified nine natural layers, numbered I–IX from top to bottom. Layer I contained Roman potsherds, while II–VII contained the distinctive blade-and-burin industry that McBurney named the "Dabban". VIII and IX were artifactually sterile. Soil with charcoal flecks from one of the Dabban layers provided a radiocarbon date of 40, 500 ± 1600 bp (Vogel & Waterbolk, 1963), which may be only a minimum age. On sedimentological and artifactual grounds, McBurney (1967) suggested that the entire Ed Dabba Dabban was broadly coeval with the "Early Dabban" at the Haua Fteah. The density of Dabban cultural debris was significantly greater at ed Dabba than at the Haua Fteah, reflecting more intense occupation or perhaps a slower sedimentation rate.

The Hagfet et Tera is a cave which McBurney excavated in 1948 to check the results of a much larger excavation by C. T. Petrocchi in 1937. Petrocchi reported that et Tera contained an industry that was transitional between the Middle and Upper Paleolithic. McBurney concluded that Petrocchi had mistakenly mixed Middle and Upper Paleolithic artifacts from two separate stratigraphic units. In his own very small excavations, McBurney recognized four natural layers (A–D from top to bottom), all of which contained Iberomaurusian ("Oranian") artifacts very similar to those which he subsequently excavated at the Haua Fteah. On this basis, the associated faunal remains from et Tera probably date between approximately 20,000 and 10,000 bp.

Table 4 and Figure 11 present the basic results of our re-analysis of the faunal samples from the three sites. We identified essentially the same species as Bate. We encountered no bones with obvious damage from stone tools or animal teeth, but the abundance of cultural debris at each site suggests the bones were accumulated mainly, if not entirely, by people.

Clearly all three samples are very small, and they contain only relatively complete bones, which suggests that non-diagnostic and even fragmentary diagnostic specimens were discarded before shipment to Britain or perhaps at an early stage in curation. The samples are almost certainly not suitable for a study of skeletal part representation, and the dental subsamples, which excavation or curation probably biased least, are generally too small to construct interpretable age profiles. (Figure 9 presents the age profile of the ed Dabba Barbary sheep, based on the largest dental subsample from any of the three sites.)

Table 4. The number of identified specimens/the minimum number of individuals by which various species are represented at Hagfet et Tera, Hagfet ed Dabba, and Hajj Creiem. There are dorcas gazelle horn-cores from et Tera, but other gazelle bones from all three sites could not be identified to species. Bate identified horn-cores of long-horned buffalo from Hajj Creiem, but these were not housed with the sample reported below. The available bovine bones from all three sites could belong to either buffalo or aurochs

	Ibero-Maurusian		Dabban		Mousterian
	et Tera A & B	et Tera C & D	ed Dabba I–II	ed Dabba III–VI	Hajj Creiem
Golden jackal	2/1	—	—	—	—
Red fox	—	—	2/1	—	—
?Egyptian mongoose	—	—	—	1/1	1/1
Lion	—	—	1/1	—	—
Burchell's zebra	10/2	2/1	28/4	4/1	15/2
Rhinoceros	—	—	1/1	—	—
Hartebeest	27/2	—	6/1	—	—
Gazelle	54/4	1/1	8/2	—	5/1
Barbary sheep	6/1	3/1	133/5	122/8	37/3
Bovines	10/2	—	14/2	8/2	15/2

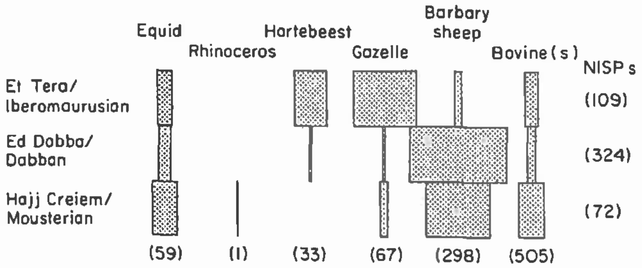

Figure 11. The relative abundance of the principal species represented at Hagfet et Tera, Hagfet ed Dabba, and Hajj Creiem. For each site, the bars are proportional to the NISP for each species divided by the NISP for all species.

Only relative species abundance is probably meaningful for comparisons with other sites, particularly the Haua Fteah.

Figure 11 shows that Barbary sheep dominate at Hajj Creiem and ed Dabba, just as they do at the Haua Fteah. The explanation is almost certainly the shared environmental setting of the sites. All three are located near the northern edge of the Akhdar hills (Gebel Akhdar; Figure 1), where topographic and vegetational circumstances combined to make Barbary sheep the most abundant wild ungulate not only historically, but probably throughout the late Quaternary.

At the Haua Fteah, relative to Barbary sheep, bovines are slightly more abundant in the Mousterian layers than in the overlying Dabban ones. We suggested previously that more bovines may mean moister climate in Mousterian times. Bovine bones are also slightly more abundant in the Mousterian deposit at Hajj Creiem than in the Dabban layers at ed Dabba, perhaps again because Mousterian climate was moister. Alternatively, it is possible that Hajj Creiem was simply closer to where bovines died or were butchered.

Unlike the other sites, et Tera is situated on the western edge of the Akhdar hills, on the margin of true desert. We follow Higgs (1967*a*), who suggested that the proximity of the desert explains why gazelle are so much more abundant at et Tera than at the other sites.

Summary and Conclusion

Interpretation of the Haua Fteah fauna is hampered by the comminuted condition of the bones from the pre-Neolithic units and also by the relatively small number of identifiable bones from the Pre-Aurignacian, Mousterian, and Dabban units. In addition, excavation by arbitrary spits mixed bones from adjacent units and may have obscured some important patterning. Still, as Higgs reported earlier, it is clear that Barbary sheep dominates throughout the prehistoric sequence and was especially abundant in the middle part, dating from the last glaciation. Relative to Barbary sheep, bovines were most abundant at the bottom of the sequence, probably dating to the last interglaciation and also near the top, firmly dated to the Holocene. A higher proportion of bovines probably reflects moister climate under interglacial conditions. Conversely, a higher proportion of Barbary sheep probably reflects drier climate in glacial times, also suggested by a tendency for tortoise remains to be most numerous in "glacial" layers.

Domestic caprines (goat and less certainly sheep) appear near the top of the Haua Fteah sequence, perhaps in the same levels as the earliest pottery and other "Neolithic" artifacts. It is possible that the same levels contain domestic cattle, but the available bones are insufficient to distinguish domestic cattle from aurochs. McBurney suggested that the Haua Fteah Neolithic began roughly 7000–6800 bp, but this date, and more generally the time when domestic caprines first appeared, must remain uncertain because of the excavation method.

Among the various taxa represented at the Haua Fteah, only Barbary sheep and bovine(s) are common enough for an analysis of skeletal part representation. In both cases, hard, compact bones tend to be disproportionately abundant, probably because softer, less dense bones were often destroyed by pre- and post-depositional destructive processes. At the same time, compared to Barbary sheep, bovine(s) are well-represented by an especially small range of parts, mainly teeth and foot bones. Binford has interpreted a similar contrast between smaller bovids and larger ones elsewhere to mean that the smaller ones were mainly hunted, while the larger ones were mainly scavenged. The principal difficulty with this hypothesis is that the contrast is extremely widespread, even extending to faunal assemblages where the smaller and larger bovids were both domesticated. We think the contrast is probably due in part to the "schlepp effect" and in part to the tendency for larger bones to become more fragmented before burial.

Small sample size and sample bias against young bones and teeth make it difficult to determine the age/sex composition of the Haua Fteah ungulate samples. Certainly the largest and probably the least biased sample is the one for Barbary sheep from the Neolithic layers. The age profile of this sample is similar to the age profile of a live population, suggesting that Neolithic people commonly hunted Barbary sheep by driving them over cliffs or into traps where all individuals were equally vulnerable, regardless of their age.

In terms of both taxonomic composition and taxonomic abundance, the faunas from Sidi el Hajj Creiem (?last interglaciation) and Hagfet ed Dabba (mid-last glaciation) are broadly similar to contemporaneous faunas from the Haua Fteah, suggesting the three sites shared similar environments then as now. The faunal sample from Hagfet et Tera (terminal last glaciation and perhaps early Holocene) contains many more gazelle bones than the other samples, regardless of age, probably because et Tera is located in a very different setting, adjacent to true desert.

With respect to species composition, the various Cyrenaican sites are broadly similar to like-aged sites in the Maghreb, where Barbary sheep tend to rule in hilly settings, while zebra, hartebeest, gazelle and other flatland ungulates dominate in less rugged environments (Vaufrey, 1955; Camps, 1974). There are also broad taxonomic similarities between the Cyrenaican faunas and ones from contemporaneous sites along the Nile, though not surprisingly the Nile faunas rarely contain Barbary sheep, but are often rich in water-loving creatures, including fish, crocodile, turtle, waterfowl, and hippopotamus (Gautier, 1968; Churcher, 1972; Gautier *et al.*, 1980).

Like contemporaneous sites in the Maghreb, the Cyrenaican sites contain several species that did not occur in the region historically. These include extant sub-Saharan forms [especially white rhinoceros, Burchell's zebra, eland (or kudu), and hartebeest] that augment evidence from the Sahara itself (Camps, 1974; Churcher, 1983; Gautier, 1984*b*; Thomas, 1979; Vaufrey, 1955; Wendorf *et al.*, 1977; Wendorf & Schild, 1980) for times when animals (and people) were able to cross the desert relatively easily. These times were probably mostly the warmer, relatively moist, early parts of interglaciations and perhaps also the less cold, ?moist, earlier parts of glaciations. Most of the sub-Saharan species probably disappeared from northern Africa in the middle to late Holocene as a result of human persecution and a trend toward less favourable (drier) climate (Klein, 1984).

There were also at least two species in Cyrenaica and the Maghreb that were totally unknown in historic times. These were the long-horned "giant" buffalo and Kirchberg's "woodland" rhinoceros. The long-horned buffalo apparently disappeared in the mid-Holocene together with other essentially sub-Saharan species. Kirchberg's rhinoceros was a Eurasiatic immigrant that first arrived in northern Africa in the late middle or early late Quaternary, between perhaps 250,000 and 130,000 bp (Vaufrey, 1955; Jaeger, 1975; Thomas, 1979). It disappeared locally at the end of the last interglaciation or the beginning of the last glaciation, probably as a result of adverse climatic change. It became extinct in southwest Asia and Europe at about the same time or slightly later, and there was thus no source population for recolonization of northern Africa when climate turned more favorable in the early Holocene.

The occurrence at the Haua Fteah of Kirchberg's rhinoceros, and possibly also wild boar and bear, hint that larger samples might contain other Eurasiatic species, especially deer, which would increase the differences between Cyrenaica and the Nile, while strengthening resemblances to the Maghreb. The Cyrenaican culture-stratigraphic sequence may also suggest closer connections to the Maghreb, though detailed analyses of artifact collections indicate there may have been important links between all three regions in the terminal Pleistocene/early Holocene (Close, 1977; Close *et al.*, 1979; Lubell *et al.*, 1984). Taken together, the faunal and artifactual data may indicate that, through most of the late Quaternary, it was easier for people or ideas to move between Cyrenaica and the Maghreb than between Cyrenaica and the Nile, but that environmental barriers to movement became less important later on, as a result of greater cultural (technological) sophistication.

Among the known Cyrenaican sites, the Haua Fteah is clearly the most important, but its full potential will only be realized by fresh excavations, when political and economic circumstances permit. Given new excavations according to the natural stratigraphy, the Haua Fteah could become not only an extremely important general source of behavioral and paleoenvironmental data for much of the late Quaternary, but a nearly unique source of vital information for the hyperarid portions of the mid-last glaciation when so many sites elsewhere in Africa seem to have been totally abandoned. The middle of the last glaciation is especially interesting as the time when anatomically modern people (*Homo sapiens sapiens*) may have first emerged, perhaps in Africa. The scanty human remains that have already been recovered from the Haua Fteah indicate that it may have witnessed this event. Fresh excavations could help to establish its behavioral correlates, as well as the possibility that it resulted from the stringent selection pressures that widespread hyperaridity exerted on more archaic human populations.

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Appendix. Technical names of the mammalian taxa mentioned in the text

Vernacular name	Technical name	Vernacular name	Technical name
Cape hare	*Lepus capensis*	Boar	*Sus scrofa*
European rabbit	*Oryctolagus cuniculus*	Greater kudu	*Tragelaphus strepsiceros*
Crested porcupine	*Hystrix cristata*	Eland	*Taurotragus oryx*
Bear	*Ursus arctos*	Hartebeest	*Alcelaphus buselaphus*
Golden jackal	*Canis aureus*	Gazelle	*Gazella* sp(p).
Domestic dog	*Canis familiaris*	Dorcas gazelle	*Gazella dorcas*
Red fox	*Vulpes vulpes*	Barbary sheep	*Ammotragus lervia*
Egyptian mongoose	*Herpestes ichneumon*	Domestic goat	*Capra hircus*
Spotted hyena	*Crocuta crocuta*	Domestic sheep	*Ovis aries*
Wildcat	*Felis libyca*	Dall sheep	*Ovis dalli*
Lion	*Panthera leo*	Bighorn sheep	*Ovis canadensis*
African elephant	*Loxodonta africana*	Aurochs	*Bos primigenius*
Kirchberg's rhinoceros	*Dicerorhinus kirchbergensis*	Domestic cattle	*Bos taurus*
White rhinoceros	*Ceratotherium simum*	Long-horned buffalo	*Pelorovis antiquus*
Burchell's zebra	*Equus burchelli*		