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New light on Mesolithic resource scheduling and site inhabitation in Central Sudan

Introduction

Early Holocene hunter-gatherers in the Central Sudanese Nile Valley are generally considered to represent mobile groups, inhabiting base camps near the Nile during the dry season and dispersing in the hinterlands at the onset of the rains, returning to the river when the waters started receding (e.g. Arkell 1949). Thus Clark (1989), referring to the Mesolithic settlement of Shabona, states: "There is every reason to suppose that the pattern of occupation was similar to that seen among ethnic groups such as the Nilotic peoples on the Upper Nile to the south. These groups occupy country that the evidence suggests is comparable to that of Shabona at the time it was occupied in the early 6th millennium B.C." The seasonal nature of the site was deduced from the "shallow nature of the site and variable weathering patterns on the bone" and the fact that "the site would almost certainly have been subject to some degree of annual flooding". However, archaeological research by Caneva (1983) at Saggai and by Haaland (1992) at the confluence of the Nile and the Atbara and further to the north strongly suggests that the Mesolithic riparian communities of the Central Sudanese Nile Valley had a much more settled lifestyle than hitherto accepted.

The question of human groups seasonality inhabiting the Nile Valley is also addressed by Marks and Mohammed-Ali (1991: 254-5) when discussing Shaqadud in the late prehistory of the Central Sudan. Located about 50 km to the east of the Nile (Fig. 1), this site was considered a possible refuge for Mesolithic human groups coming from the Nile Valley during the rains. According to Marks and Mohammed-Ali (1991), however, archaeological evidence does not support this view, " ... it seems more likely that the Mesolithic occupants of Shaqadud were basically steppe-adapted, and used to the steppe's raw material resources, its plants, and its animals. Shaqadud's proximity to the Nile Valley does not seem to have acted as a magnet on these folk. They did not go to the Nile to get 'desirable' raw materials, and they did not seem to have traded for them either".



Fig. 1. Map of the Central Sudan with the location of the sites mentioned in the text. Inset shows region relative to the Sudan.

Conceivably, a more coherent picture of how Central Sudanese Mesolithic hunter-gatherers ordered their lives throughout the year in response to the availability of plants and animals might come from palaeobotanical and archaeozoological research. In the case of archaeozoology, detailed studies about the exploitation of riverine vertebrates, i.e. mammals and reptiles that live near the river, are available (e.g. Gautier 1983, 1989; Peters 1986, 1989). However, these studies only deal with one aspect of Mesolithic subsistence, since at all sites a

large part, if not the bulk of the faunal remains pertain to fishes. Because fish bones from excavations prior to 1989 have never been analysed in detail (Peters 1991), it is clear that any conclusion with respect to resource scheduling in space and time made so far is a priori based on an incomplete set of data. Unfortunately, most of the faunal material of the older excavations (Khartoum Hospital, Shabona) is not available anymore for detailed analysis, but extensive faunal samples were recently recovered by members of the Atbara Research Project (directed by R. Haaland and A.-A. Magid) during excavations at three Khartoum Mesolithic sites: Abu Darbein, El Damer and Aneibis (Fig. 1).

The faunas

The faunal remains reported here were obtained from three sites situated between the 5th and the 6th Nile cataract (Fig. 1). The sites are located on gravel ridges representing old river terraces. They are bordered by an alluvial plain towards the river (Nile/Atbara) and by a desert plateau away from the river. According to A. A. Magid and A. Al-Nadi (in litt.) large floodplains must have been present near El Damer and Aneibis, whereas at Abu Darbein the alluvial plain was considerably more narrow. The ^{14}C dates available for Abu Darbein range between 8640 ± 120 to 8330 ± 100 bp (Haaland & Magid 1992). At El Damer, faunal samples were taken from two areas. The dates for the two areas are broadly contemporaneous and fall essentially between 8040 ± 120 and 7780 ± 110 bp. At Aneibis, the archaeofauna has been collected in area 4, which was inhabited mainly between 7890 ± 100 and 7570 ± 60 years bp.

It lies out of the scope of this paper to present detailed inventories of the archaeofaunas from the three sites - these will be published elsewhere (Peters in press), but a short overview of the animal species found might be useful. Five groups of animals are present, i.e. molluscs, fish, reptiles, birds and mammals. As to the molluscs, the freshwater snail *Pila* and the land snail *Limicolaria* form the bulk of the material. The rest of the shells mainly pertain to freshwater bivalves of the genera *Aspatharia*, *Mutela* and *Etheria*. The ichthyofauna is very rich, with at least 20 species in each of the samples. The genera *Polypterus*, *Protopterus*, *Mormyrus*, *Mormyrops*, *Gymnarchus*, *Distichodus*, *Citharinus*, *Barbus*, *Labeo*, *Clarias*, *Bagrus*, *Synodontis*, *Lates* as well as tilapias were caught by the site inhabitants. Reptilian remains include monitor (*Varanus niloticus*), crocodile (*Crocodylus niloticus*), rock python (*Python sebae*) and at least three freshwater turtles (*Trionyx*, *Pelomedusa*, *Pelusios*). The avifauna exhibits a riverine (darter, heron, stork, pochard) and a terrestrial component (ostrich, common quail, francolin, Arabian bustard). Over 35 species of mammals are present, including grivet (*Cercopithecus aethiops*), patas (*Erythrocebus patas*), porcupine (*Hystrix cristata*), cane rat (*Thryonomys swinderianus*), at least 10 species of carnivores, African elephant (*Loxodonta africana*), black rhinoceros (*Diceros bicornis*), hippopotamus (*Hippopotamus amphibius*), warthog (*Phacochoerus aethiopicus*), Salt's dikdik (*Madoqua saltiana*), oribi (*Ourebia ourebi*), bohor reedbuck

(*Redunca redunca*), kob (*Kobus kob*), red-fronted gazelle (*Gazella rufifrons*), barbary sheep (*Ammotragus lervia*), topi (*Damaliscus lunatus*), roan antelope (*Hippotragus equinus*) and African buffalo (*Syncerus caffer*).

Resource scheduling and site inhabitation

Biological data

On the basis of the habitat preferences of the different species it is possible to distinguish within the Central Sudanese Mesolithic faunas an aquatic, a riverine and a non-riverine component. Thus fish, crocodiles and Nile soft-shell can be considered aquatic species, whereas for example *Pila*, Nile monitor, rock python, guineafowl, cane rat, hippopotamus, oribi, reedbuck, kob, topi and buffalo prefer habitats adjacent to a river, hence riverine species. Aquatic and riverine species form the bulk of the material, implying that most Mesolithic fishing, gathering and hunting activities were confined to this part of the ecosystem. However, in each of the archaeofaunas we also find evidence for species that are independent of surface water and adapted to arid environments, e.g. dorcas gazelle, red-fronted gazelle, barbary sheep and Salt's dikdik. Sahelian living conditions prevailed outside the Nile and Atbara river valleys during the first half of the Holocene (Wickens 1982; Peters 1989, 1992), and the presence of these ungulates suggests that the north-western Butana and the western Atbai (Fig. 1) respectively formed part of the Mesolithic site catchments.

When, where and how animals can be captured is primarily determined by the biology of the species and only secondarily by the available equipment (e.g. Seitz 1977: 66; von Brandt 1984: 32). In many fluvial systems in Africa, the horizontal and vertical distribution of (semi)aquatic and riverine animals is related to the annual hydrological cycle of rivers and lakes. Consequently, a good knowledge of the topography of the waterbody and its surroundings, and of its behaviour in relation to, for example, rainfall patterns are necessary to maximize the exploitation of the animals frequenting this particular environment.

Traditional procurement of freshwater resources in sub-Saharan Africa is a function of the fluctuations of the water level. The arrival of the floodwaters causes a temporal expansion of the water area adjacent to a river or a lake. During the following dry period most of the floodplain is drained, leaving a network of depression pools, lagoons and swamps, some of which persist until the next flood (Welcomme 1979: 94). At the beginning of this cycle, many aquatic species undertake lateral migrations into these shallow flooded areas to feed and reproduce, both adults and new-borns benefiting from the mass of food and shelter available (e.g. Daget 1954: 21-23). As the plain dries out, most animals migrate back to the major water body, but part of the community remains in the standing waters. As is still the case in Africa, a good deal of fishing will take place at the beginning of the flooding. However, by far the most productive time for mollusc and fish procurement is when the waters are receding and at low waters in the dry

season (e.g. Boulenger 1901: XXV; Sundström 1972: 17; Stewart 1989: 70, with references).

Collecting fresh *Pila*, *Lanistes*, *Aspatharia* and perhaps *Limicolaria* in a drying out floodplain does not pose particular problems. *Pila* and *Lanistes* will aestivate when their habitats, smaller waterbodies and papyrus swamps, are drying out, while *Aspatharia* are known to survive low river stands by burying themselves in the mud (van Damme 1984: 8,68). *Limicolaria* are partial to well-drained areas and clay-pans along the river (Crowley & Pain 1970) and may have been harvested there. At the edge of the river, empty *Mutela*, *Etheria* and *Aspatharia* shells could be collected all year round.

Fish species such as *Clarias*, *Barbus*, *Labeo*, tilapias, mormyrids and many other species undertake spawning runs when the floodwaters arrive (e.g. Gautier & van Neer 1989: 141-2, with references). For *Lates*, *Bagrus*, *Synodontis* and *Hydrocinus* detailed information on their spawning behaviour is lacking for the (Central Sudanese) Nile and the (lower) Atbara, but observations made elsewhere confirm that they lay their eggs in less deep parts of the main river or in smaller streams that are well-aerated (e.g. Daget 1954: 121, 245, 357). If adult *Lates*, *Bagrus*, *Synodontis* and *Hydrocinus* visit the alluvial plain at all, their stay is of short duration and limited to the deeper parts, i.e. in floodplain channels. When the waters recede adult fish migrate back towards the main waterbody before the juveniles (Gautier & van Neer 1989: 141, 144, with references). The extent and depth of the residual pools will determine which species are able to survive. At first, the number of species present may still be considerable. Molloy (1956: 58-59) notes that in the Southern Sudan, Nile perch (*Lates*), tilapias and a dozen other species were caught in a khor (= seasonal gully) that was drying out in a string of pools. Gradually, when pools become shallower and increasingly more deoxygenated because of evaporation, the species composition will change in favour of fish with a high affinity for dissolved oxygen (*Tilapia*, *Barbus*) or of fish that can breath atmospheric oxygen (*Clarias*; [Gautier & van Neer 1982]).

Aquatic reptiles are not trapped in residual pools since the animals can easily migrate over land. Being carnivorous, however, *Varanus*, *Trionyx*, *Crocodylus* and *Python* are attracted by the concentration of fish and this habit certainly makes them vulnerable to human predation, not the least because they interfere with human fish harvesting. In the present day Nile and Atbara, turtles and monitor are mainly captured with nets, as are python, which are known to swim well (Sweeney 1961: 46-47).

Hérons, storks and the African darter are riverine species, feeding on fish and other aquatic organisms. As in reptiles, these species will frequent the alluvial plain in search of food and may therefore have been killed. Birds of the genera *Numida*, *Coturnix*, *Francolinus* and *Otis* are all adapted to arid environments, but a critical habitat feature appears to be the availability of surface water, especially in the dry season (Urban et al. 1986).

The temporary expansion of a waterbody also initiates a shift in dispersal patterns within the mammalian fauna. With the onset of the rains, certain species will leave the river valley and travel considerable distances or cover large areas in search of food. Other herbivores, however, have much smaller home ranges (*sensu* Jewell 1966), and might essentially be encountered in the same area throughout the year. Some of the frequently hunted ungulates at Abu Darbein, El Damer and Aneibis belong to the latter type. Topi, for example, may move onto the perimeter grasslands as soon as the plain is inundated. Later on they concentrate on the remaining patches of dry ground at the edge of the floodplain (Vesey-Fitzgerald 1960). Bohor reedbeek frequent the channels on the floodplain and stay there during the rains, resorting to areas of shallower flooding. For reasons of food and/or availability of surface water, it is likely that a number of other plant eating species were also met all year round in the early Holocene Nile and Atbara valleys, e.g. cane rat, hippopotamus, warthog, oribi and kob. With the onset of the dry season, game density at the confluence of the Nile and the Atbara can be expected to increase gradually, free water becoming rare in the arid hinterland. Towards the end of the dry season, many herbivore species will make (daily) excursions to and from points with surface water, following certain trails. This is the case in African buffalo, hippopotamus, zebra and kob. These animals are essentially drinkers and will also spend time foraging on the riverine pastures of the open plains. Other ungulates such as topi, bohor reedbeek and eland appear to be shapers by preference and will generally feed on green pasture in the vicinity of trees where they have no access to surface water (Vesey-Fitzgerald 1960).

Although game can be obtained all year round, the foregoing suggests that hunting may be of varying importance throughout the year. Because hunting success generally is related to game density, two periods of intensive hunting can a priori be postulated on the basis of the biological data, namely towards the end of the dry season, when game starts to concentrate in the river valleys, and at high water, when ungulates are packed on the narrow strip between alluvial plain and the arid hinterland. For sub-Saharan Africa there is ample ethnological information on game stalking during the dry season. Descriptions of hunting near waterbodies when flooding is at its maximum are also available in literature. For example in the Bangweulu swamps, the big lechwe (*Kobus leche*) drives take place in April and May when the high water following the rains has packed the lechwe on the southern plains (Brelsford 1946: 129). The game is driven into the water and killed with spears.

Archaeozoological data

The foregoing biological data demonstrate when and where food animals can be most easily obtained by riparian communities. On the basis of the composition of the faunas and size or age distribution within the different animal groups, we will try to evaluate Central Sudanese Mesolithic animal exploitation in terms of season and place of capture.

To separate fish species with a prolonged stay on the alluvial plain from those that frequent the alluvial plain for a short period of the year or do not enter it at all, van Neer (1989) proposed the terms "floodplain dwellers" and "open water forms". If the ratio of "floodplain dwellers" (*Protopterus*, *Polypterus*, *Gymnarchus*, *Barbus*, *Labeo*, *Clarias* and *tilapias*) to "open water forms" (*Hydrocinus*, *Bagrus*, *Synodontis*, *Lates*) is considered, fishing at Abu Darbein focused on the river, whereas at El Damer I and II the floodplain witnessed an intensive exploitation. This is in agreement with the extent of the Early Holocene floodplain near the two sites, i.e. narrow at Abu Darbein, wide at El Damer. At Aneibis there must have been at least a 2 km wide floodplain between the site and the Nile, yet about 60% of the fish taken are open water forms (Peters 1991; 1993; in press). It could be argued that Aneibis represents some kind of dry season (fishing) camp, but its distance from the Nile makes this unlikely: traditionally temporary dry season fishing camps are located very close to the edge of the river (e.g. Sundström 1972: 40).

The size distribution of fish species can be used to deduce more precise information on season and place of capture. Unfortunately, as pointed out by Gautier and van Neer (1989: 143), growth rates of fish are very dependant on local circumstances, and from the size distribution of the fish remains alone it is not always easy or even possible to distinguish among mature animals that came to spawn on the alluvial plain, sexually immature fish that came to the floodplain only to feed, and juveniles that hatched at the beginning of the flood season. An overview of the literature on growth rates of *Clarias* and *Tilapiini* in different bodies of water in sub-Saharan Africa is given by these authors. For the other major fish groups, almost no such data exist for Nilotic populations. For the Niger river, however, data on size of fingerlings and somewhat older individuals are available (Daget 1954). If applicable to our Mesolithic finds, the smallest size class proposed for each group would almost exclusively consist of individuals that are less than one year old.

As said, floodplain fishing was not practised on a large scale at Abu Darbein, and this may account for the absence of fingerlings or juvenile individuals in the ichthyofauna. Although the Atbara river must have been the principal fishing ground, the numerical importance of large Cyprinids and *Clarias* indicate that people also exploited the backwaters for spawning individuals at the beginning of the rainy season.

Fish procurement on the alluvial plain was a major activity at El Damer I. Given the size distribution of the fish, floodplain exploitation witnessed several stages, with spawning individuals (*Barbus*, *Labeo*, *Clarias*) taken at the floods. Fishing in the receding waters is perhaps illustrated by the presence of fingerlings of *Synodontis* and *Lates* in the samples. Fish were also captured in the residual ponds, as can be deduced from the number of small Clariids (20 to 50 cm TL), small Cyprinids (20-40 cm TL) and other species, likely to represent sexually immature fish that came to the floodplain only to feed. Fishing in the main Nile

was practised after the waters receded, the economic important species now being *Synodontis*, *Bagrus* and *Lates*. Some *Protopterus* may have been dug out from their burrows in the mud after the floodplain dried out.

The ichthyofauna of El Damer II reflects a comparable situation as described for El Damer I, be it that for the first time very large Nile perch (*Lates niloticus*; > 140 cm) occur in the samples. Such creatures are confined to the deepest parts of fluvial systems and the exploitation thereof may imply progress in fishing technology (Peters 1991, in press).

Despite an extensive floodplain, which may have been exploited the way the site inhabitants of El Damer did, there is evidence that fishing in the river provided most of the fish at Aneibis. Perhaps floodplain topography altogether differed at the two places, or the flooding phase was shorter, making floodplain procurement less profitable at Aneibis. Judging from the size distribution of the open water forms *Bagrus* and *Lates*, a more intensive exploitation of the deeper facies of the Nile can be considered another alternative to explain the difference observed.

Reptiles have the potential for continual growth throughout their lives, and a comparison between growth rates in recent populations and bone size in fossil assemblages may provide information about age, and hence place and season of capture. Though we noted the presence of infantiles, juveniles and adults among the aquatic reptiles, the comparative collection available did not allow for a more precise evaluation.

Growth rates in bird bones are of limited use to evaluate the season of capture since epiphysional fusion in long bones occurs at an early stage of life, leaving almost no possibility to estimate the age of the animal macroscopically after the skeleton has reached maturity. Fortunately, many birds species undertake annual migrations and their appearance in the faunal record will inform us about the season of capture. Two such species are noted among the bird remains from El Damer II, namely the common quail (*Coturnix coturnix*) and the corn-crake (*Crex crex*). These Palaearctic birds visit North Africa during winter and will frequent the Nile Valley from November to March (Urban et al. 1986).

In mammals, size of long bones and the state of fusion of the epiphyses can be used to age individuals. Unfortunately the fragmentation of the Mesolithic bone material made such an analysis impossible. However, age determination by means of tooth eruption and replacement and attrition of permanent teeth may provide a clue on hunting behaviour in the past (e.g. Klein 1978; Davis 1980). Fossil samples from the Atbara sites turned out too small to be meaningful, except at El Damer II, where a fair number of upper and lower jaws of oribi (MNI = 43) and alcelaphines (MNI = 15) were found. For alcelaphines such as tsessebe (Huntley 1973) and Lichtenstein's hartebeest (Mitchell 1965), the approximate ages at which different teeth erupt are available, and it can be reasonably assumed that they compare well with those of their North African relatives. For oribi, we could not find published information, but conceivably its

eruption scheme would be broadly comparable to that in bovid species of like size and longevity, such as dorcas gazelle (Davis 1980) or Thomson's gazelle (Robinette & Archer 1971). The resulting age distributions for the fossil specimens are given in Fig. 2.

Topi, hartebeest and oribi are seasonal breeders, most offspring being born towards the end of the dry season or after the rains have started (Haltenorth et al. 1979: 47, 72; Smithers 1983: 619, 640). Since the length of the reproductive season decreases with increasing latitude, mainly as a result of differing rainfall and primary productivity (cf. Happold 1987: 304-5), it is to be expected that lambing and calving in Central Sudanese Mesolithic bovid populations was rather restricted in time, perhaps from March to May. If we plot this information against the age distributions obtained, it becomes visible that game stalking must have been a year round activity at El Damer II, a good deal of animals being hunted during the rainy season. Conceivably, this was also the case elsewhere along the Nile and the lower Atbara.

Mesolithic site inhabitation in relation to resource scheduling

As shown, the animal biomass in a riverine environment is related to the annual hydrological cycle of the river, implying a careful scheduling in time and space to maximize the exploitation of these resources. Based on the fauna of El Damer II, the following sequence of food harvesting can be proposed (Fig. 3):

1. With the beginning of the rains or the arrival of the floodwaters, spawning fish are captured in considerable numbers;
2. The alluvial plain being increasingly flooded, fishing becomes difficult because the waters are too turbulent and the fish well dispersed. However, hunting conditions improve as part of the terrestrial fauna will concentrate on the narrow strip between floodplain edge and arid hinterland;
3. As soon as the waters start to recede, fishing on the alluvial plain becomes a major activity;
4. With the increasing exposure of the floodplain, fishing activities will gradually shift towards the main Nile and Atbara. *Pila* snails can now be harvested and lungfish dug out of their burrows. Fowling and hunting will be intensified because the animals start to concentrate along the river;
5. Towards the end of the dry season, people still continue to fish in the main river, but hunting will provide most of the meat since game densities are high and ungulate movements along trails to water points fairly predictable.

Thus at El Damer II a year round exploitation of the catchment can be postulated. Consequently, its occupants must have been far more sedentary than accepted up to now for Mesolithic populations living along the Central Sudanese Nile and the lower Atbara. However, as pointed out by Gautier (1983: 107), site permanence does not exclude resource scheduling by restricted groups abandoning the settlement in certain periods for activities at appreciable distance from the base camp. At El Damer and elsewhere, such excursions are illustrated by the

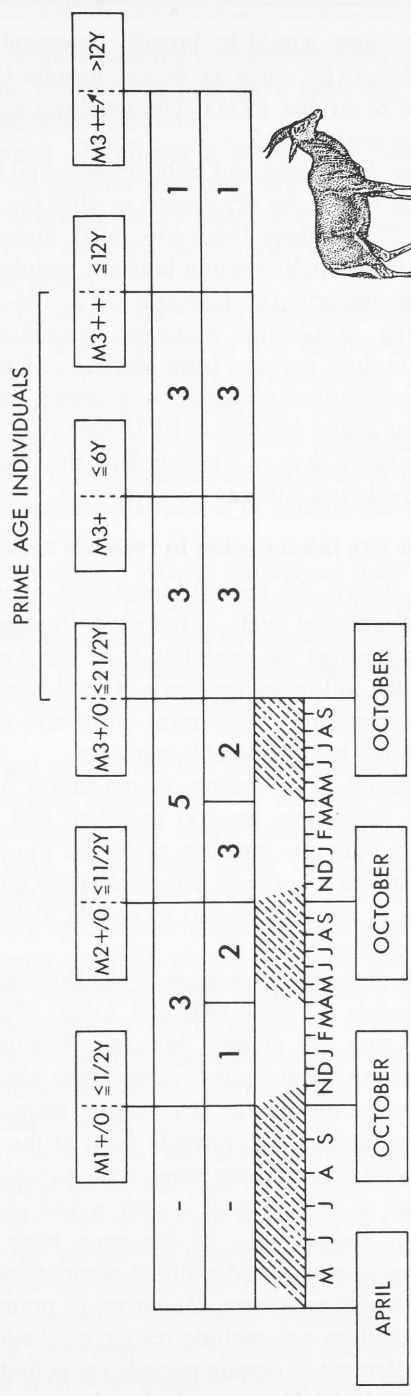
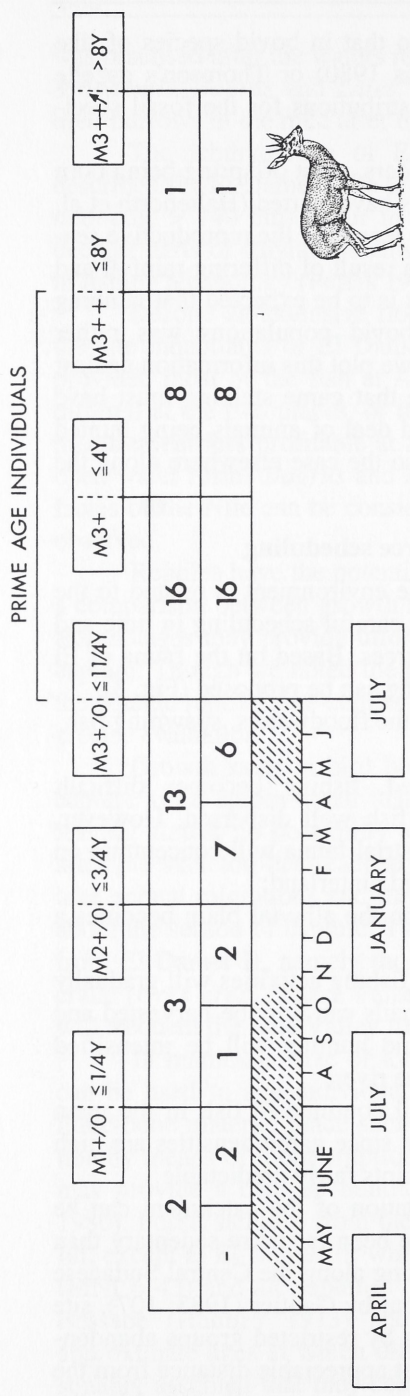


Fig. 2. The number of individuals in the oribi and alcelaphine dental samples from El Damer II according to age class. Age of eruption here is taken to be the age when a tooth starts to exhibit wear on the occlusal surface. Subclasses separate individuals with poor and advanced tooth wear. Dental data are plotted against the (hypothetical) annual rainfall pattern in order to evaluate Mesolithic hunting behaviour in terms of seasonality. For additional discussion, see the text.

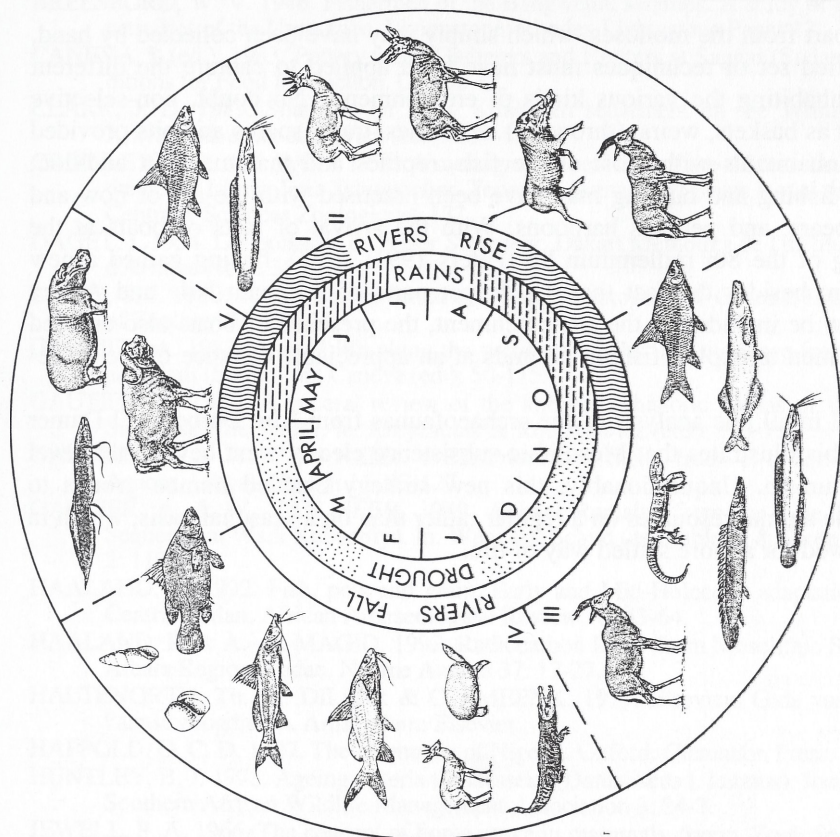


Fig. 3. A model for Mesolithic animal exploitation along the Central Sudanese Nile and the lower Atbara. Five stages are distinguished and roughly illustrated. Species depicted include *Clarias*, *Barbus* (Stage I); *Ourebia*, *Phacochoerus*, *Redunca*, *Damaliscus* (Stage II); *Clarias*, *Mormyrops*, *Polypterus*, *Barbus*, *Damaliscus*, *Varanus* (Stage III); *Crocodylus*, *Trionyx*, *Ourebia*, *Synodontis*, *Bagerus*, *Limicolaria*, *Lates*, *Pila* (Stage IV); *Protopotamus*, *Hippopotamus*, *Syncerus* (Stage V). For additional discussion, see the text.

presence in the faunal record of non-riverine mammals adapted to arid environments, for example dorcas gazelle and barbary sheep.

A settled life style can also be postulated for the other riparian human groups inhabiting the Nile environment, such as the inhabitants of Aneibis, Abu Darbein, or those living above the 6th Cataract, but larger faunal samples are necessary to confirm this.

Concluding remarks

Apart from the molluscs, which simply may have been collected by hand, a diversified set of techniques must have been applied to capture the different species inhabiting the various kinds of environments. No doubt, non-selective gear such as baskets, weirs, (throwing) nets, lines, traps, snares and pits provided the site inhabitants with most of the fish, reptiles and mammals. In addition, selective fishing and hunting may have been practised with the aid of bow and arrow, spears, and perhaps harpoons. With the arrival of rafts or boats at the beginning of the 8th millennium bp (Peters 1991; 1993), fishing gained a new dimension: besides the fact that the deeper parts of the main Nile and Atbara could now be included in the site catchment, the presence of boats also enabled the fishermen to exploit fishing grounds at an appreciable distance of the settlement.

All in all, the analysis of the archaeofaunas from Abu Darbein, El Damer and Aneibis illustrates that Mesolithic subsistence clearly went beyond the level of opportunism. Unquestionably, this new strategy enabled human groups to exploit the animal resources on a regular rather than on a seasonal basis, which in turn allowed for a more settled way of life.

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