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FISH REMAINS FROM LATE PLEISTOCENE AND HOLOCENE ARCHAEOLOGICAL SITES NEAR KHASHM EL GIRBA, SUDAN

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ABSTRACT: Described are the fish remains found in preceramic and ceramic sites along the Atbara in the Khashm el Girba region. The assemblages, ranging in time from some 10000 to 3000 B.P., do not indicate an evolution in the fishing techniques. All the observed differences can be explained in terms of the location of the sites in relation to the surrounding waterbodies.

KEYWORDS: FISH REMAINS, SUDAN, HOLOCENE, LATE PLEISTOCENE

RESUMEN: Se describen los restos de peces procedentes de yacimientos acerámicos y cerámicos a lo largo del Atbara en la región de Khashm el Girba. Las muestras, que cubren un lapso temporal comprendido entre el 10.000-3.000 B.P., no evidencian ningún tipo de evolución de las técnicas de pesca. Todas las diferencias faunísticas pueden, en cambio, explicarse en términos de la situación de cada yacimiento en relación con las masas de agua circundantes.

PALABRAS CLAVE: RESTOS DE PECES, SUDAN, HOLOCENO, PLEISTOCENO TARDIO

INTRODUCTION

The fish remains described in this paper were collected in the Khashm el Girba area during the 1981 and 1982 field seasons conducted by the Joint University of Khartoum/Southern Methodist University Archaeological Project (Marks *et al.*, 1987). More than one hundred Late Pleistocene and Holocene sites were discovered along the Upper Atbara (Figures 1 and 2).

Three main landscape types can be distinguished in the explored area today: the former Atbara floodplain, the "karab" where badland formation occurs, and a steppe environment (Figure 1). Analysis of the mammal remains (Peters, 1986, Marks *et al.* 1987), indicates a transition from dry grassland in the Late Pleistocene to a lightly wooded savannah, with gallery-forest along the Atbara, in the Early Holocene. During the Mid-Holocene period a deterioration of the landscape occurred.

The Atbara is a temporary river the water regime of which was partly altered by the construction of a dam south of Khashm el Girba. Normally, the river was flowing from July to October, but from November to January the flow was greatly reduced and in March to May the Atbara dried up, leaving only some pools of waters (Rzóska, 1976). Data on the present-day fish fauna or on the effects of the dam on this fauna, were not found in the literature, making a comparison with the prehistoric assemblages difficult.

Some 10 km north of Khashm el Girba the Atbara makes a 9° turn to the east and then returns to its generally northerly direction 7 km further (Figure 1). This part of the river still shows an earlier meander channel, slightly north of but parallel to the present active river channel. Most of the sites which have yielded fish remains lie just north of the old meander in earlier Atbara silts and gravel bars. The approximate center of these fluvial deposits is at about 2 km west of the present, northward flowing Atbara and reaches a maximum elevation of some 12 m above the floodplain (Figure 2). A

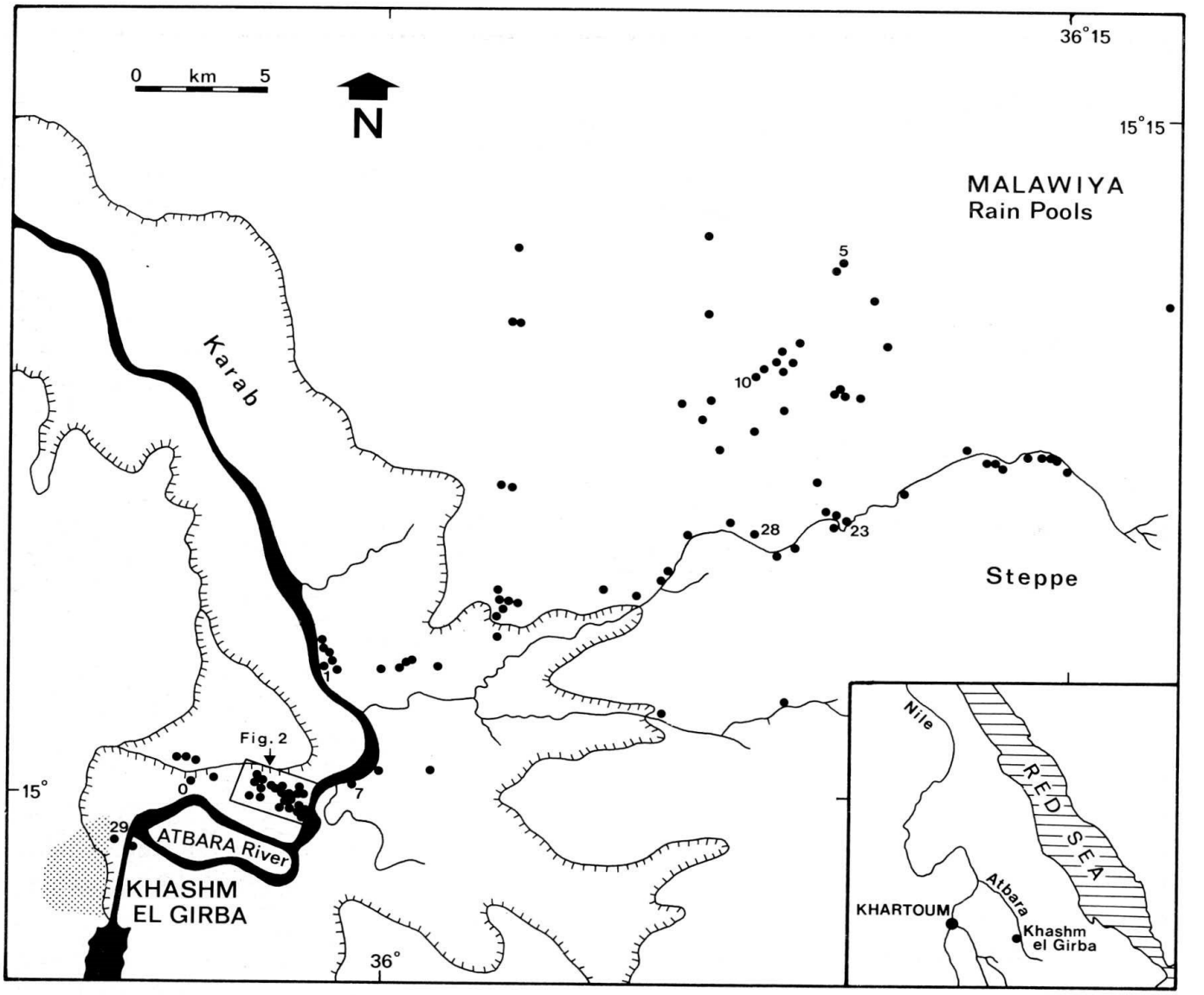

FIGURE 1. Overview of the Khashm el Girba area. The sites are indicated as dots of which only the numbered ones have yielded fish remains (redrawn after Marks *et al.*, 1987; Peters, 1986).

small basin-like depression of about one square km occurs at this elevation and holds more moisture than the surrounding sediments. Preceramic sites were found at the eastern edge of the depression (i.e. KG-15, KG-73) and eastwards on the gentle slope which leads down to the modern floodplain (i.e. KG-68). Radiocarbon dates place the occupation around 10 000 bp for KG-15 and around 7700 bp for KG-68. The Pre-Saroba site KG-14 lies on an old levee at some 200 m off the present Atbara. According to a radiocarbon date this site was inhabited at about 6200 bp. From the Saroba-phase only KG-10 yielded fish remains. This site lies at some 20 km east of the Atbara and was dated to some 5600 bp. Only a few fish bones from the Saroba/Kassala transitional phase were found, namely at site KG-28 lying at some 15 km east of the Atbara and dated to approximately 5200 bp. Finally, a series of sites with fish remains belong to the Kassala phase dated between 4700 to 2700 bp. These settlements are situated within a distance of a few hundred metres of the main river, with the exception of KG-23 and KG-5 lying at some 18 and 30 km east of the Atbara.

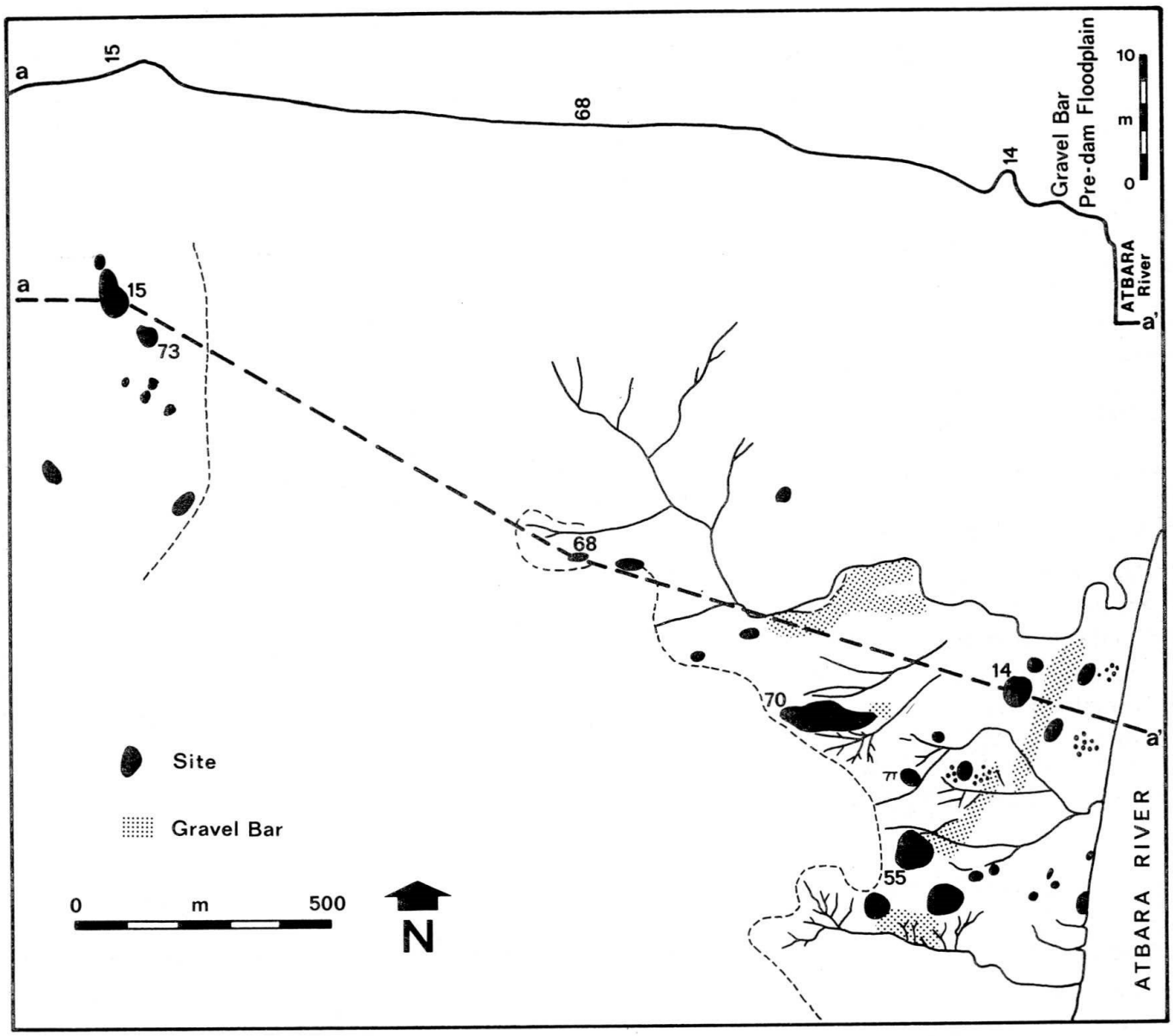

FIGURE 2. Enlarged detail of an area investigated west of the Atbara. The numbered black spots correspond to sites with fish remains. The upper section shows the elevational changes along the transect (after Marks *et al.*, 1987; Peters, 1986).

DESCRIPTION OF THE FINDS

Table 1 summarizes the fragment counts of the fish bones found at the different Khashm el Girba sites. The intraskeletal distribution of the well represented fish groups is given in Tables 2 to 6. As far as the state of preservation allowed it, the sizes of the fish corresponding to the bones were estimated. The results of these determinations are given in tabular form for the most common groups (Tables 7 to 12) and are simply mentioned in the text for the rare species.

PHASE	LATE PRECERAMIC					PRE-SAROBA				SAR	SAR/KAS		KASSALA (EARLY) → KASSALA (LATE)							
SITE	KG-15	KG-70	KG-73A	KG-68		KG-55		KG-14		KG-10	KG-28A	KG-28B	KG-1	KG-7	KG-23C	KG-29N		KG-29S	KG-0	KG-5
FISH				S	E	S	E	S	E							S	E			
Protopterus aethiopicus	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-
Polypterus sp.	-	-	-	-	9	-	-	1	11	-	-	-	-	-	-	-	-	-	-	-
Mormyridae indet.	-	-	-	-	1	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-
Cyprinidae	-	-	-	-	29	-	-	21	240	-	-	-	1	-	1	-	-	-	-	-
Bagrus sp.	-	-	-	-	1	1	-	1	13	-	-	-	-	-	-	-	-	-	-	-
Clariidae	-	1	-	76	364	-	12	8	86	-	-	1	-	3	5	1	3	1	30	1
Synodontis sp.	2	-	3	-	4	-	2	35	258	-	1	1	-	7	-	-	-	15	63	-
Lates niloticus	-	-	-	2	52	-	2	80	294	-	-	-	-	9	1	-	4	8	1	-
Tilapiini	-	-	-	-	36	-	-	8	103	-	-	-	-	-	-	-	-	-	1	-
Percomorphi indet.	-	-	-	-	6	-	1	-	29	-	-	-	-	-	-	-	-	2	-	-
Tetraodon lineatus	-	-	-	-	-	-	-	-	5	-	-	-	1	1	-	-	-	-	-	-
Total identifiable	**2**	**1**	**3**	**78**	**502**	**1**	**17**	**154**	**1041**	**2**	**1**	**2**	**2**	**20**	**9**	**1**	**7**	**26**	**95**	**1**

TABLE 1. Fish remains from Khashm el Girba. SAR= SAROBA; SAR/KAS= SAROBA/KASSALA.

	KG-68	KG-14/S	KG-14	KG-1	KG-23C
Syncranium + pectoral girdle	-	-	-	-	-
Precaudal vertebrae	4	9	71	-	-
Caudal vertebrae	8	5	55	1	-
Precaudal or caudal vertebrae	12	7	144	-	1
Dorsal fin ray	1	-	-	-	-
Dorsal pterygiophore	4	-	-	-	-

TABLE 2. Intraskeletal distributions for Cyprinidae (*Barbus* and *Labeo*).

	KG-68/S	KG-68	KG-14/S	KG-14
Skull roof	74	146	7	68
Other syncranium elements	-	96	-	6
Pectoral girdle	1	76	-	4
Precaudal vertebrae	1	25	1	7
Caudal vertebrae	-	19	-	1
Precaudal or caudal vertebrae	-	2	-	-

TABLE 3. Intraskeletal distributions for Clariidae.

Protopterus aethiopicus

Remains of lungfish were only found at sites KG-10 and KG-23. They are represented by toothplates of individuals ranging in size from 30 to 60 cm total length. Other skeletal parts of this fish are only exceptionnaly encountered on archaeological sites (e.g. Koyom; Rivallain & Van Neer, 1983, 1984); vertebrae normally do not preserve as their centra are not ossified. The remains are assigned to *P. aethiopicus* on the basis of the present-day distribution (El-Hakeem 1970).

	KG-15	KG-68	KG-73A	KG-14/S	KG-14	KG-28A	KG-28B	KG-7	KG-29S	KG-O
Skull roof (including nuchal shield)	-	-	-	-	40	-	-	-	-	19
Pectoral girdle	1	2	3	38	159	1	1	7	9	32
Dorsal spines	-	2	-	7	30	-	-	-	4	12
Pectoral or dorsal spine	1	-	-	-	14	-	-	-	-	-
Precaudal vertebrae	-	-	-	-	4	-	-	-	-	-
Caudal vertebrae	-	-	-	-	10	-	-	-	2	-
Precaudal or caudal vertebrae	-	-	-	-	1	-	-	-	-	-

TABLE 4. Intraskeletal distribution for *Synodontis*.

	KG-68/S	KG-68	KG-14/S	KG-14	KG-55	KG-7	KG-23C	KG-29N	KG-29S	KG-O
Syncranium + pectoral girdle	-	13	4	52	-	2	-	-	1	-
Precaudal vertebrae	2	6	51	80	1	1	-	3	-	1
Caudal vertebrae	-	7	7	48	-	1	-	-	1	-
Precaudal or caudal vertebrae	-	14	9	78	-	2	-	-	1	-
Ribs	-	-	-	1	-	-	-	-	-	-
Pelvic girdle	-	-	-	2	-	-	-	-	-	-
Ventral finray	-	-	-	1	1	-	-	-	-	-
Dorsal finray	-	8	7	21	-	-	1	-	5	-
Dorsal pterygiophore	-	1	1	1	-	-	-	-	-	-
Anal finray	-	-	-	2	-	2	-	1	-	-
Anal pterygiophore	-	3	1	8	-	1	-	-	-	-

TABLE 5. Intraskeletal distribution for *Lates*.

	KG-68	KG-14S	KG-14	KG-O
Syncranium + pectoral girdle	4	1	-	-
Precaudal vertebrae	7	3	34	-
Caudal vertebrae	4	3	23	-
Precaudal or caudal vertebrae	-	-	2	-
Pelvic girdle	-	-	-	-
Ventral finray	1	-	6	-
Dorsal finray	11	1	31	-
Dorsal pterygiophore	2	-	-	-
Anal finray	1	-	4	-
Anal pterygiophore	6	-	3	-

TABLE 6. Intraskeletal distribution for Tilapiini.

Polypterus sp.

Sites KG-68 and KG-14 yielded vertebrae of individuals with sizes estimated at some 40 to more than 60 cm standard length (S.L.). The vertebrae are easily recognizable by the general shape of their centrum and especially by the typical neural canal. Three species of *Polypterus* occur in the Sudan today : *P. bichir*, *P. endlicheri* and *P. senegalus*. According to Sandon (1950) the latter species does not grow larger than 50 cm S.L.

MORMYRIDAE

Three vertebrae of elephant-snout fish were identified; they have rather elongated centra with an external lateral morphology typical for the family. The size of the individuals corresponding to the vertebrae (ranging from 40 to 60 cm S.L.) excludes smaller members of the mormyrid family (*Gnathonemus*, *Marcusenius*, *Petrocephalus*).

CYPRINIDAE

Of the 292 fragments of cyprinids only 5 elements (1 dorsal fin ray and 4 dorsal pterygiophores) do not belong to the vertebral column. The lateral morphology of the vertebral centra often allows a distinction between *Labeo* and *Barbus*, the largest cyprinids in Sudan today. In *Labeo* the longitudinal strut, and often also other parts of the vertebral centrum show more trabeculae than in *Barbus*. The sediment crust adhering to the vertebral centra found at the Khashm et Girba sites, often masks the features necessary for a generic identification. It proved to be difficult to remove enough of the sediment, either mechanically or chemically, without destroying the vertebrae. Among the centra that were sufficiently cleaned some *Barbus* as well as *Labeo* were recognized, but the precise ratio could not be established.

Bagrus

Only one head element was found, an articular that could be attributed to *Bagrus bajad* with the aid of the diagnostic characters established by Boessneck & Driesch (1982). The external morphology of the vertebral centra allowed an identification at generic level only.

CLARIIDAE

The clariid family is represented today in Sudan by two genera, *Clarias* and *Heterobranchus*, the osteological differences of which have been described by Driesch (1983). Of the 55 proximal pectoral spine fragments, only one (from KG-O) was attributable to *Heterobranchus*; all the others are from *Clarias* as it is the case for two well preserved dentaries. Fifteen vomera were well preserved and allow a specific identification. Vomerine toothplates of *Clarias* and *Heterobranchus* can be distinguished by the smaller teeth and hence by the smaller dental alveoli of *Heterobranchus* (Greenwood, 1959:39). The 15 toothplates found at the Khashm el Girba sites all *Clarias* have wide alveoli and in three cases teeth typical of were preserved; the overall shape of the plates is typical of *C. gariepinus* (cf. Figure 6.2. in Gautier & Van Neer, 1989).

Synodontis

Synodontis is a well represented catfish at the Khashm el Girba sites. The identified bones are mostly pectoral and dorsal spines, skull roof fragments and humeral processes. Specific identification is hampered by the great number of *Synodontis* species (11) living in Sudanese waters today (Sandon, 1950).

Precise data on the distribution in the Atbara seem not to be available. The river seems not to have been explored sufficiently yet, judging from the revision of Poll (1971) in which not a single locality on the Atbara is mentioned. It is, however, likely that the Atbara species will occur in the

Nile. *Synodontis serratus* seems to be well represented as indicated by the many dorsal spines with a pronounced serration on the anterior side: 58% of the dorsal spines show this feature. *S. clarias* and *S. sorex* also show serration on the anterior side of the dorsal spine but, judging from the figures in Poll (1971), it is never as pronounced as in *S. serratus*. The humeral process is another element allowing specific identification although misidentification may occur as a result of the intraspecific variation and changes in shape as the animal grows. Two humeral processes could be identified with great certainty : one as *S. schall*, another one as *S. serratus*. Among the skull roof fragments of *Synodontis*, two different types of external ornamentation were observed: a fine tubercular pattern that is found in most *Synodontis* species and a more reticulate pattern. The latter is typical of the whole skull roof and of the nuchal shield of *S. serratus*. In the other species seen so far, this kind of ornamentation is sometimes present in the posterior head region (nuchal shield).

Remarkable is that at site KG-O all pectoral spines are still in articulation with the pectoral girdle. This indicates a rapid burial that occurred before decay caused the separation of the condylar cavity formed by cleithrum and coracoid.

PERCOMORPHI (*Lates niloticus* AND TILAPIINI)

Remains of Nile perch (a Centropomidae) and Tilapia (a Cichlidae) are very well represented in the ichthyofaunas from the Khashm el Girba area. Distinction between both fish is rather difficult on the fin rays and their supporting elements (pterygiophores) (Figure 6.3 in Gautier & Van Neer, 1989; Van Neer in preparation). In previous studies, these elements therefore are sometimes labeled as unidentified Percomorphi. If, as is done here, these bones are precicely identified, a shift in the relative frequencies can be observed: Tilapia become numerically more important as their total number of fin rays is much higher than in Lates. The unidentified Percomorphi mentioned in Table 1 represent distal parts of fin spines and pterygiophores on which diagnostic features are lacking.

Tetraodon lineatus

Five vertebrae and a dentary of individuals of some 25 cm S.L. of *Tetraodon* were found.

SIZE CLASSES OF THE FISH

Absolute and relative frequencies of the fragments that could be assigned to a certain size class are given in Tables 2 to 6. It is obvious that smaller size classes are systematically underrepresented. Different explanations for this distribution are possible: fishing may have been concentrated on larger individuals, differential preservation may have resulted in the destruction of the smaller pieces, or sampling (4 mm mesh sieves and hand picking) may have been biased towards larger fragments. The low number of unidentifiable fish remains, as well as the absence of certain skeletal elements normally found in subfossil ichthyofaunas (see next paragraph) seem to indicate that a certain sampling bias has occurred.

INTRASKELETAL DISTRIBUTION

The skeletal elements by which the different fish are represented are given in Tables 7 to 12. Various elements are lumped into rough units that do not necessarily correspond to anatomical entities used in comparative anatomy, but were choosen in such a way that they may reflect effects of butchery (e.g. decapitation, removal of fins) or further preparation, conservation or consumption of the fish. The remarks made in the foregoing paragraph with respect to the large average size of the representated fauna, imply that care must be taken when interpreting certain patterns in the intraskeletal distributions.

	small (< 15 cm)	medium (15 - 30 cm)	large (30 - 60 cm)	very large (> 60 cm)	sample size
KG-68	-	-	84.6	15.4	13
KG-14S	-	-	54.5	45.5	11
KG-14	-	-	73.1	26.9	134
KG-1	-	-	-	100	1
KG-23C	-	-	100	-	1

TABLE 7. Percentage frequencies of the different size classes in Cyprinidae.

	small (< 25 cm)	medium (25 - 50 cm)	large (50 - 75 cm)	very large (> 75 cm)	sample size
KG-68	-	-	100	-	1
KG-14S	-	-	-	100	1
KG-14	-	16.7	83.3	-	12
KG-55/S	-	-	-	100	1

TABLE 8. Percentage frequencies of the different size classes in *Bagrus*.

	small (< 25 cm)	medium (25 - 50 cm)	large (50 - 75 cm)	very large (> 75 cm)	sample size
KG-68/S	-	100	-	-	2
KG-68	0.6	68.4	30.4	0.6	174
KG-55	-	-	-	100	2
KG-23C	-	100	-	-	2
KG-29	-	-	50	50	2
KG-O	-	-	12.5	87.5	8

TABLE 9. Percentage frequencies of the different size classes in Clariidae.

	small (< 15 cm)	medium (15 - 30 cm)	large (30 - 45 cm)	very large (> 45 cm)	sample size
KG-68	-	100	-	-	2
KG-14/S	-	18.2	81.8	-	33
KG-14	-	30.0	67.8	2.2	90
KG-28A	-	100	-	-	1
KG-28B	-	-	100	-	1
KG-7	66.8	16.6	16.6	-	6
KG-29S	50	25	25	-	12
KG-O	-	57.1	42.9	-	14

TABLE 10. Percentage frequencies of the different size classes in *Synodontis*.

	small (< 25 cm)	medium (25 - 50 cm)	large (50 - 100 cm)	very large (> 100 cm)	sample size
KG-68/S	-	-	-	100	2
KG-68	15.4	33.3	38.5	12.8	39
KG-71	-	100	-	-	1
KG-14/S	-	47.2	48.6	4.2	72
KG-14	-	43.0	54.9	2.1	286
KG-55	-	-	-	100	1
KG-7	-	60	40	-	5
KG-29N	-	-	75	25	4
KG-29S	-	14.3	85.7	-	7

TABLE 11. Percentage frequencies of the different size classes in *Lates*.

	small (< 15 cm)	medium (15 - 30 cm)	large (30 - 45 cm)	very large (> 45 cm)	sample size
KG-68	-	73.5	23.5	3.0	34
KG-14	-	18.6	62.8	18.6	97
KG-O	-	-	-	100	1

TABLE 12. Percentage frequencies of the different size classes in Tilapiini.

Four trends are observed in the tables : the caudal vertebrae of *Lates* are underrepresented in comparison with the precaudal ones; syncranium and pectoral girdle elements are heavily underrepresented for tilapia and even completely lacking for the cyprinids; *Synodontis* skull roof fragments are underrepresented (absent) in the surface collection of KG-14; vertebrae of Clariidae and *Synodontis* are rare. The underrepresentation of the caudal vertebrae of *Lates* is taken as a result of lesser preservation chances. The centra of the caudal vertebrae are less robustly built; in particular

their longitudinal strut is very narrow. The absence of cranial remains of cyprinids and the low number of tilapia head bones can not be unequivocally explained. Maybe it is a combined effect of differential preservation, sampling bias, lack of or invisibility of diagnostic features on the encrusted flat fish bones. The absence of skull roof fragments from *Synodontis* was only observed at the surface of site KG-14. Explanations may be incomplete hand picking of the surface material or vertical movements of certain elements. The underrepresentation of *Synodontis* and clariid vertebrae, finally, is considered as a result of differential preservation. At the Wadi Kubbaniya sites there is evidence for this factor being involved, rather than decapitation, preparation and subsequent removal of fish bodies (Van Neer, 1986).

DISCUSSION AND CONCLUSIONS

The discussion will be concentrated on sites KG-68, KG-14 and KG-0, the fish bone samples from the other localities being too small. This does not necessarily mean that fishing was of minor importance at those sites, since other vertebrate remains also seem to be badly preserved.

For the interpretation of the ichthyofauna it is important to consider the behavior of the fish in relation to the water regime of the Atbara. During the yearly inundation of the floodplain, adult fish living in the main river will migrate laterally to spawn. Only a few genera are said to seldom leave the main channel (*Lates* and *Hydrocynus*); if they enter the floodplain at all, they occur only on those places where water is sufficiently oxygenated. The lateral migration is explained in terms of availability of food and shelter against predation for the young. When the water level drops, adult fish as well as many young migrate back to the main river. Depending on the local geomorphologic situation more or less extensive residual pools can persist on the floodplain. The species living in these backwaters can differ from place to place and are related to factors such as oxygen and carbon dioxide tensions and salinity. In general, it can be said that, the more extreme the living conditions are, the less species occur. In very shallow water clariids and lungfish are the only fishes that are able to survive, thanks to their accessory respiratory organs. Of the genera that have gills only for breathing, tilapia and cyprinids seem to require the lowest oxygen tensions and therefore may also live in not too shallow residual pools. *Bagrus*, *Lates*, and *Synodontis* can be considered as open water species. *Lates* in particular seems to prefer well oxygenated water. The oxygen requirements of *Bagrus* and *Synodontis* are lower, especially young *Synodontis* which are able to survive on alluvial plains.

As the dry season continued in the Khashm el Girba area, the floodplain will have dried up completely and even the river itself may have stopped flowing. Today large isolated waterbodies are formed in the riverbed during the dry season, but it is difficult to know if this was also the case during the period considered here. The fact that *Lates* is present in the fossil assemblage indicates that strong deoxygenation did not occur in every part of the river system. At least certain parts must have remained sufficiently deep and oxygenated. The fact that the present-day ichthyofauna has not been described makes it difficult to compare with the past situation. The hydrographic situation may have changed also during the 7000 years considered here. Nowadays the northerly meander is dried up, but it may have been an active part of the river or maybe a seasonally cut off meander retaining a lot of fish during the dry season.

The percentage frequencies in Table 13 can be explained by the location of the different sites in relation to the Atbara river system rather than in terms of changing fishing techniques. Of the three sites that yielded large fish bone samples, KG-68 has the highest percentage of clariids. This probably is related to the fact that the site is lying far away from the main river (1100 m westward of the main channel and some 2 km of the southern bend). The catfish bones may come from animals captured at the beginning of the floods when the adults seek shallow marginal places to spawn (spawning run through the temporary tributary river). When the waters receded, catfish and other species, returning to the main channel, could be captured. If residual pools were formed on the floodplain, catfish may also have been taken from them later within the year. Site KG-68 lies close to a large depression that may have contained water for a considerable part of the year, if not year round. Site KG-68 yielded 9,3% *Lates* bones indicating that fishing may have been practised in deep water as well. These Nile perch may have been captured in the main channel, or eventually in the alluvial plain, if we assume that the water had been sufficiently deep and well oxygenated. In both cases techniques for fishing in open water must have been known. The presence of *Etheria* at site KG-68 indicates that the main channel was exploited and it seems likely that the Nile perch were also taken from there.

	Clariidae	Cyprinidae	Tilapia	Bagrus	Synodontis	Lates	Others
KG-68	75.9	5.0	6.2	0.2	0.7	9.3	2.7
KG-14	7.9	21.8	9.3	1.2	24.5	31.3	4.0
KG-O	31.6	-	1.0	-	66.4	1.0	-

TABLE 13. Percentage frequencies of the most common fish at sites KG-68, KG-14 and KG-0.

Site KG-14 is located some 200 m west of the present-day main channel of the Atbara and lies on an elevation representing an old levee. Striking differences with KG-68 in the species composition is the low number of catfish remains and the high contribution of *Lates*, *Synodontis* and cyprinids. Because of the location of the site, it is likely that most of the fish were captured in the main channel. This may explain the high percentage of *Lates* and of large *Synodontis*, as well as the low percentage of clariids.

Site KG-0 lies at some 500 m north of the east-west oriented part of the Atbara. The site is characterized by a higher percentage of clariids than KG-14. Noteworthy is the high percentage of *Synodontis* and the near absence of other fish. This may be an artifact due to small sample size or may reflect certain microenvironmental conditions. Another possibility is the existence of a specialised fishing technique.

The only sites that have yielded lungfish (*Protopterus*) remains are KG-10 and KG-23, lying at some 20 and 18 km respectively off the Atbara. Those areas received water only during restricted periods of the year, allowing the survival of only well adapted fishes such as *Protopterus*, which can burrow in the mud and aestivate.

Fishing equipment such as harpoons, net sinkers or hooks are not preserved at the Khashm el Girba sites. The high diversity of species, however, indicates that all parts of the river, including the

main channel, were exploited. The presence of large *Lates* at site KG-68 dated to some 7700 bp indicates that the necessary technology for fishing in deep water had already developed by that time. In Upper Egypt (Elkab) and in the Khartoum area (Early Khartoum sites) it is also from around 8000 bp and onwards that *Lates* is regularly found in the fish bone samples (Gautier & Van Neer, 1989: 153; Van Neer, in press).

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