BRONZE AGE FISH REMAINS FROM SIDON

Archaeology & History in the Lebanon Issue Twenty Four: Winter 2006, Pp. 86-95.

WIM VAN NEER

Acknowledgements

This text presents research results of the Interuniversity Attraction Poles Programme - Belgian Science Policy. Wim Wouter's (RBINSc) help during the identification of the material is greatfully acknowledged.

In this contribution the fish remains described are those thus far retrieved during the 1998-2003 British Museum excavations at the ancient city of Sidon. The material consists mainly of hand-collected bones from occupation layers dated to the Early, Middle and Late Bronze Age. In addition, some fish remains are available from Iron Age levels and from thirteen Middle Bronze Age burials. Finally, two samples have been analysed that were collected through sieving the content of two Late Bronze Age jars. Attention will be paid to the type of fish species represented through time, their meaning in terms of diet, ritual/religion, exploited fishing grounds and trade.

A total of 961 fish remains were analysed of which 504 were identifiable after comparison with the reference collection of modern fish skeletons housed at the Royal Belgian Institute of Natural Sciences (Brussels). The body size of the fish, corresponding to the individual bones, was reconstructed by direct comparison with modern specimens of known length. The size of the bony fish was expressed in centimetres standard length (SL), i.e. the distance of the tip of the snout to the base of the tail. Body sizes of the sharks are total lengths (TL). An overview of the finds is given in Tables 1 to 3. These find numbers include the specimens that were mentioned in a review article (Van Neer *et al.*, 2005) at a time when only a smaller amount of material was available for analysis.

Fish remains in the occupation layers

The occupation layers have yielded thus far 260 fish bones which are unevenly spread over the various time periods, with the largest amount found in stratum 6 corresponding to the EB III B (Table 1). The number of fish remains is low in the other EB III contexts and the same is true for the EB II strata 3 and 4, and for the Iron Age. Besides bones from Bronze Age and Iron Age contexts, there is also an assemblage that represents a mixture of Late Bronze and Iron Age material. Given the small average sample size of the various temporal assemblages, an evaluation of possible diachronic changes will need to be restricted to a more qualitative level. Furthermore it should be noted that the recovery method involved only hand-collecting and that therefore the species spectrum may be biased towards the larger taxa.

The most frequently represented fish taxa are sharks, groupers, carangids and sparids. The shark remains include only vertebral centra of large individuals of porbeagle (*Lamna nasus*) and hammerhead shark (*Sphyrna* sp.).

The exact reconstruction of the body length on the basis of such vertebrae is difficult because, unlike in bony fish, there is little variation in the morphology of these elements along the vertebral column. This, combined with the fact that vertebral size varies with the position in the axial skeleton within one individual, only allows an accurate estimation of a minimum size. Both the porbeagle and the hammerhead sharks that were landed at Sidon were animals measuring at least one and a half metre TL, some individuals even exceeded a length of 2.5 metre and may have reached sizes of up to 3 m TL. The abundance of such large specimens indicates that off-shore fishing was already well-developed and the same is shown by the presence of large-sized carangids. The remains of greater amberjack (*Seriola dumerili*) found in Early Bronze through Late Bronze Age levels are from individuals ranging in size between 80-90 cm SL and 120-130 cm SL. These fish are typical open water animals, although they occasionally enter coastal bays. Also the tunnids are typical open water species and the specimens represented at Sidon are again very large. The two *Euthynnus* remains are from individuals measuring 100-110 cm SL and 120-130 cm SL respectively and for *Thunnus* the following reconstructed lengths were obtained: 110-120 cm SL, 110-120 cm SL, 170-180 cm SL and about 200 cm SL. Besides the aforementioned fish, there are a number of taxa that are typical inhabitants of coastal, inshore waters. The best represented families are the Serranidae (groupers) and the Sparidae (seabreams). Among the groupers reconstructed sizes vary between 20-30 cm SL and 80-90 cm SL, with the majority of the remains belonging to fish measuring between 30 and 70 cm SL. No decrease in size is seen through time in the Sidon assemblages that could indicate a possible effect of over-exploitation, but the fact that relatively few large specimens are observed from the EB II period onwards seems to suggest that already in previous periods heavy coastal fishing may have been carried out. In more pristine situations, such as Neolithic Cyprus, groupers were found that largely exceed the maximum size generally accepted for these fish (Desse & Desse-Berset 2003). Among the sparids, no really large individuals are encountered either: most reconstructed sizes are between 20-30 and 30-40 cm SL. Sparids, and especially *Sparus aurata*, are known to enter estuaries and the exploitation of this environment may also have yielded the mullets (Mugilidae) and at least part of the meagre (*Argyrosomus regius*). Of the latter species both small specimens (20-25 and 30-40 cm SL) and larger individuals (two fish between 80 and 100 cm SL) were found. Juveniles and subadults enter estuaries and coastal lagoons, whereas adults congregate inshore during spawning in spring and summer. The mullets are represented by a specimen of about 50 cm SL and by two remains of fish measuring between 35 and 40 cm SL. At least four mugilid species live along the Mediterranean shores of Lebanon and they are all known to seasonally enter rivers. The grey triggerfish (*Balistes capriscus*) finally, is an inhabitant of bays, harbours, lagoons, and seaward reefs.

Besides the marine fish there is also a freshwater component in the ichthyofauna of Sidon. Two of these taxa, the bagrid catfish (*Bagrus sp.*) and the Nile perch (*Lates niloticus*), are certainly imports from Egypt. The single bagrid

bone, a precaudal vertebra of a fish measuring 80-90 cm SL, was found in a Middle Bronze Age context. A total of 9 Nile perch bones occur. The oldest securely dated find of Nile perch is a precaudal vertebra belonging to a fish of 70-80 cm SL from a Middle Bronze Age IIB context. In the Late Bronze Age levels a single second precaudal vertebra occurs of a Nile perch measuring 90-100 cm SL and a precaudal vertebra of an individual of 140-150 cm SL was found in an Iron Age context. Finally, six vertebrae of this species were found in layers comprising a mixture of Late Bronze Age and Iron Age material. All these fish were also of large size: standard lengths vary between 80-90 and 100-110 cm SL. In the Iron Age levels, two remains occur of *Clarias* sp., an additional freshwater catfish. Both finds are precaudal vertebrae belonging to individuals of 50-60 cm SL and about 100 cm SL, respectively. Possibly these fish are also imports from Egypt, but in the Levant *Clarias gariepinus* occurs naturally as well. It is therefore not excluded that these remains represent fish that were locally captured in one of the rivers north or south of Sidon (e.g., Awali, Sainiq, Zahrani, Litani), but a provenance from more distant coastal rivers or from the Jordan basin also belongs to the possibilities.

Fish bones from two Late Bronze Age jars

In Area Ic trench 3 a deposit was found of two Late Bronze Age jars with one jar found within the other. They contained only mammal and fish bones, possibly representing the remains of a single meal. The content was sieved with a 1 mm mesh and this explains why smaller remains were recovered than in the other contexts from the site. The mammal bones include mainly remains of all body parts of several individuals of cattle and sheep (Vila pers. communication). Sparids and mullets are the major fish taxa represented in the jars (Table 2). The reconstructed lengths of the mullets vary between 10-20 and 30-40 cm SL. In jar 1 the smallest size class is represented by 28 specimens and in addition there are 10 remains from fish measuring 20-30 cm SL and 3 between 30 and 40 cm SL. In the other jar, 3 specimens occur of 10-20 cm SL and 5 of between 20 and 30 cm SL. The majority of the remains are vertebrae, but cranial and pectoral girdle elements are present as well. Also the sparid bones consist of vertebrae and cranial elements. The latter include a few diagnostic bones indicating the presence of gilthead seabream (*Sparus aurata*) of 10-20 and 20-30 cm SL. The overall size distribution of the sparids is as follows for jar 1: 11 specimens of 5-10 cm SL, 15 of 10-20 cm SL and 5 specimens of 20-30 cm SL. In the other jar sparids of 5-10 cm are more numerous (4 specimens) than fish of 10-20 cm SL (2 specimens) or 20-30 cm SL (1 specimen). The variation in size and the lack of evidence for partial or more or less complete skeletons seems to indicate that the vessels were probably not storage containers for complete fish. The same remark is valid for the mullets and for the other, less abundant fish taxa in the jars. Both vessels yielded clupeid remains, mainly vertebrae, of fish measuring between 10 and 20 cm SL. Although these bones were not diagnostic enough to permit a more precise identification, these finds are relevant since they show that exploitation of pelagic schooling fish existed as well. All the other fish taxa found in the jars are represented by a few bones

only, but these remains are interesting since the majority of the species was not found elsewhere at the site. Besides two caudal vertebrae of small (20-30 cm SL) carangids, a caudal and a precaudal vertebra occur of barracuda (*Sphyraena barracuda*) measuring also 20-30 cm SL. The parrotfish is another marine species that has only been found thus far in the jars. A caudal vertebra and an inferior pharyngeal bone both belong to fish that were between 20 and 30 cm SL. The pharyngeal bone is typical of *Sparisoma cretense*, the only parrotfish living in the Mediterranean. This indicates that this fish represents local marine catch and not an import from the Red Sea where *Sparisoma cretense* does not occur, but where several other parrotfish taxa are found. Finally, jar 1 also yielded a palatine of a tilapia (Tilapiini indet.) of 20-30 cm SL. The only tilapia species that is presently found in Lebanon is *Tilapia zillii*, an African species whose distribution extends into the Levant as far north as the Litani basin (Krupp 1987). That river is located at about 30 km south of Sidon, but it is not excluded that the bone find is derived from one of the other African tilapia species that are also found in the Jordan basin or in the coastal rivers of the Palestinian ichthyofaunal province. However, an import from an even farther region is possible as well. Tilapia may have been brought in as dried or smoked fish from Egypt, together with the other Nilotic species found at the site from the Middle Bronze Age onwards.

Fish bones in the burials

Fish remains have been found in at least 13 of the tombs thus far excavated (Table 3). Eleven of them can be attributed to the various phases of the Middle Bronze Age (cf. Doumet-Serhal 2003, 9-15). Burial 38 could not be exactly dated because it was disturbed or even re-deposited during the Iron Age. Burial 51 is a constructed grave that was partially disturbed by a later jar burial 49 belonging to phase 3, and can therefore not be dated precisely either (levels 1, 2 or 3, see Doumet-Serhal in this issue p. 36). In nine of the burials the number of fish remains was very low (between 1 and 6 bones) possibly indicating that they may not represent food offerings. Instead, these isolated fish bones could correspond to residual material that was already present in the sediment at the time that the graves were dug in earlier occupation levels. However, in the case of burial 37 and burial 51, it is clear that the bones represent complete fish that were intentionally deposited in the graves. Burial 37, dating to level 1, was aligned with mudbrick and included the partial skeleton of an adult. Amongst the grave goods were animal bones and two complete ceramic vessels (Doumet-Serhal 2004). Burial 37 yielded the remains of a single grouper individual that measured between 35 and 40 cm SL. In burial 51, numerous head bones and vertebrae were found all belonging to a single seabream of about 25 cm SL. In addition to a large number of bones that were only identifiable at family level, there were also five remains clearly belonging to the genus *Sparus* and six other bones were diagnostic at species level. The left and right maxillae, premaxillae and dentalia can be securely identified as gilthead seabream (*Sparus aurata*).

Discussion and concluding remarks

Despite the fact that the majority of the fish bone samples from Sidon were obtained through hand-collecting, the species spectrum gives a good impression of the various fishing grounds that were exploited. In addition to coastal fishing on benthic species (mainly groupers and sparids) and open water fishing on sharks, tuna and carangids, exploitation of pelagic clupeids also occurred. Some of the marine species that were identified (mullets, gilthead seabream, meagre) can enter estuaries and it is therefore possible that fishing was also practiced in the lower reaches of rivers such as the nearby Awali (to the north) or the Sainiq (to the south). It is unclear if the finds of the catfish *Clarias* and of tilapia are indicative of local freshwater exploitation or if they represent imports from the Nile (see below).

As already mentioned above, the two fish taxa that are typically obtained through littoral fishing (the groupers and sparids), are mainly represented by specimens of small to medium size. The lack of larger individuals may indicate that the coastal fish populations already suffered from overfishing in the third millennium. Possibly this explains why offshore fishing developed, as shown by the large-sized sharks, carangids and tuna. In a recent overview of pre- and protohistoric fishing in the Eastern Mediterranean (Van Neer *et al.*, 2005), it was already underlined that the Early Bronze Age ichthyofauna of Sidon is the earliest firm evidence in the region for intensive pelagic fishing and shark exploitation. Information on marine exploitation in the region during the preceding Chalcolithic period is virtually inexistent. The only data that are currently available come from Tel Katif where the ichthyofauna consists for about 90% of species obtained through coastal fishing. The remaining material is from sharks of different size classes, including some of very large size that could indicate a beginning of open water exploitation. The more systematic fishing in open waters from the Early Bronze Age onwards that is seen at Sidon is also observed along the coast of western Anatolia. At Troy (Rose 1994; Van Neer & Uerpmann 1998; Uerpmann & Van Neer 2000) and nearby Besik-Yassıtepe (von den Driesch 1999) extensive exploitation of large pelagic fish is shown by the abundant remains of tuna. Swordfish (*Xiphias gladius*) and large sharks occur in smaller quantities. All these observations seem to be in agreement with the general idea that better fishing equipment and vessels were available from the Bronze Age onwards (McGrail 2001; Morales *et al.* 2001).

In accordance with the foregoing observations on the evolution of seafaring capacities, the diachronic study of Nilotic fish imports in the Eastern Mediterranean (Van Neer *et al.* 2004) shows few such finds in the Late Chalcolithic and Early Bronze Age. Bone finds of Nile fish are initially limited to the more southerly located coastal settlements of the Levant, but the imported Egyptian fish become more numerous from the Middle Bronze Age onwards. Since that period they occur not only on more northerly located coastal sites, but also inland. The new evidence from Sidon is in accordance with this general picture. The earliest securely dated find of Nile perch is from the Middle Bronze Age from which also a bagrid catfish is available. A single Nile perch bone occurs in the Late Bronze Age levels. The species is more abundant in the mixed Late Bronze/Iron Age contexts in which it represents about a quarter of all the identified fish bones (Table 1). The small Iron Age sample also yielded a Nile perch bone. The archaeological evidence for Egyptian contacts that is amply available at Sidon seems to follow the same diachronic trend that is seen in the fish remains. Ceramic vessels from Egypt are found in the Early Bronze Age (Doumet-Serhal 2003), but are more common from the Middle Bronze Age onwards (Bader 2003; also Doumet-Serhal in this issue p. 34; Forstner-Müller, Kopetzky & Doumet-Serhal p. 52; Forstner-Müller, Kopetzky, p. 60). Scarabs occur regularly from the Middle Bronze Age onwards (Taylor 2004).

The exact provenance of two fish taxa is still unclear at the moment. In an Iron Age context remains have been found of the catfish *Clarias* that lives in the area, and one of the Late Bronze Age jars yielded an unidentified tilapia. Of the latter taxon, one species (*Tilapia zillii*) can be found in the Litani River, but not farther north. The Jordan basin is an alternative region from where these two fish may have been obtained. Because there is no unequivocal evidence thus far at Sidon for the capture of freshwater species that exclusively live in the rivers adjacent to the site, the *Clarias* and tilapia could be part of the 'package' of Nilotic species that were imported from Egypt. In the case of these African fish taxa that have a geographical distribution extending into the Levant, ancient DNA can be a successful provenance indicator (Arndt *et al.* 2003).

The fish remains found thus far at Sidon already give a first impression of the various fishing grounds that were exploited, but more material and sieved samples will be necessary to establish more accurately the relative importance of these fishing activities. As fish bone samples increase it will also become possible to further quantify the importance of Nilotic imports through time. The contribution of fish and other food resources to the diet is difficult to quantify using traditional methods of quantification, mainly because of effects of differential preservation and recovery chances. Isotopic analyses currently carried out at Bradford University on Middle Bronze Age human and animal bone will address these issues of dietary composition.

In two instances the Middle Bronze Age tombs of Sidon clearly included fish as a grave gift, namely a grouper in burial 37 and a gilthead seabream in burial 51. The role of fish in ritual and religious practices in the Levantine area and beyond is still poorly documented. Four Early and Middle Bronze Age burials at Lachish yielded fish remains from mullets, groupers, sparids, carangids, Nile perch and cichlids that, although representing isolated bones, were reported as possible grave offerings (Lernau 2002). Similarly, there was a single bone of catfish (*Clarias*) in a Middle Bronze Age tomb at Sasa (Horwitz 1987). Farther east, in Mesopotamia, a more or less complete skeleton of a large cyprinid (*Barbus sharpeyi*) was found in one of the 200 investigated tombs dating to the Early Dynastic I-III (von den Driesch 1986). Still 8 other graves yielded fish bones, but these were

isolated finds that may have ended up accidentally in the burials. At Isin-Isān Bahryīāt II (von den Driesch 1981; Boessneck & von den Driesch 1992) isolated remains of cyprinids have also been found inside tombs, mainly dating to the Old Babylonic period. Also from a small number of graves in Eridu isolated, unidentified fish bones have been reported (Safar *et al.* 1981). At Nippur, a partial skeleton of a cyprinid has been found (Boessneck 1993) that can more confidently be considered as a grave gift.

	stratum 3	stratum 4	stratum 5	stratum 6
	EB II A	EB II B	EB III A	EB III B
Marine fish				
porbeagle *(Lamna nasus*)	-	-	-	1 (+1?)
hammerhead shark (*Sphyrna* sp.)	-	10	1	74
sharks (Pleurotremata indet.)	-	-	-	1
groupers (Serranidae indet.)	1	3	1	13
greater amberjack (*Seriola dumerili*)	-	1	1	3 (+1?)
jacks (Carangidae indet.)	-	-	-	-
gilthead seabream (*Sparus aurata*)	-	-	-	-
common seabream (*Sparus pagrus*) / bluespotted seabream (P*agrus caeruleostictus*)	-	-	-	-
seabreams (Sparidae indet.)	-	1	-	1
meagre (*Argyrosomus regius*)	-	-	-	1
mullets (Mugilidae indet.)	-	-	-	1
tuna (*Thunnus* sp.)	-	-	1	4
tunny (*Euthynnus* sp.)	-	-	-	-
grey triggerfish (*Balistes capriscus*)	-	-	-	-
Freshwater fish				
catfish (*Clarias* sp.)	-	-	-	-
catfish (*Bagrus* sp.)	-	-	-	-
Nile perch (*Lates niloticus*)	-	-	-	-
total identified fish	1	15	4	101
unidentified fish	1	-	1	3

Table 1: Overview of the fish remains found in the various occupation layers of Sidon. Figures indicate NISP (number of identified specimens).

Table 2: Overview of the fish remains found in two Late Bronze Age jars of Sidon. Figures indicate NISP (number of identified specimens).

EB III	EB sum	MB	LB	LB/IA	EB/IA
-	1 (+1?)	-	-	-	-
13	98	6	17	1	4
-	1	-	-	1	-
2	20	14	4	5	1
-	5 (+1?)	3	2	3	-
-	-	-	-	1	-
-	-	1	-	-	-
-	-	1	-	-	-
-	2	6	3	3	3
-	1	1	-	1	1
-	1	-	-	2	-
-	5	1	-	-	-
-	-	-	2	-	-
-	-	2	-	-	-
-	-	-	-	-	2
-	-	1	-	-	-
-	-	1	2	6	1
15	136	37	30	23	12
1	6	4	9	1	2

	LB jar1	**LB jar2**	**sum**
herrings (Clupeidae indet.)	9	8	17
jacks (Carangidae indet.)	2	-	2
gilthead seabream (*Sparus aurata*)	2	-	2
seabream (*Sparus* sp.)	-	1	1
seabreams (Sparidae indet.)	29	8	37
mullets (Mugilidae indet.)	41	8	49
great barracuda (*Sphyraena barracuda*)	2	-	2
parrotfish (*Sparisoma cretense)*	2	-	2
tilapia (Tilapiini indet.)	1	-	1
total identified fish	88	25	113
unidentified fish	214	81	295

Levels	1	1	1	2	2	3	3	1-3	end 4 early 5	5	5	5	?
burial number	**burial 9**	**burial 27**	**burial 37**	**burial 42**	**burial 43**	**burial 19**	**burial 45**	**burial 51**	**burial 29**	**burial 32**	**burial 34**	**burial 35**	**burial 38**
hammerhead shark (*Sphyrna* sp.)	-	-	-	1	-	-	2	-	1	-	-	-	-
mottled grouper (*Mycteroperca rubra*)	-	-	-	-	-	-	-	-	1	-	-	-	-
groupers (Serranidae indet.)	-	1	50*	3	2	2	-	-	3	2	-	-	2
seabass (*Dicentrarchus labrax*)	1	-	-	-	-	-	-	-	-	-	-	-	-
greater amberjack (*Seriola dumerilii*)	-	-	-	-	-	1	-	-	-	-	-	-	-
jacks (Carangidae indet.)	-	-	-	-	-	-	-	-	-	1	-	-	-
gilthead seabream (*Sparus aurata*)	-	-	-	-	-	-	-	6*	-	-	-	-	-
seabream (*Sparus* sp.)	-	1	-	-	-	-	-	5*	-	-	-	-	-
seabream (*Diplodus* sp.)	-	-	-	1	-	-	-	-	-	-	-	-	-
seabreams (Sparidae indet.)	-	1	-	4	1	1	-	50*	-	1	2	2	1
mullets (Mugilidae)	-	-	-	1	-	-	-	-	-	-	-	-	-
barracuda (*Sphyraena* sp.)	-	-	-	1	-	-	-	-	-	-	-	-	-
tuna (*Thunnus* sp.)	-	-	-	-	-	-	-	-	-	2	-	-	-
total identified fish	1	3	50	11	3	4	2	61	5	6	2	2	3
unidentified fish	-	1	39	42	2	1	-	31	1	21	-	1	1
			* 1ind					* 1ind					

Table 3: Overview of the fish remains found in the Middle Bronze Age burials of Sidon. Figures indicate NISP (number of identified specimens). MNI (minimum number of individuals) are given in the case when more or less complete specimens are present.

A. Arndt, W. Van Neer, B. Hellemans, J. Robben, F. Volckaert & M. Waelkens, 2003, "Roman trade relationships at Sagalassos (Turkey) elucidated by ancient DNA of fish remains", *Journal of Archaeological Science,* 30, p. 1095-1105.

B. Bader, 2003, "The Egyptian jars from Sidon in their Egyptian contexts", *Archaeology & History in Lebanon,* 18, p. 31-37.

J. Boessneck, 1993, "Appendix A. Tierknochenfunde aus Nippur: 13. Saison", in: R. L. Zettler, *Nippur III. Kassite building in area WC-1. Excavations at Nippur,* Oriental Institute Publications 111, Chicago/Illinois, p. 269-298.

J. Boessneck & A.von den Driesch, 1992, "Tierknochenfunde IV. Serie 1986 und 1988", in: B. Hrouda, Isin-Isān Bahryīāt *IV. Die Ergebnisse der Ausgrabungen 1986-1989*, Bayerische Akademie der Wissenschaften, Philosphische-Historische Klasse, Abhandlungen - Neue Folge, Heft 105, München, p. 176-187.

J. Desse & N. Desse-Berset, 2003, "Les premiers pêcheurs de Chypre" in: J. Guilaine & A. Le Brun, *Le Néolithique de Chypre*, Actes du Colloque International organisé par le Département des Antiquités de Chypre et l'Ecole française d'Athènes, Nicosie 17-19 mai 2001, Nicosia, p. 279-291.

C. Doumet-Serhal, 2003, "Sidon - British Museum excavations 1998-2003", *Archaeology & History in Lebanon*, 18, p. 2-19.

C. Doumet-Serhal, 2004, "Sidon (Lebanon): twenty Middle Bronze Age burials from the 2001 season of excavation", *Levant*, 36, p. 89-154.

L. K. Horwitz, 1987, "Animal offerings from two Middle Bronze Age tombs", *Israel Exploration Journal*, 37, p. 251-255.

F. Krupp, 1987, "Freshwater ichthyogeography of the Levant", *Beiträge zum Tübinger Atlas des Vorderen Orients*, A. Naturwissenschaften, 28, p. 229-237.

O. Lernau, 2002, "Fish bones", in: A. Kempinski, *Tel Kabri. The 1986-1993 excavation seasons*, Emery and Claire Yass Publications in Archaeology, Institute of Archaeology, Tel Aviv, p. 409-427.

E. Lieske & R. Myers, 2001, *Collins Pocket Guide. Coral reef fishes. Indo-Pacific & Caribbean including the Red Sea*, Harper Collins Publishers, London.

S. McGrail, 2001, *Boats of the World. From the Stone Age to Medieval Times*, Oxford University Press, Oxford.

A. Morales, E. Roselló & M. Ruíz, 2001, "A renewable fish exploitation model for application on ichthyoarchaeological assemblages", in: H. Buitenhuis & W. Prummel, *Animals and Man in the Past*, ARC - Publication 41, Groningen, p. 44-52.

M. J. Rose, 1994, *With line and glittering bronze hook: fishing in the Aegean Bronze Age*, Doctoral thesis, Indiana University.

F. Safar, M.A. Mustafa & S.Lloyd, 1981, *Eridu*, Ministry of Culture and Information, State Orga-nization of Antiquities and Heritage Baghdad, Baghdad.

J. H. Taylor, 2004, "Scarabs from the Bronze Age tombs at Sidon (Lebanon)", *Levant*, 36, p. 155-158.

M. Uerpmann & W. Van Neer, 2000, "Fischreste aus den neuen Grabungen in Troia (1989-1999)", *Studia Troica*, 10, p. 145-179.

W. Van Neer & M. Uerpmann, 1998, "Fish remains from the new excavations at Troy", in: H. Buitenhuis, L. Bartosiewicz & A. M. Choyke, *Archaeozoology of the Near East III. Proceedings of the third international symposium on the archaeozoology of southwestern Asia and adjacent areas*, ARC - Publication 18, Groningen, p. 243-254.

W. Van Neer, O. Lernau, R. Friedman, G. Mumford, J. Poblome & M. Waelkens, 2004, "Fish remains from archaeological sites as indicators of former trade connections in the Eastern Mediterranean", *Paléorient,* 30, (1), p. 101-148.

W. Van Neer, I. Zohar & O. Lernau, 2005, "The emergence of fishing communities in the Eastern Mediterranean region: a survey of evidence from pre- and protohistoric periods", *Paléorient*, 31 (1), p. 131-157.

A. von den Driesch, 1981, "Fischknochen", in: B. Hrouda, *Isin-Isān Bahryīāt II. Die Ergebnisse der Ausgrabungen 1975-1978*, Bayerische Akademie der Wissenschaften, Philosphische-Historische Klasse, Abhandlungen - Neue Folge, Heft 87, München, p. 157-167.

A. von den Driesch, 1986, "Fischknochen aus Abu Salabikh/Iraq", *Iraq*, 48, p. 31-38.

A. von den Driesch, 1999, "Archäzoologische Unter-suchungen an Tierknochen aus dem dritten und ersten vorchristlichen Jahrtausend vom Besik-Yassıtepe, Westtürkei", *Studia Troica*, 9, p. 439-474.