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OF THE UNITED ARAB EMIRATES

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Editors: Daniel Potts, Hasan Al Naboodah, Peter Hellyer.

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Foreword

It is now more than 40 years since the first archaeological excavations in the United Arab Emirates were undertaken, at the island of Umm an-Nar, adjacent to Abu Dhabi. Those excavations, which began in 1959, led to the recognition of a previously unknown civilisation, and, during the decades that have followed, further excavations and studies by archaeological teams, both from the U.A.E. and from universities and other academic institutions from around the globe, have made discoveries that have placed this country firmly on the map, in terms of its contribution to world heritage and to the emergence of modern civilisation.

Yet, despite those discoveries, we, the people of the United Arab Emirates, still know little of our past. While there have been papers presented at international conferences abroad, or published in international scientific journals, relatively little has been published in the U.A.E. itself, and even less in Arabic. Nor, despite the extensive amount of work that is undertaken in the U.A.E. every year, there has never before been a conference devoted specifically to the archaeology of this country.

In recognition of that and inspired by the words of President His Highness Sheikh Zayed bin Sultan Al Nahyan, “a people that does not know its past can have neither present nor future,” the Zayed Centre for Heritage and History, organised the First International Conference on the Archaeology of the United Arab Emirates, held in Abu Dhabi in April 2001.

As the papers in this volume show, the conference was attended by many of the leading local and international archaeologists who have worked in the U.A.E. over the last 40 years. It would be impossible to present the whole of the country’s archaeological record in detail in one publication, or at a single conference. From this volume, however, a coherent picture emerges of the whole range of the archaeological heritage of the people of the U.A.E., from the Late Stone Age, over 7000 years ago, until the Late Islamic period. That picture also includes insights into the important cultural heritage of the Emirati people, who have interacted with countries throughout the world for thousands of years. Especially with the Arabian Peninsula.

It is my hope that this volume will help not only the people of the Emirates, but also others, to gain an insight into that past. It is one of which we can rightly be proud.

Sultan bin Zayed Al Nahyan
Deputy Prime Minister of the U.A.E.

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The Development of Fishing in the U.A.E.: A Zooarchaeological Perspective

MARK BEECH (ABU DHABI)

Introduction

Fishing forms an important activity in many societies throughout the world today and also played a significant role in the life and subsistence of many prehistoric societies (Acheson 1981; Yesner 1980). For the coastal communities of southeast Arabia fishing has always been an important economic activity. Marine resources undoubtedly made an important dietary contribution to the inhabitants of this region. The first part of this paper discusses the archaeological evidence for fishing equipment and traps. In the following section, the zooarchaeological evidence available from the recent analysis of archaeological fish bone assemblages from the United Arab Emirates is then evaluated. The chronological focus of this study is from the 5th millennium B.C. to the Late Islamic period.

Fishing equipment

Past studies of archaeological fishing equipment have demonstrated that changes in the technology employed in coastal fishing may reflect developmental changes in the organisation of fishing (e.g. Anell 1955; Coutts 1975; Hurum 1976). In southest Arabia a range of artefacts associated with fishing have been discovered on coastal sites, including stone net sinkers and fish hooks made from shell and copper.

Net and line sinkers

Probably the commonest traces of fishing equipment found on archaeological sites in the region are stone net sinkers. These have been found at coastal sites in the Gulf as well as along the coast of Oman. It is generally assumed that these were used in conjunction with fishing nets of some sort, on the basis of their general size and weight. Stone anchors discovered so far in this region during underwater archaeological surveys tend to be much larger and more substantial (T. Vosmer, pers. comm.). Larger net sinkers may have been used in conjunction with gill nets or beach seines; small examples may have been used in conjunction with casting nets or small beach seine nets. It is also possible that some were used as line sinkers to weigh down a line baited with a number of hooks. The interpretation and classification of small to medium sized modified stones as net sinkers or line sinkers is thus somewhat problematic. The general opinion seems to be that 'small size' and 'weight' = 'casting' or 'beach seine net', and that 'large' examples = 'gill net' or large 'seine net' net sinkers. This still leaves us with a problem interpreting some of the middle sized examples.

A number of different types of net sinkers have been identified in southeast Arabia. Whilst some of these do appear to have some chronological significance, others appear to be more part of certain local traditions (Uerpmann 1992: 94–6). It is interesting to note that net sinkers appear to have received much more attention than the chipped stone industry in reflecting the materialised expression of group identity (Uerpmann 1992: 96). Simpler more functional explanations may account, however, for some of these apparent differences.

The first type of net sinkers are flat oval pebbles, notched roughly in the middle of their long sides (fig. 20). They occur at a number of Omani coastal sites belonging to the Saruq of Bandar-Jissa-Facies, i.e. dating to between about 5500–3500 B.C. (Uerpmann 1992: 94), but can be also found at some later sites. These simple notched pebbles were the major type of net sinker reported at Ra's al-Hamra RH5 (Durante and Tosi 1977). A variation on these are simple notched net sinkers which are sometimes 'retouched' along their outline, being flaked on one side with careful notches at each end. Examples of this type were discovered at Khor Milkh 1 in Oman, a site broadly contemporary with RH5. At the later site of Khor Milkh 2, which is only about 300 years later than Khor Milkh 1, however, only the simpler first type were present, along

with an example with a large pecked waistline and additional notches in its ends. Some sites like Al Haddah (BJD1) in Oman also have these notched net sinkers, some of which were quite large, between 5–7 cm. Other examples have also been reported from various coastal sites in the Ja'alan region of Oman, including Khor al-Hajar (KHJ2), Ra's al-Khabbah (KHB1), Ruwais (RWY1) and Suwayh (SWY2) in Oman (Charpentier et al. 1997: 103).

A second type of net sinker found at some sites are small and relatively thick pebbles which have a pecked shallow groove around the 'waistline' of the pebble, facilitating the attachment of lines. These smaller net sinkers are generally not bigger than about 2.5–3 cm. Such net sinkers appear to be especially common during the early 5th–4th millennium B.C. at a number of sites along the Omani coast (Charpentier et al. 1997: 103). Examples of this type have been found at Saruq (Uerpmann 1992: 95) and at BJD1 at Al Haddah. Similar net sinkers have also been discovered at Nad al-Walid, a shell midden located near Jazirat al-Hamra in Ra's al-Khaimah, U.A.E., which is broadly contemporary with Saruq. It is interesting to note, however, that this particular type of net sinker has not been found at the broadly contemporary sites at Ra's al-Hamra in Oman. A further variation on these small net sinkers with a pecked waistline are examples which have a sawn-in waistline. These are known from Ra's al-Hamra 6, which is partly contemporary with Saruq, and one example of this type is also known from Saruq (Uerpmann 1992: 95). Examples with pecked waistlines are known, however, in later contexts but only on quite large net sinkers. At Umm an-Nar in the U.A.E., similar larger net sinkers with pecked waistlines have been discovered in the 3rd millennium B.C. settlement.

A third type of net sinker, and the commonest type found at Umm an-Nar in Abu Dhabi, was made from the local limestone (Frifelt 1995: 113). These were usually circular, flattish and perforated and were found in all levels of the excavation. A total of 201 net sinkers were recovered, 182 of which had their weight recorded. A good proportion of these came from House 227/228 and Area 499. All were 1.5–5 cm thick and had a diameter often less than 10 cm. The Umm an-Nar net sinkers varied in weight from quite small examples of less than a 100 g in weight to more substantial examples of 0.5 kg plus. The majority was between 100–200 g in weight.

Other artefacts which may have been utilised in fishing are so-called 'perforated disks'. These have been found at a wide range of sites throughout the area, from sites dating between the 5th–3rd millennium B.C. Examples are known from the early 5th millennium B.C. site on Dalma Island, as well as from the 3rd millennium B.C. settlement at Umm an-Nar. Some of these are made from stone whilst others appear to be made from ceramics (possibly re-used, broken pottery vessels). The precise function of these is not known, but various hypotheses have been suggested for them including their use as spindle whorls or items of jewellery. A further possibility is that they may have been used in fishing equipment. Smaller net sinkers and perforated disks could have easily been used with casting nets. These are occasionally used in the traditional local fisheries of the region. The casting net is cast in a ring about a school of fish and encloses the prey from the sides and from above but not from below. Although some of the perforated disks seem quite light and unsuitable to weigh down nets, once immersed in water they may have acted as effective tracers holding the position of the net in the water. The author has witnessed very similar small disks being sold today with such nets in the U.A.E.

Little published data concerning net sinkers are available for later period sites in the Gulf and southeast Arabia. It is clear though that predominantly locally available materials were used to manufacture net sinkers in the various regions. In the southern Gulf, as at Umm an-Nar, the inhabitants continued to use the locally available limestone as it was almost the only source available to them. In the Northern Emirates, harder granite-like stones were more readily available and could be used to manufacture net sinkers, e.g. the quite large 9.5 cm Early Islamic example discovered at Jazirat al-Hulayla.

Shell fish hooks

There is a considerable body of literature concerning traditional fishing equipment, in particular the use of fish hooks within the tropics, in Polynesia and the Pacific (e.g. Anell 1955; Best 1929). One of the problems in interpreting the precise use of fish hooks is that very few detailed studies have been made connecting preserved hook types with particular fishing methods. This is often because metal hooks have been used for over a century in many parts of the world, and traditional knowledge was not recorded and so has been lost.

The earliest fish hooks in southeast Arabia are made of marine shell, usually from pearl oyster or large bivalves. Examples have been recovered from a number of coastal

sites in Oman dating between the early 5th–late 4th millennium B.C., including Khor Milkh 1 and 2, Ra's al-Hamra RH5, Ra's al-Hadd, Ra's al-Jinz RJ2, Ra's al-Khabbah KHB1, and Suwayh SWY2 (Biagi and Nisbet 1989; Charpentier and Méry 1997; Phillips and Wilkinson 1979; Uerpmann 1992).

The deliberate selection of such a raw material may have been advantageous for a number of reasons. Shells were plentiful along the entire coastal regions of southeast Arabia. It was fairly easy to work the shell into the desired equipment, and the material itself was hard and durable. A further advantage of using shells with a shiny/glistening surface was that it served to entice fish to bite. It is reported in some parts of the tropics that such hooks do not even require any bait, as the glitter of the pearl shell is far more attractive to the fish (Anell 1955: 146). In some parts of Polynesia (e.g. the Luisiades) it is reported that the natives had such effective hooks of their own that they preferred them to European steel hooks.

Grooves incised across the top of the shanks of these hooks enabled fishing lines to be bound to them, and some hooks had a pair of holes drilled in the top of the shank where lines could be tied. The shell hooks found along coastal sites in southeast Arabia all appear to be unbarbed. This appears to follows the general rule that the earliest fish hooks were made without any barb or refinement; only after thousands of years did they regularly become equipped with barbs as well as grooves, bulges and holes (Hurum 1976: 25). Hooks without barbs generally help the fishermen save time and avoid damage to the fish. The fish can be literally just shaken off the hook. Although some fish may be lost whilst hauling them in, the amount would be negligible at a time of year when there is a superabundance of fish. In the Pacific, fishing for bonito has for centuries used a method whereby barbless hooks are utilised from a stationary vessel carrying live bait. In the case of very large tuna, individual lines may be manned by two men using two rods attached to the same line (Hurum 1976: 86). Some of the fish hooks found along the Omani coast do have incurved points. This may have been a deliberate choice as, unlike barbed hooks, they would not stick so easily to the seabed.

Shell fish hooks are strong and can be used to capture quite large fish. In western Melanesia hooks of mussel shell, mainly *Trochus*, are commonly used to catch specimens as big as sharks. The lower part of the fishing line is protected from the shark's teeth by a hollow stick through which it is drawn (Anell 1955: 87). Some of the shell fish hooks had quite long shanks and these may have been deliberately manufactured to be more effective if the particular fish being caught had sharp teeth in order to prevent them cutting through the leader (Hurum 1976: 82–3).

It is possible that other raw material may have been used in the past to manufacture fish hooks in southeast Arabia. Three examples of fish hooks made from dugong bone are known from the Huon Gulf and the Sepik River in Polynesia (Anell 1955: 88). G. Landtman observed in 1927 that hooks made from marine turtle shell were amongst the commonest types of hooks in use in the Torres Straits area, and by the Kiwait Papuans of British New Guinea (cited in Anell 1955: 142). It is reported that hooks were made out of a piece of turtle-shell that was cut narrow and ground on a stone. Both ends were then sharpened on the stone and bent over a fire, after which the piece of shell was cut in two and so formed two fish hooks.

It is curious that no shell fish hooks have yet been discovered/published from sites within the Arabian Gulf. This may simply be a result of the greater focus and intensity of research on early coastal sites on the Omani coast. No shell fish hooks were discovered by Abdullah Masry in the late 1960s at any of the 'Ubaid sites he investigated on the Saudi Arabian Gulf coast. None have been found at the recent excavations of the 'Ubaid settlement on Dalma Island, U.A.E. (Flavin and Shepherd 1994; Beech and Elders 1999). Only relatively small areas have been excavated on these sites, so they may have simply been missed. A possible shank of a shell fish hook has been collected from the surface of site MR1 on Marawah Island during a field survey carried out by the Abu Dhabi Islands Archaeological Survey (ADIAS). This unfortunately is not from a provenanced context although the site itself has been radiocarbon dated to the late 6th millennium B.C. It is also possible that the general absence of shell fish hooks within the Gulf reflects different marine conditions from those in Oman. The deeper waters lying immediately next to the Omani coast would have made hook and line fishing an attractive proposition, in contrast to the exceedingly shallow waters of much of the Gulf where basket traps and intertidal barrier traps may have been often preferred. Another possibility is that hooks were so highly prized by their owners that they were carefully curated and had comparatively little chance to enter the archaeological record. In Tahiti, for example, it is reported that fisherman were unwilling to sell their inherited hooks to strangers.

An old and highly successful hook used to catch bonito was considered to be

> *'. . . property almost beyond price, cherished not only for its utilitarian value, but because in the course of forty or fifty years it has acquired in the catching of countless fish a tremendous charge of mana ('magical property') . . .'* (Anell 1955: 176)

Some of the coastal sites situated on the Omani coast were clearly workshops for the production of fish hooks and shell beads like *Engina mendicaria*, a fact that should also be taken into account. This means that shell fish hooks may have had a greater chance of inclusion in the archaeological deposits if they were broken, discarded or accidentally dropped. One of these 5th–4th millennium B.C. workshops was identified at Suwayh, where a number of limestone tools were also discovered. It has been suggested on the basis of strong ethnographic parallels with known examples from Hawaii and other sites in the Pacific, that these tools were used in the production of shell fish hooks (Charpentier and Méry 1997: 150–3, Figs. 4–5). On the island of Tahiti, Sir Joseph Banks observed that

> *'. . . the shell is first cut by the edge of another shell into square pieces. These are shaped with files of coral, with which they work in a manner surprising to any one who does not know how sharp corals are. A hole is then bored in the middle by a drill [. . .] the file then comes into the hole and completes the hook . . .'* (Best 1929: 32–3).

Metal fish hooks

Once copper and bronze came into use, it became possible to manufacture fish hooks from metal. Copper started to be used from approximately 4000 B.C., followed by the gradual development of bronze. Once fish hooks began to be manufactured they were even used for barter, and in later periods even as coinage (Hurum 1976).

Some of the oldest fish hooks known from the region are examples from Ur in Mesopotamia dating to about 2600 B.C. These are unbarbed hooks made from copper. Curiously, broadly contemporary fish hooks from sites like Lothal within the Indus Valley civilisation have barbs, suggesting that distinctive regional trends in technology (as in the case of net sinkers) may have been adopted. On the Omani coast unbarbed hooks are also found similar to the Mesopotamian examples. An almost complete copper fish hook and fish hook fragment were discovered at the 3rd millennium B.C. site of SWY-3 at Khor Bani Bu Ali, about 70 km south of Ra's al-Hadd (Méry and Marquis 1998). These fish hooks have a long tradition in the region, from the beginning of the 3rd millennium B.C. at Ra's al-Hadd HD-6 and continuing after 2500 B.C. at Ra's al-Jinz RJ-2 (Cleuziou and Tosi 1986: Fig. 19 nos. 2–4; 1988: Fig. 18 no. 6, Fig. 19, Fig. 20 no. 2) and Ra's al-Hadd HD-1 (Cleuziou et al. 1990: Fig. 35). The same type of unbarbed copper fish hooks were also reported at the settlement of Umm an-Nar (Frifelt 1995), both within the 3rd millennium B.C. graves and within settlement contexts. Two examples were found in graves I and V at Umm an-Nar but the majority of the fish hooks, a total of 14 fragments, came from the settlement (Frifelt 1991, 1995).

Copper/bronze fish hooks may have been used for a considerable period of time. It was not until the Early Islamic period when other metals such as iron were used in the manufacture of hooks. Examples of such fish hooks have been found at both Jazirat al-Hulayla and Julfar in Ra's al-Khaimah in the Northern Emirates.

Other fishing equipment

Other fishing equipment which would have undoubtedly been used in the region were gorges and lures. A number of bone gorges were discovered at Ra's al-Hamra at site RH5 (Biagi and Nisbet 1989). More recently some similar examples have been identified at the 'Ubaid settlement of H3 in Kuwait (Beech in prep.). Such artefacts may easily have been overlooked on other excavations. In the Marshall Islands in the Pacific, lures are mostly made from pearl shell and sometimes from *Spondylus* (Anell 1955: 152). Gorges consisted of a straight stick of shell, bone or wood where the line was attached in the middle. Once baited, the gorges were laid out parallel with the line. Any fish swallowing the bait and attempting to swim away was then trapped as the line is pulled taut and the gorge sticks in the throat or belly of the fish. In the Pacific it is also reported that gorges can be made from tortoise shell and even out of mangrove wood, and in New Zealand slightly curved gorges are made out of mussel shell (Anell 1955: 73–5).

Other evidence of fishing equipment utilised in the region includes the occasional discovery of metal harpoons or tridents. Bronze fish-tridents are known from Mesopotamia (Saggs 1965: 131, Fig.75). A possible

Fig. 1. Circular fish trap on the west coast of Dalma. Note the additional fish trap walls in the distance.

fishing spear (Fig. 55) was also reported from the 3rd millennium B.C. settlement of Umm an-Nar, reportedly discovered on the spoil heaps of one of the trenches! (Frifelt 1995: 71). Harpoons or tridents may have been used to catch rays and sharks, and in the Torres Straits in Australia such equipment is used to catch dugongs (Anell 1955: 66). Dugong bones were also recorded at the Umm an-Nar settlement. Harpoons are also used by the Kiwai Papuans to hunt marine turtle, and by Mimika natives in southeast Asia to catch sawfish (Anell 1955: 67). Again, both these taxa were represented in the bone assemblage at Umm an-Nar.

Ancient fish traps

Traps certainly appear to have been particularly favoured along the shallower waters of the western and southern Gulf. As stated earlier, there is comparatively little archaeological evidence for the use of traps largely because the majority may have been made of organic materials which simply do not survive. The recent identification of a whole series of stone wall fish traps on offshore islands in the Western Region of Abu Dhabi is a remarkable discovery. Unfortunately, it is very difficult to precisely date these structures. As they are situated in the present intertidal zone, it seems likely that they belong to the Islamic period and since 1000 A.D., when sea levels attained similar levels to the present day. Such traps may, of course, have been utilised further back in antiquity. The coastal geology of western Abu Dhabi, large flat sandy beaches with high salinity and evaporation, often means that the shallow water bottoms develop into a kind of hardened crust of sand, mollusc and coral fragments, making the construction of such traps quite simple. This local 'beach-rock' could be collected and used to build the walls of these traps.

A number of fish traps were observed by the author (together with Ernie Haerinck and Liz Shepherd Popescu) in 1996 on the west coast of Dalma Island in the Western Region of Abu Dhabi (figs. 1–2). Unfortunately, these appeared to be deteriorating in 1998 when the author returned to Dalma; this is a great pity as it would be worthwhile preserving some of the larger well preserved elaborate traps as heritage sites (Hellyer and Beech 2001). A number of the other offshore islands in western Abu Dhabi still have such traps, e.g. Ghagha' and the Yasats.

These stone traps fall into a number of types. Some of them are semicircular walls enclosing small bays (e.g. on the northwest coast of Ghagha'). A gap in the wall was blocked as the tide receded trapping all the fish in the shallow water on the landward side of the wall. Sometimes the walls extend outwards from the coastline like giant pincers to channel fish into restricted shallower waters (e.g. on the west coast of Dalma). Other traps consist of a stone wall running perpendicular to the shoreline, the seaward end terminating in a circular or oval shaped enclosure (e.g. off the small islands just west of Abu Dhabi Island).

Fig. 2. Fish trap on the west coast of Dalma.

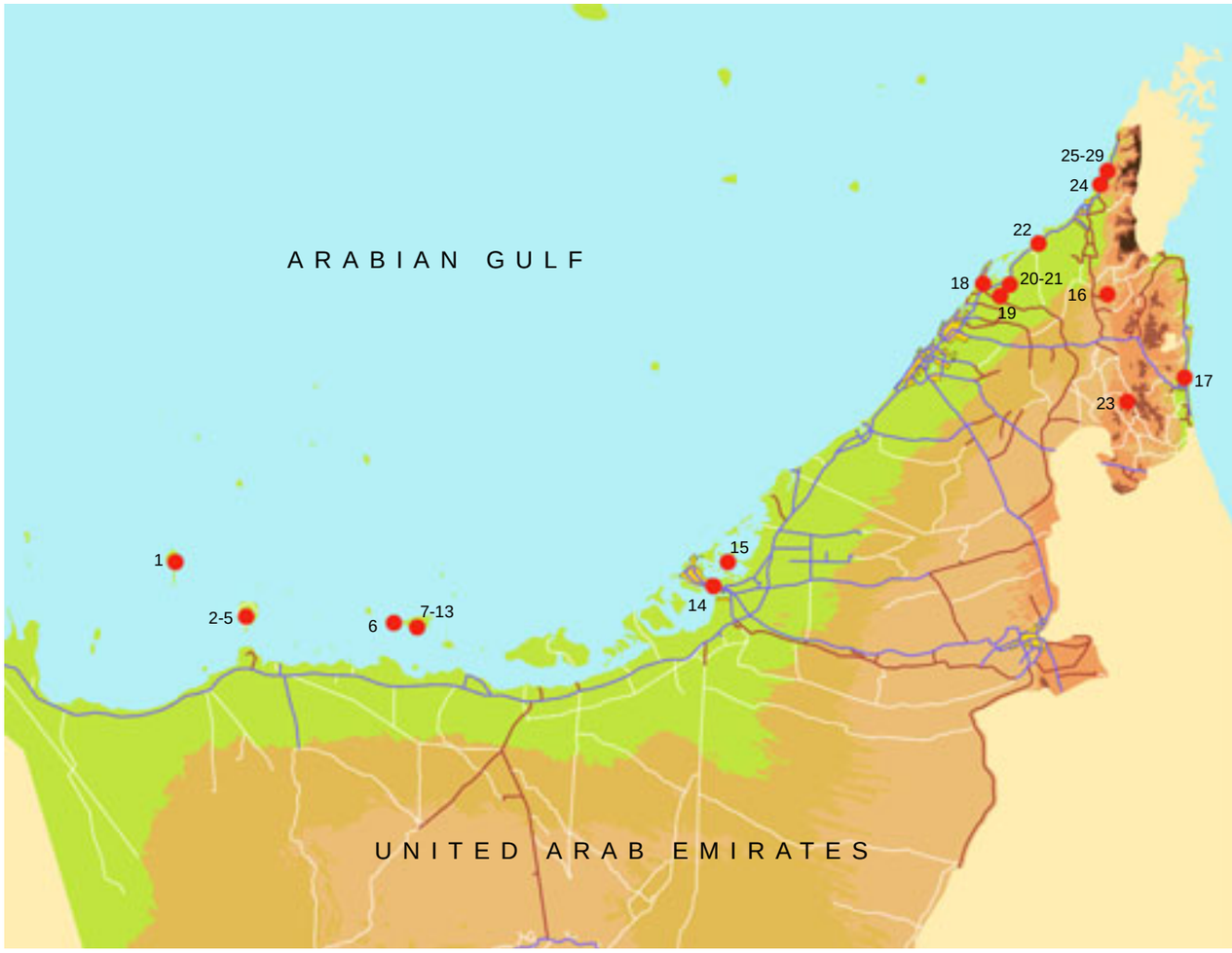

Fig. 3. Location of archaeological sites with fish bone assemblages.

Archaeological fish bone assemblages

Although we can infer the types of fish which may have been caught using fish hooks or traps, the best means we have for establishing which kinds of fish were caught in the past is from the direct evidence of their bones. Excavations of middens from the coastal settlements provide us with an opportunity to examine which fish were caught and consumed by the inhabitants.

Fish bone assemblages from 23 archaeological sites in the United Arab Emirates were examined by the author during the course of this study (table 1). Some comparable information was also available from seven other previously published sites: Umm an-Nar (Hoch 1979), ed-Dur (Van Neer and Gautier 1993), Umm al-Qaiwain (site 69) (Uerpmann and Uerpmann 1996), Mleiha (Mashkour and Van Neer 1999), Tell Abraq (Potts 2000; Margarethe Uerpmann, pers. comm.), Julfar (Desse and Desse-Berset 2000) and Shimal (von den Driesch 1994). These sites are located along both the Arabian Gulf and eastern (Gulf of Oman) coast (fig. 3).

The following sections provide a general overview of the results of the analysis of the fish bone assemblages from these sites. Further details concerning the methodology of sampling, quantification and analysis are presented in Beech (2001).

Modelling the ancient fisheries

Tables 2–4 present the overall quantification results of the analysis of the archaeological fish bone assemblages. The assemblages vary in size and richness which may be due to a number of factors.

Discussion of the stratigraphic origin and taphonomy of the various assemblages will not be discussed in any great detail here, as this has been dealt with elsewhere (*ibid*). In brief, an inherent problem in using the bone and body part distribution of fish to infer differences between archaeological sites is the question of bone survival. Many factors can affect this, and one of these can be the density and morphology of particular elements. However, other less controllable factors may also dramatically affect the

Table 1. List of archaeological sites with fish bone assemblages. H = hand collected.

Location	Site Code	Emirate	Date	Type Of Site	Rec Meth	Map Code	Ref.
Dalma	DA11	Abu Dhabi	'Ubaid (early 5th mill B.C.)	Settlement	4mm	1	Beech 2001
Sir Bani Yas	SBY2	Abu Dhabi	Pre-Islamic, 6th–7th c. A.D.	Settlement	4mm	2	Beech 2001
Sir Bani Yas	SBY4	Abu Dhabi	Pre-Islamic, 6th–7th c. A.D.	Settlement	4mm	3	Beech 2001
Sir Bani Yas	SBY7	Abu Dhabi	Pre-Islamic, 6th–7th c. A.D.	Settlement	4mm	4	Beech 2001
Sir Bani Yas	SBY9	Abu Dhabi	Pre-Islamic, 6th–7th c. A.D.	Settlement	4mm	5	Beech 2001
Liffiyah	LF94	Abu Dhabi	Late Islamic	Midden	4mm	6	Beech 2001
Marawah	MR1	Abu Dhabi	'Ubaid (6th mill B.C.)	Settlement	H	7	Beech 2001
Marawah	MR6.1	Abu Dhabi	Early Islamic	Lime Kiln/ Midden	4mm	8	Beech 2001
Marawah	MR6.3	Abu Dhabi	Early Islamic	Burial cairn	4mm	9	Beech 2001
Marawah	MR12.3	Abu Dhabi	Pre-Islamic	Burial cairn	4mm	10	Beech 2001
Marawah	MR14	Abu Dhabi	Late Islamic	Midden	4mm	11	Beech 2001
Marawah	MR15	Abu Dhabi	Late Islamic	Midden	4mm	12	Beech 2001
Marawah	MR16	Abu Dhabi	Late Islamic	Midden	4mm	13	Beech 2001
Umm al-Nar	UAN	Abu Dhabi	3rd mill. B.C.	Settlement	H ?	14	Hoch 1979
Balghelam	BG12	Abu Dhabi	Iron Age	Midden	4mm	15	Beech 2001
Mleiha	MLE	Sharjah	3rd–4th c. A.D.	Settlement	?	16	Mashkour and Van Neer 1999
Kalba	KAL	Sharjah	Umm an-Nar (KAL1) Wadi Suq (KAL2) Late Bronze age (KAL3) Iron I (KAL4) Iron II A / Iron II B (KAL5-7)	Settlement	?4mm	17	Beech 2001
Umm al-Qaiwain (site 69)	UAQ69	Umm al-Qaiwain	5th mill. B.C.	Midden	?1mm	18	Uerpmann and Uerpmann 1996
Umm al-Qaiwain	UAQ92-3	Umm al-Qaiwain	'Ubaid (6th–5th mill B.C.)	Cemetery/ Midden	2mm	19	Beech 2001
Ed-Dur	ED	Umm al-Qaiwain	0–200 A.D.	Settlement	?	20	Van Neer and Gautier 1993
Ed-Dur North	EDN	Umm al-Qaiwain	Early Iron Age	?Settlement	4mm	21	Beech 2001
Tell Abraq	TAB	Umm al-Qaiwain	3rd mill. B.C. – Iron Age	Settlement	?	22	Potts 2000; Uerpmann, pers.comm.
Rafaq	RFQ2	Ra's al-Khaimah	Early–Late Iron Age	Settlement	4mm	23	Beech 2001
Julfar (French)	JU-F	Ra's al-Khaimah	Islamic–Late-Islamic	Settlement	?	24	Desse and Desse-Berset 2000
Julfar (Japanese)	JU-J	Ra's al-Khaimah	Islamic–Late-Islamic	Settlement	4mm	24	Beech 1998
Kush	KU	Ra's al-Khaimah	Sasanian (KU1) Early Islamic (KU2) Abbasid (KU3)	Settlement	4mm	25	Beech 2001
Shimal	UNAR2	Ra's al-Khaimah	3rd mill. B.C.	Tomb	4mm	26	Beech 2001
Shimal	SH602	Ra's al-Khaimah	2nd mill. B.C.	Tomb	H	27	Beech 2001
Shimal	SH	Ra's al-Khaimah	3rd mill. B.C. – Iron Age	Settlement	H	28	Von den Driesch 1994
Jazirat al-Hulaylah	JHU	Ra's al-Khaimah	Islamic	Settlement	4mm	29	Beech 1998

Table 2. Archaeological fish bone assemblages from Abu Dhabi Emirate

SPECIES	SITE CODE / MAP CODE / Common Name	DA 11(*) 1	SBY 2 2	SBY 4 3	SBY 7 4	SBY 9 5	LF 94 6	MR 1 7	MR 6.1 8	MR 6.3 9	MR 12.3 10	MR 14 11	MR 15 12	MR 16 13	UAN 14	BG 12 15
Alopiidae indet.	Pelagic thresher	5														
Carcharhinidae *Carcharhinus* spp..	Requiem shark	277				130						2	10	25		
Sphyrnidae *Sphyrna* spp.	Hammerhead shark	44														
Pristidae indet.	Sawfish	22				1		2						12	P	113
Dasyatidae indet.	Stingray					1			38			1	2		P	
Myliobatidae indet.	Eagleray	18										2		1		
Chondrichthyes indet.	Shark/Ray/Skate	629				1119			2			2		1	P	763
Ariidae *Arius* spp.	Sea catfish	3	1			9								1		
Belonidae indet.	Needlefish	844	2			16			7	20	9	230	135	344		
Platycephalidae indet.	Flathead			1						1	5					
Serranidae *Epinephelus* spp.	Grouper	208				7								8		1
Serranidae indet.	Grouper	477	2	3	29	45					1	11	9	13		
Teraponidae *Terapon* spp.	Terapon													1		
Rachycentridae *Rachycentron canadum* (Linnaeus, 1758)	Cobia								1							
Carangidae *Carangoides* spp.	Jack	8							4	1		1				8
Gnathanodon speciosus (Forsskål, 1775)	Golden trevally	9							2	6						
Megalaspis cordyla (Linnaeus, 1758)	Torpedo scad	3							2							
Scomberoides spp.	Queenfish	6				1			3	3		2		4		
Carangidae indet.	Jack / Trevally	74			2	11	1		14	8	1	28	62	233		4
Gerreidae *Gerres* spp.	Mojarra										1			3		
Lutjanidae indet.	Snapper	1														
Haemulidae indet.	Grunt	1							2							
Lethrinidae *Lethrinus lentjan* (Lacepède, 1802)	Redspot emperor					25										
Lethrinus nebulosus (Forsskål, 1775)	Spangled emperor			1												
Lethrinus spp.	Emperor	128	1	4	2	63			85	31	43	10	5	7		1
Sparidae *Acanthopagrus* spp.	Seabream	35		1		3										
Argyrops spinifer (Forsskål, 1775)	King soldierbream	3												2		
Rhabdosargus spp.	Gold-striped/ Haffara seabream	174			5	64	2		12	4	5	4	1	3		1
Sparidae indet.	Seabream	1389	4	16	28	86	7	1	23	7	14	1	1	12		3
Scaridae indet.	Parrotfish	8				4			66	5	9					
Sphyraenidae *Sphyraena* spp.	Barracuda	2				3				10	1	4		2		
Scombridae *Euthynnus affinis* (Cantor, 1849)	Kawakawa	15												1		
Thunnus spp.	Tuna	5														
Thunninae	Tuna	195														
Scomberomorus spp.	Spanish mackerel	3										1		21		
Scombridae indet.	Tuna/Mackerel	13		1		11			1	4			12	2		
Tetraodontidae *Arothron* spp.	Puffer											2		1		1
Unknown large fish															P	
TOTAL		**4599**	**10**	**27**	**66**	**1599**	**10**	**3**	**262**	**100**	**89**	**301**	**237**	**697**	**?**	**895**

For explanation of site codes see Table 1. Map codes relate to locations in Figure 3. Totals indicate number of bones identified to a particular family, genus or species. P = present. (*) = only the fish bones from the Dalma 1993-4 excavation season are included here.

Table 3. Archaeological fish bone assemblages from Sharjah and Umm al-Qaiwain Emirates

	SITE CODE	MLE	KAL 1	KAL 2	KAL 3	KAL 4	KAL 5-7	UAQ 69	UAQ 92-3	ED	EDN	TAB
	MAP CODE	16	17	17	17	17	17	18	19	20	21	22
SPECIES	Common Name											
Carcharhinidae indet.	Requiem shark	2			1	3	2			R		P
Sphyrnidae indet.	Hammerhead shark									RR		P
Pristidae indet.	Sawfish				1					R	2	P
Dasyatidae indet.	Stingray									R		P
Chondrichthyes indet.	Shark / Ray / Skate										6	
Clupeidae indet.	Herring / Sardine								6	RR		
Chanidae *Chanos chanos* (Forsskål, 1775)	Milkfish									R		
Ariidae *Arius* spp.	Sea catfish									R		P
Belonidae indet.	Needlefish									RR		
Platycephalida, indet.	Flathead								1	RR		
Serranidae *Epinephelus* spp.	Grouper				3					F	2	FF
Serranidae indet.	Grouper				1	3	6		1	F	3	FF
Carangidae *Alectis* spp.	Threadfish									RR		
Carangoides spp.	Jack	1		3	2	3	16		3	F	1	
Caranx spp.	Trevally									RR		
Elagatis bipinnulata (Quoy & Gaimard, 1824)	Rainbow runner		1									
Gnathanodon speciosus (Forsskål, 1775)	Golden trevally						2		3	F	5	
Megalaspis cordyla (Linnaeus, 1758)	Torpedo scad									RR		
Scomberoides spp.	Queenfish									R		
Seriola spp.	Amberjack									RR		
Ulua mentalis (Cuvier, 1833)	Longrakered jack									RR		
Carangidae indet.	Jack / Trevally	6	1	4	1	17	43		6	F	16	FF
Gerreidae *Gerres* spp.	Mojarra									RR		
Lutjanidae indet.	Snapper								11	RR		P
Haemulidae indet.	Grunt					2	2		1	RR		P
Lethrinidae *Lethrinus lentjan* (Lacepède, 1802)	Redspot emperor								65			
Lethrinus spp.	Emperor				5		5	F	66		9	P
Sparidae *Acanthopagrus* spp.	Seabream									R		
Argyrops spinifer (Forsskål, 1775)	King soldierbream		2	5		2	2			R		
Rhabdosargus spp.	Gold-striped/ Haffara seabream	14				2	3		168	FF	13	
Sparidae, indet.	Seabream	8		1	2	8	3	F	835	FF	11	P
Mugilidae indet.	Mullet	6								F		P
Scaridae indet.	Parrotfish									RR	1	
Sphyraenidae *Sphyraena* spp.	Barracuda						1		33	R	3	FF
Scombridae *Euthynnus affinis* (Cantor, 1849)	Kawakawa	180				1	1			FF		
Thunnus spp.	Tuna	16		1						FF		
Thunninae	Tuna	151								FF		
Scomberomorus spp.	Spanish mackerel			1		1	3		1			
Scombridae, indet.	Tuna/ Mackerel		3	23	4	21	22		7	FF	3	P
Ephippidae indet.	Batfish									RR		P
Siganidae *Siganus* spp.	Rabbitfish									R		P
Tetraodontidae *Arothron* spp.	Puffer									RR		
TOTAL		**384**	**7**	**38**	**20**	**63**	**111**	**?**	**1207**	**?**	**75**	**?**

For explanation of site codes see Table 1. Map codes relate to locations in Figure 3. Totals indicate number of bones identified to a particular family, genus or species. P = present; RR = very rare; R = rare; F = frequent; FF = very frequent.

Table 4. Archaeological fish bone assemblages from Ra's al-Khaimah Emirate

SPECIES	SITE CODE / MAP CODE / Common Name	RFQ 2 23	JU -J 24	JU -F 24	KU 1 25	KU 2 25	KU 3 25	UN AR2 26	SH 602 27	SH 28	JAZH 29
Triakidae indet.	Houndshark									2	
Carcharhinidae indet.	Requiem shark	14	1			8		1		13	6
Sphyrnidae indet.	Hammerhead shark			1						13	
Pristidae indet.	Sawfish	2								2	
Rhinobatidae indet.	Guitarfish									6	
Dasyatidae indet.	Stingray									20	
Myliobatida, indet.	Eagleray										14
Chondrichthyes indet.	Shark / Ray / Skate	13	1			2			2		10
Elopiida, indet.	Tenpounder									10	
Clupeidae indet.	Herring / Sardine		73	105							
Chanidae											
Chanos chanos (Forsskål, 1775)	Milkfish					1				4	
Ariidae *Arius* spp.	Sea catfish			1			7			161	
Belonidae indet.	Needlefish			1			7			7	1
Platycephalidae indet.	Flathead					1				5	2
Serranidae											
Epinephelus spp.	Grouper	2	2	22							9
Serranidae, indet.	Grouper	5				7				21	
Teraponidae *Terapon* spp.	Terapon			16						3	
Rachycentridae											
Rachycentron canadum (Linnaeus, 1758)	Cobia									4	
Echeneidae											
Echeneis naucrates Linnaeus, 1758	Sharksucker									4	
Carangidae											
Alectis spp.	Threadfish									1	
Alepes spp.	Scad			22							
Carangoides spp.	Jack		11	15		47				98	20
Caranx spp.	Trevally		1							1	
Decapterus spp.	Scad									2	
Elagatis bipinnulata (Quoy and Gaimard, 1824)	Rainbow runner					1				1	
Gnathanodon speciosus (Forsskål, 1775)	Golden trevally			2		9				17	1
Megalaspis cordyla (Linnaeus, 1758)	Torpedo scad			344		2				2	
Scomberoides spp.	Queenfish			28		17				143	
Seriola spp.	Amberjack									5	
Trachinotus spp.	Pompano									2	
Trachurus indicus (Nekrasov, 1966)	Arabian scad									2	
Carangidae indet.	Jack / Trevally	1	71			83	61			496	47
Gerreidae *Gerres* spp.	Mojarra		8	122		1					
Lutjanidae indet.	Snapper	2		58						6	1
Haemulidae											
Pomadasys spp.	Grunt		14	6		1				1	
Haemulida indet.	Grunt			5		2					1
Nemipteridae indet.	Threadfin bream		1	60							
Lethrinidae											
Lethrinus nebulosus (Forsskål, 1775)	Spangled emperor									3	
Lethrinus spp.	Emperor	1	7	216		60				15	47
Sparidae											
Acanthopagrus spp.	Seabream			28	5					43	30
Argyrops spinifer (Forsskål, 1775)	King soldierbream		5		1					18	
Rhabdosargus spp.	Gold-striped / Haffara seabream		4	59	57				1	45	107
Sparidae indet.	Seabream	2	4	86	2	194				154	104
Mugilidae indet.	Mullet			158						193	
Scaridae indet.	Parrotfish			1							2
Sphyraenidae											
Sphyraena spp.	Barracuda		7	2						24	22
Scombridae											
Euthynnus affinis (Cantor, 1849)	Kawakawa	4		204		6				42	
Thunnus spp.	Tuna	2	79	157		9		3		516	257
Thunninae	Tuna	85		67							
Scomberomorus spp.	Spanish mackerel		11	77		13					
Rastrelliger kanagurta (Cuvier, 1817)	Indian mackerel									9	
Scombridae indet.	Tuna / Mackerel		111			248					241
Istiophoridae, indet.	Sailfish			5							
Drepanida: *Drepane* spp.	Sicklefish									2	
Ephippidae *Platax* spp.	Batfish									13	
Siganidae *Siganus* spp.	Rabbitfish			50						10	
Balistidae indet.	Triggerfish						1				
TOTAL		**133**	**411**	**1918**	**65**	**712**	**76**	**4**	**3**	**2140**	**922**

For explanation of site codes see Table 1. Map codes relate to locations in Figure 3. Totals indicate number of bones identified to a particular family, genus or species.

survival of fish bones, including destruction by carnivores and rodents (Jones 1983, 1986), scavenging (Walters 1984), burning and cooking (Richter 1986; Nicholson 1996), weathering (Bullock and Jones 1987), and trampling (Jones 1987). Subsequently, human factors, such as the impact of particular butchery or processing techniques, may also affect which fish and particular elements enter the archaeological record (Belcher 1991, 1994, 1998; Zohar and Cooke 1997).

One of the key problems which must be tackled before we can proceed with modelling of the ancient fisheries is the identification of the archaeological fish bones. An extensive osteological reference collection of fishes is required, as well as considerable expertise and familiarity with the skeletal anatomy of the large range of fishes present in the region. An integral part of the author's research has been the construction of a skeletal reference collection of modern Arabian Gulf fishes (Beech 2001). Some problems, however, still remain for the analyst. Certain fish families and species, as well as particular anatomical elements, are more readily identified than others. The morphology of certain taxa and elements also means that it is more likely that they survive and are subsequently encountered by the analyst. Such factors should be taken into consideration when making comparisons between different assemblages (*ibid.*).

Fishes represented

A wide range of fish species are present at archaeological sites along the coast of the United Arab Emirates. In general, these are quite similar to the range of species which occur at the present day in the region.

At least four types of sharks have been so far identified. These include pelagic thresher sharks (Alopiidae), houndsharks (Triakidae), requiem sharks (Carcharhinidae) and hammerhead sharks (Sphyrnidae). Other cartilaginous fishes recorded to date include sawfish (Pristidae), guitarfish (Rhinobatidae), stingrays (Dasyatidae), and eaglerays (Myliobatidae).

Requiem sharks were found at 17 sites. These are also the most numerous type of shark caught and sold in the modern day fish markets in the region. Hammerhead sharks were found at Dalma, ed-Dur, Tell Abraq, Julfar and Shimal. The remains of pelagic thresher sharks have so far only been identified at the 'Ubaid 5th millennium B.C. settlement on Dalma Island (Beech 2000, 2001). Houndsharks have only been identified at the 3rd millennium B.C. Iron Age settlement of Shimal (von den Driesch 1994). Sawfish were caught at 12 sites, but guitarfish at only one site, Shimal (*ibid*). Stingrays occurred at eight sites and eaglerays at only four sites.

Bony fishes are represented by tenpounders (Elopiidae), herring/sardine (Clupeidae), milkfish (Chanidae), sea catfish (Ariidae), needlefish (Belonidae), flatheads (Platycephalidae), groupers (Serranidae), terapons (Teraponidae), cobias (Rachycentridae), sharksuckers (Echeneidae), jacks and trevallies (Carangidae), mojarras (Gerreidae), snappers (Lutjanidae), grunts (Haemulidae), threadfin bream (Nemipteridae), emperors (Lethrinidae), seabream (Sparidae), mullet (Mugilidae), parrotfish (Scaridae), barracuda (Sphyraenidae), tuna and mackerel (Scombridae), sailfish (Istiophoridae), sicklefish (Drepanidae), batfish (Ephippidae), rabbitfish (Siganidae), triggerfish (Balistidae) and pufferfish (Tetraodontidae).

Tenpounders have only been identified at Shimal. Herring/sardines were only noted at four sites, where fine sieving had been carried out permitting the recovery of their small bones. Milkfish were only observed at three sites, ed-Dur, Kush and Shimal, all, perhaps significantly, located in the Northern Emirates. Sea catfish occurred at nine sites, needlefish at 14 sites, and flatheads at eight sites. Groupers appear to have been commonly caught, 19 of the 29 study sites having traces of their remains. Terapons were only observed in assemblages from three sites, Marawah MR16, from the French excavations at Julfar and from Shimal. Cobias were only caught at two sites, Marawah MR6.1 and Shimal. Sharksuckers occurred at only one site, Shimal. Jacks and trevallies were commonly caught, occurring at 22 of the 29 study sites. Mojarras were only present at five sites, snappers at eight sites, grunts at ten sites, and threadfin bream at only one site, Julfar. Emperors and seabream were commonly caught at, respectively, 22 and 27 out of the 29 study sites. Mullet occurred at only five sites and parrotfish at nine sites. Barracuda and tuna/mackerel were commonly caught at, respectively, 14 and 19 sites. Bones from sailfish have only been identified from one archaeological site, the Late Islamic levels at Julfar (Desse and Desse-Berset 2000). Sicklefish have only been observed at one site, Shimal. Batfish occurred only at three sites, ed-Dur, Tell Abraq and Shimal. Rabbitfish were caught at four sites, triggerfish at only one site (in the Abbasid levels at

Table 5. Association of major fish species with particular marine habitats in the Arabian Gulf.

FAMILY	SPECIES	COMMON NAME	SANDBEACH	TIDAL CREEK	SUBTIDAL ROCK	SUBTIDAL SAND	SUBTIDAL MUD	GRASS BEDS	CORAL REEF	OPEN WATER
Carcharhinidae	*Carcharhinus melanopterus*	Blacktip reef shark							■	■
Sphyrnidae	*Sphyrna spp.*	Hammerhead shark								■
Pristidae	*Anoxypristis cuspidata*	Knifetooth sawfish						■		
Rhinobatidae	*Rhynchobatus djiddensis*	Giant guitarfish						■		
Dasyatidae	*Dasyatis* spp.	Stingray						■		
Myliobatidae	*Aetobatis narinari*	Spotted eagle ray							■	■
Clupeidae	*Nematalosa nasus*	Bloch's gizzard shad		■						■
Clupeidae	*Sardinella* sp.	Sardinella		■						
Engraulidae	*Stolephorus* spp.	Anchovy	■							■
Ariidae	*Arius thalassinus*	Sea catfish					■			
Belonidae	*Belonidae* spp.	Needlefish								■
Platycephalidae	*Platycephalus indicus*	Bartail flathead				■	■	■		
Serranidae	*Cephalopholis hemistiktos*	Yellowfin hind							■	
Serranidae	*Epinephelus coioides*	Orangespotted grouper								
Teraponidae	*Therapon jarbua*	Jarbua terapon		■						
Teraponidae	*Therapon puta*	Smallscaled terapon					■	■		
Rachycentridae	*Rachycentron canadus*	Cobia								■
Echeneidae	*Echeneis naucrates*	Sharksucker							■	■
Coryphaenidae	*Coryphaena hippurus*	Common dolphinfish								■
Carangidae	*Carangoides fulvoguttatus*	Yellowspotted trevally							■	■
Carangidae	*Decapterus* sp.	Scad								■
Carangidae	*Gnathanodon speciosus*	Golden trevally							■	■
Carangidae	*Scomberoides commersonnianus*	Talang queenfish								■
Carangidae	*Seriola dumerili*	Greater amberjack								■
Carangidae	*Trachinotus blochii*	Snubnose pompano							■	■
Carangidae	*Ulua mentalis*	Longrakered trevally							■	■
Leiognathidae	*Leiognathus* spp.	Ponyfish				■				
Gerreidae	*Gerres oyena*	Mojarra	■	■		■				
Lutjanidae	*Lutjanus fulviflamma*	Blackspot snapper			■		■	■	■	
Haemulidae	*Plectorhinchus pictus*	Trout sweetlips							■	
Haemulidae	*Pomadasys argenteus*	Silver grunt				■				
Nemipteridae	*Nemipterus peronii*	Notched threadfin bream				■	■	■		
Nemipteridae	*Scolopsis ghanam*	Arabian monocle bream			■				■	
Lethrinidae	*Lethrinus lentjan*	Pinkear emperor				■			■	
Lethrinidae	*Lethrinus nebulosus*	Spangled emperor	■			■			■	
Sparidae	*Acanthopagrus bifasciatus*	Twobar seabream			■				■	
Sparidae	*Argyrops spinifer*	King soldier bream				■	■	■		
Sparidae	*Rhabdosargus spp.*	Goldlined/ Haffara seabream						■		
Mugilidae	*Mugilidae*, indet.	Mullet		■						
Scaridae	*Scaridae*, indet.	Parrotfish							■	
Sphyraenidae	*Sphyraena jello*	Pickhandle barracuda								■
Scombridae	*Euthynnus affinis*	Kawakawa								■
Scombridae	*Rastrelliger kanagurta*	Indian mackerel							■	■
Scombridae	*Scomberomorus commersoni*	Narrowbarred Spanish mackerel							■	■
Scombridae	*Thunnus tonggol*	Longtail tuna								■
Istiophoridae	*Istiophorus platypterus*	Indo-pacific sailfish								■
Ephippidae	*Platax* spp.	Batfish							■	
Siganidae	*Siganus* spp.	Rabbitfish			■		■	■		
Balistidae	*Balistidae*, indet.	Triggerfish							■	
Tetraodontidae	*Arothron stellatus*	Stellate puffer						■		
Tetraodontidae	*Chelanodon patoca*	Milkspotted puffer				■	■	■		

Based on data in Basson et al. 1977: 219–72. Taxonomy follows Carpenter et al. 1997. Shaded boxes indicate occurrence of that particular species within the habitat category.

Kush), and pufferfish at four sites.

The relative occurrence of fishes on all the archaeological sites studied can be better viewed in figure 4. This clearly shows the relative importance of fishing for requiem sharks, groupers, jacks/trevallies, emperors, seabream and tuna/mackerel, all of which occur in 60% or more of the 29 study sites. These particular fish families still form a major part of annual modern catches in U.A.E. waters (Beech 2001).

Discussion

Chronological Change

There is comparatively little evidence of major changes in the selection of particular fish species though time (tables 1–4). This is probably because coastal communities in different periods were fishing in similar, if not the same, fishing grounds within the region. The variation which exists can largely be explained as a result of different recovery methods utilised on the excavations, sample size, preservational factors, different local/regional habitats exploited, or as the specialised exploitation of certain resources at particular locations and/or times of year.

During the earliest period, namely the 5th–4th millennium B.C., fishing appears to have been carried out in both shallow inshore waters and lagoons (e.g. at the coastal midden UAQ69 and midden/cemetery UAQ92-3 in Umm al-Qaiwain), as well as occasionally on offshore reefs and deeper waters (e.g. at the coastal settlement on Dalma Island, DA11). In the Umm al-Qaiwain lagoon fishing may have largely concentrated on spawning aggregations of emperors (*Lethrinus* spp.) during the early summer months, whilst on Dalma Island fishing also encompassed the exploitation of offshore coral reefs for larger groupers as well as deeper waters for pelagic species like tuna (Beech 2000, 2001).

For the 3rd millennium B.C. we have some information from Umm an-Nar, Tell Abraq, Shimal and Kalba. At Umm an-Nar (UAN), although the fish fauna has not been published in detail, we know that sawfish, stingrays, some species of shark, and other large fish were caught (Hoch 1979). At Tell Abraq (TAB) a range of cartilaginous fishes were caught, including requiem sharks, hammerhead sharks, sawfish and stingrays. Bony fishes which were commonly caught included groupers, jacks/trevallies and barracuda (Margarethe Uerpmann, pers. comm.). At the multi-period site of Shimal in Ra's al-Khaimah Emirate, a settlement has been excavated dating from the Umm an-Nar to Iron Age periods, ca. 2300–800 B.C. (Vogt and Franke-Vogt 1987). A total of 27 families, including more than 46 fish species, were identified despite all the bones being recovered by hand and no sieving being carried out (von den Driesch 1994). The assemblage was dominated by jacks/trevallies, followed by tuna/mackerel, seabream, mullet and sea catfish. Smaller quantities of barracuda, followed by groupers, stingray, emperors, spadefish, requiem shark, hammerhead shark, tenpounders, rabbitfish, needlefish, flatheads, guitarfish, snapper, milkfish, cobia, sharksucker, grunts, terapon, houndshark, sawfish and wrasse, were also present. Unfortunately, a complete breakdown of which particular species occurred in each of the four site phases was not given in this publication. Only the combined percentages for the major families were presented in the form of a histogram (von den Driesch 1994: 79, Diagramm 2); this suggested that during the Umm an-Nar period (phase 1, ca. 2300–2000 B.C.) the assemblage was dominated by jacks/trevallies and tuna/mackerel. During the subsequent Wadi Suq period (phase 2, 1900–1600 B.C.), there were far less jacks/trevallies and tuna/mackerel, seabream dominating these levels. During the following Late Bronze Age (phase 3, ca. 1600–1300 B.C.) and Iron Age periods (phase 4, 1200–800 B.C.) the relative amounts of seabream decreased again as jack/trevallies, followed by tuna/mackerel, re-emerged as the dominant families represented. It was suggested that this may represent an impoverishment of the settlement during the Wadi Suq period when fishing strategies concentrated on shallow inshore species such as seabream, rather than on deeper water pelagics. This theory should be viewed cautiously, however, as the fish remains from the site were recovered entirely by hand with no systematic sieving being carried out. Thus, comparisons between phases may simply reflect differential recovery and preservation in the deposits. Requiem shark and tuna were both noted in Umm an-Nar tomb 2 (UNAR) at Shimal. At Kalba (KAL1), jacks/trevallies, seabream and tuna/mackerel were all of some importance.

Unfortunately, we have comparatively little information for the Wadi Suq and Late Bronze Age periods. The small quantities of bones studied thus far from Kalba (KAL2-3) suggest that sawfish, groupers, jacks/trevallies, emperors, seabream and tuna were all exploited. At the Shimal settlement a similar range of fish was of importance. In addition, a 2nd millennium B.C. tomb at

Shimal (SH602) had the remains of an unidentified shark plus seabream within it. The future publication of the fish fauna from Tell Abraq will go some way towards filling this gap in our knowledge of fishing during this period (Margarethe Uerpmann, pers. comm.).

Iron Age fish bone assemblages have been studied from five sites. At Balghelam (BG12), a coastal midden, the fauna was completely dominated by the remains of some species of shark as well as the remains of sawfish. The site may well have been a locality used for the specialised exploitation of cartilaginous fishes. Such sites are well known during recent historical periods, when large quantities of sharks were processed on coastal sites, their fins being cut off for export principally to the Far East. At ed-Dur North (EDN), the presence of sawfish, groupers, jacks/trevallies, emperors, seabream, parrotfish, barracuda, and tuna/mackerel were all noted. At Shimal (SH) a wide range of fish was reported. At Kalba (KA4, KA5-7), requiem sharks, groupers, jacks/trevallies, grunts, emperors, seabream, barracuda, tuna and mackerel were all caught. About 25 km inland from the eastern Emirates coastline, to the west of Kalba in the Wadi al-Qawr, the settlement site of Rafaq 2 (RFQ2) had a fish bone assemblage dominated by the remains of tuna. Other fishes present that had been transported to the site included requiem shark, sawfish, grouper, jack/trevally, snapper, emperor and seabream (Beech et al. in prep.). This remarkable assemblage demonstrates what a wide variety of fish were already being traded to the interior of southeast Arabia from the coastal regions during the Iron Age.

During the Early pre-Islamic period we only have data from three sites, Marawah site 12.3, ed-Dur and Mleiha. At Marawah site 12.3 (MR12.3), a pre-Islamic burial cairn, fishing was mostly carried out in shallow inshore waters; emperors and seabream were regularly caught, as well as needlefish, flatheads, groupers, jacks/trevallies, mojarra, parrotfish and barracudas. At the site of ed-Dur, located in Umm al-Qaiwain Emirate, a vast 1st–4th century A.D. settlement located east of the Umm al-Qaiwain Lagoon appears to have functioned as an important trading harbour as well as a focus for settlement and religious activities. Here, it was noted that seabream and tuna/mackerel were 'very frequent' (Van Neer and Gautier 1993). Groupers, jack/trevallies and mullets were all described as being 'frequent'. Requiem sharks, sawfish, stingrays, milkfish, sea catfish, barracuda and rabbitfish were all described as being 'rare'. Hammerhead sharks, herrings/sardines/shads, needlefish, flatheads, snappers, mojarras, grunts, parrotfish, spadefish and puffers were all described as being 'very rare'. A single pharyngeal bone from a freshwater cyprinid, *Barbus*, was also noted which is most likely a foreign import, as cyprinids of this genus do not occur on the Arabian Peninsula (Van Neer and Gautier 1993: 113). At the inland site of Mleiha, located in Sharjah Emirate, the remains of a 3rd–4th century A.D. fort with associated buildings have been excavated. Fish bones were reported from both the fort (area CW) as well as from adjacent houses (area DA). The assemblage was dominated by the remains of tuna, in particular kawakawa/little eastern tuna (*Euthynnus affinis*), with smaller amounts of longtail tuna (*Thunnus* spp.). Other fish represented in small quantities included goldstriped/haffara seabream, jacks/trevallies, mullets and requiem shark (Mashkour and Van Neer 1999). Mleiha is located at least ca. 50 km from the East Coast and 80 km from the west coasts of the U.A.E. All these fish remains must, therefore, represent deliberate imports to the site.

During the occupation of the Late pre-Islamic Nestorian monastic community on Sir Bani Yas Island (sites SBY2, SBY4, SBY7 and SBY9), the occupants appear to have been particularly keen on the consumption of small cartilaginous fishes, many of which belong to requiem sharks. Other fishing tended to concentrate on small fish like emperors and seabream, taken from the shallow inshore coastal waters around the island.

Four sites provide information about fishing during the Sasanian/Early Islamic period, Marawah sites 6.1 and 6.3 in Abu Dhabi Emirate, as well as Kush and Jazirat al-Hulayla in Ra's al-Khaimah Emirate. At Marawah 6.1, a pair of pre/Early Islamic lime kilns, debris associated with an adjacent hearth included moderate quantities of jacks/trevallies, emperors, seabream and parrotfish, with stingrays, needlefish, cobia, grunts and tuna/mackerel also being present. At Marawah 6.3, a nearby small oval shaped sunken burial cairn, needlefish, flatheads, jacks/trevallies, emperors, seabream, barracuda, parrotfish and tuna/mackerel were all recorded. At Kush (KU1-3), most of the fish bones so far studied come from the Early Islamic period, only small quantities of bones being recorded from the Sasanian and Abbasid periods. In the Early Islamic levels, seabream was the most ubiquitous family represented, followed by tuna/mackerel and jacks/trevallies. Scombrids present included both tuna species, *Euthynnus affinis* and *Thunnus*, as well as Spanish mackerel, *Scomberomorus* spp. Other taxa represented included milkfish (*Chanos chanos*). At Jazirat al-Hulayla

(JHU), tuna were the commonest remains, most belonging to the longtail tuna (*Thunnus* spp.). Other fishes present were requiem sharks, eaglerays, needlefish, flatheads, groupers, jacks/trevallies, snappers, grunts, emperors, seabream, parrotfish, and barracuda.

Four fish bone assemblages were dated to the Late Islamic period: Marawah sites MR14, MR15, MR16 and Julfar. At Marawah site 14 (MR14), a shell midden located about 150 m north of Marawah Village, needlefish were the most ubiquitous remains, followed by jacks/trevallies, emperors, then groupers. Other fishes represented included requiem sharks, stingrays, eaglerays, seabream, barracuda, tuna/mackerel and puffers. At Marawah site 15 (MR15), a small midden located a short distance to the north of MR14, needlefish were again the commonest type of fish caught, followed by requiem sharks and groupers. Other fishes present included stingrays, jacks/trevallies, emperors, seabream and tuna/mackerel. At Marawah site 16 (MR16), a midden located near the village of Ghubba on the mid southern coast of Marawah, the most ubiquitous taxa were needlefish and jacks/trevallies, followed by requiem sharks. Other fishes recorded included sawfish, eaglerays, sea catfish, groupers, terapons, mojarras, emperors, seabream, barracuda, tuna/mackerel and puffers. At Julfar, the well known coastal port in Ra's al-Khaimah Emirate, the remains of tuna (especially *Euthynnus affinis*) were common. Other fishes present were requiem sharks, hammerhead sharks, herring/sardines, sea catfish, needlefish, groupers, terapons, jacks/trevallies, mojarra, snapper, grunt, threadfin bream, emperor, seabream, mullet, parrotfish, barracuda, Spanish mackerel, sailfish and rabbitfish. This is the first time that sailfish have been discovered on an archaeological site in the region (Desse and Desse-Berset 2000). The sailfish, often sought after by modern day sports fishermen, who charter boats from Abu Dhabi and Dubai during the main fishing season (usually during the cooler late autumn and winter months, October–February), is an extremely powerful fish. It is possible catching this fish with the basic fishing equipment of earlier periods may have been difficult. As its occurrence in Emirati waters is highly seasonal, its absence from earlier period sites might also be simply explained by the fact that there were fewer opportunities for the coastal inhabitants to catch such a fish.

Habitats

The fishes caught in U.A.E. waters can be broadly grouped into one or more of the following habitat categories: fishes caught within sandy beach areas, in tidal creeks, on subtidal rocks, in subtidal sand, in subtidal mud, in grassbeds, on or near coral reefs or in open waters. Some of the major fish species and their associated habitats are detailed in table 5.

Sandy Beach Areas

Many of the fishes represented at the archaeological sites would have been caught in lagoons or shallow coastal waters. Typical fish caught in such habitats include anchovies, mojarra and spangled emperors (*Lethrinus nebulosus*). These may have been caught by beach seine nets, hook and line or even in the barrier traps discussed earlier in this paper.

Tidal Creeks

Typical fishes caught in tidal creeks include shads and sardinella, terapons, mojarra and mullet. It is likely that these would have been caught by nets or barrier traps.

Subtidal Rocks

Orangespotted groupers, blackspot snappers, Arabian monocle bream, twobar seabream and rabbitfish are amongst the fish commonly caught in subtidal rock areas. Fishing with hook and line, and occasionally with basket traps and nets depending on the degree of rockiness of the strata, are the typical methods utilised in such areas today.

Subtidal Sand

Typical fishes caught in subtidal sand areas include bartail flatheads, orangespotted groupers, ponyfish, mojarra, silver grunts, notched threadfin bream, pinkear emperors, spangled emperors, king soldier bream and milkspotted puffers. Various fishing methods are used in such areas including barrier traps, basket traps, nets, and hook and line.

Subtidal Mud

Sea catfish, bartail flatheads, small-scaled terapon, blackspot snappers, notched threadfin bream, king soldier bream, rabbitfish and milkspotted puffers are amongst the fishes typically caught in subtidal mud habitats. Various fishing methods are used in such areas including barrier traps, basket traps, nets, as well as hook and line.

Grassbeds

Fishes caught in grassbed areas include sawfish, guitarfish, stingrays, flatheads, small-scaled terapons, blackspot snapper, notched threadfin bream, king soldierbream,

goldlined/haffara seabream, batfish, triggerfish and milkspotted puffers. Various fishing methods are used in such areas including basket traps, nets, and hook and line.

Coral Reefs

A wide variety of fishes are commonly associated with coral reefs. In the Arabian Gulf typical fishes represented include blacktip reef shark, spotted eagleray, yellowfin hind, orangespotted grouper, sharksucker, yellowspotted trevally, golden trevally, snubnose pomano, longrakered trevally, blackspot snapper, trout sweetlips, pinkear emperor, spangled emperor, twobar seabream, parrotfish, Indian mackerel, batfish and triggerfish. Various fishing methods are used in such areas including basket traps, nets, and hook and line.

Open Water

Fishes caught in open waters include blacktip reefshark, hammerhead shark, eagleray, shad, anchovy, sea catfish, cobia, sharksucker, common dolphinfish, yellowspotted trevally, scad, golden trevally, talang queenfish, greater amberjack, snubnose pomano, longrakered trevally, pickhandle barracuda, kawakawa, Indian mackerel, longtail tuna and Indo-Pacific sailfish. Fishing methods used in open waters usually include predominantly the use of drift nets as well as hook and line.

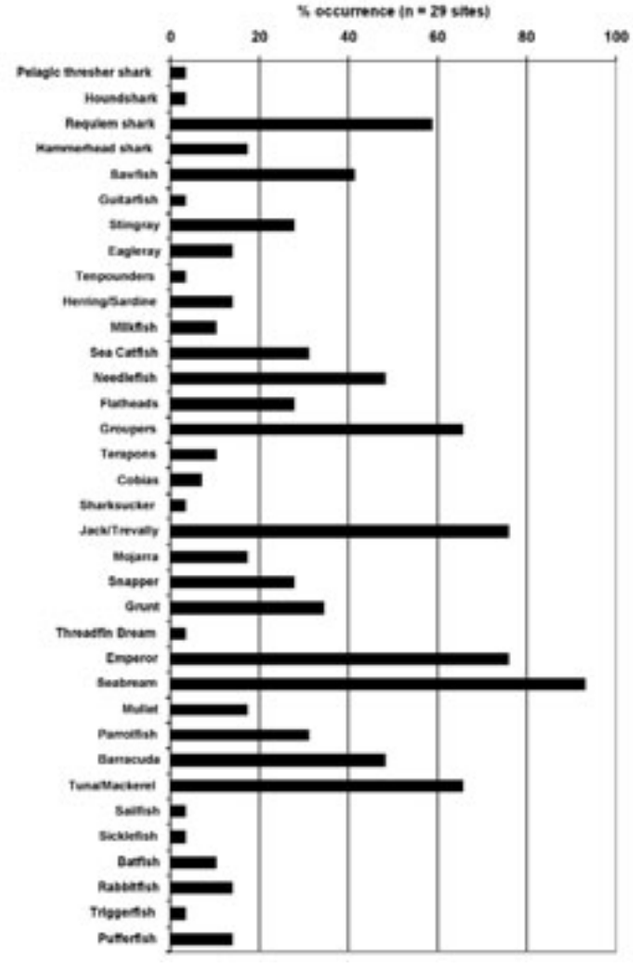

Fig. 4. Relative occurrence of fishes on archaeological sites in the U.A.E.

Regional variability

It has already been observed that there is comparatively little evidence of major changes in the selection of particular fish species though time. What is clear, however, is that there is a tendency for regional groupings of particular types of fish. This tendency has been demonstrated in more detail elsewhere; Shannon-Wiener and Simpson's biological diversity indices, as well as Renkonen's percentage similarity index, have been used to compare all the archaeological fish bone assemblages (Beech 2001). One of the conclusions of this aforementioned study was that fishing for members of the scombrid family, tuna and mackerel, was more marked at archaeological sites located in the Northern Emirates and on the eastern Emirates coast. This is clearly demonstrated in figure 5. In this graph, the archaeological sites are listed in geographical order from the Abu Dhabi coastline at the top to the East Coast and Northern Emirates at the bottom of the graph. The relative percentage of identified scombrid remains is plotted as a percentage of the total number of identified bones. Note that the majority of the sites located at both the Northern Emirates and on the East Coast have a much higher ratio of identified scombrid remains. To a great extent this matches the modern day fisheries catches in the Emirates, the bulk of the tuna and mackerel being caught in these waters. These pelagic fishes are more readily caught in the deeper waters in the Northern Emirates and on the East Coast. Another important factor is that the season in which they can be caught in these areas is far more prolonged than in Abu Dhabi waters, e.g. tuna are only available in any great number for about 6–8 weeks each year in waters close to Dalma Island in western Abu Dhabi (Beech 2000).

Another important phenomenon to be considered is specialisation. Despite considerable documentary evidence for the shark fin trade in recent historical periods, we have little direct zooarchaeological data to confirm its great antiquity. Perhaps this is because comparatively few Late Islamic middens have been examined in any great detail. The Iron Age site on Balghelam Island near Abu

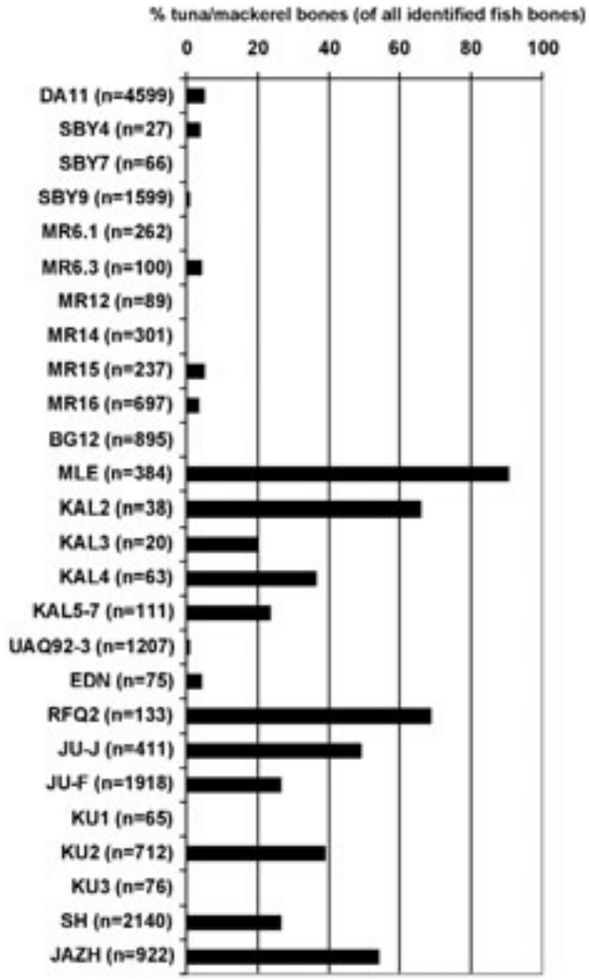

Fig. 5. Relative percentage of tuna/mackerel (Scombridae) bones as a proportion of the total fish bone assemblage from archaeological sites in the U.A.E.. For explanation of site codes, see Table 1. Figures in brackets represent total number of identified bones from that particular site.

Dhabi (BG12) provides us with some of the earliest evidence of a site purely specialised in the exploitation of shark and sawfish. Although cartilaginous fishes do not generally survive well in the archaeological record, their vertebrae may become well calcified if the preservation conditions are suitable. On Balghelam there appears to have been an organised temporary camp for the exploitation of sharks and sawfish.

Early coastal communities not only targeted particular coastal locations in order to exploit fish such as sharks and pelagic species, but they would have also targeted certain coastal areas during particular seasons in order to maximise the success of their resource procurement schedule. One of the challenges facing future zooarchaeologists working in this area is to pin point some of these typical seasonal exploitation patterns. One possible way to examine this question is to undertake a detailed study of fish otoliths to determine when the fish were originally captured (Beech in prep.).

Concluding statements

Regional variability in fisheries resources is of some significance to the movements of early communities occupying the coastal zone of the United Arab Emirates. Certainly, the fishing of pelagic species appears to be far more developed at the archaeological sites located in the Northern Emirates and on the East Coast. Fishing on the majority of sites, however, concentrated on local shallow inshore coastal waters. Such areas provided a rich supply of fish, as they still do today. Early coastal communities would have exploited lagoons and creeks, as well as shallow sandy beaches to capture the majority of their fish. Fishing on coral reefs and in open waters does date back, however, as early as the 5th millennium B.C. Elucidating the complex scheduling of past marine resource exploitation in the coastal zone of the United Arab Emirates is not an easy matter. Future archaeological research should concentrate on developing multi-disciplinary teams for investigating the question of seasonality. By comparing such data as growth rings on fish otoliths and marine mollusca, isotopic dietary studies on human bones, etc., it may be possible to advance our understanding of the complexities of fisheries subsistence strategies in southeast Arabia.

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