Fishing in the 'Ubaid: a Review of Fish-bone Assemblages from Early Prehistoric Coastal Settlements in the Arabian Gulf

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> 'The coastal location of the sites and their obvious marine exploitation strongly favour seaborne relations, with the Mesopotamian explorers obtaining pearls, flint, dried fish, possibly hides from gazelle and equids, (ostrich eggs?) and in exchange bringing grain, textiles, a little jewellery, and introducing pottery. The settlements with more substantial housing and with pottery production on some of the coastal sites could be evidence of longer and recurrent seasonal visits, during the pearling season for instance...' (Frifelt 1989: 415).

There has been much speculation concerning the subsistence and economy of early prehistoric coastal communities of the Arabian Gulf (Oates 1978; Tosi 1986; Frifelt 1989; Vogt 1994). A general model has been proposed suggesting that, as many of the archaeological sites appear to be quite ephemeral (i.e. largely consisting of small scatters of lithics, pottery and/or shell midden debris), certain locations may simply have been visited on a seasonal basis. Some sites however do appear to have much more substantial traces of housing, e.g. site H3 in Kuwait (Carter in press; Crawford 2000, 2001; Crawford *et al.* 1999), Dosariyah in Saudi Arabia (Masry 1974), Shagra in Qatar (Inizan 1988), and Dalma Island in the U.A.E. (Beech and Elders 1999; Beech *et al.* 2000; Shepherd-Popescu and Beech *in prep.*).

This paper aims to review the evidence of fish bone assemblages from the earliest known coastal settlements within the Arabian Gulf, namely between the late 6th - 4th millennium BC, during the period of the so-called Arabian bifacial tradition. A now well-attested phenomenon in this region is the trickling down of 'Ubaid pottery from southern Mesopotamia, down the Gulf along the Saudi Arabian coast, beyond Qatar, to a number of sites located along the coast of the United Arab Emirates (Crawford 2000, 2001; Crawford *et al.* 1999; Burkholder 1972; Burkholder and Golding 1971; Hermansen 1993; Masry 1974; McClure and Al-Shaikh 1993; Beech and Elders 1999; Beech *et al.* 2000; Boucharlat *et al.* 1991a, 1991b; Flavin and Shepherd 1994; Haerinck 1991; Millet 1991; Phillips *in prep*; Jasim 1996; Uerpmann and Uerpmann 1996). Various hypotheses have been proposed to explain this phenomenon such as the existence of 'sea-faring merchants of Ur' (Oates *et al.* 1977; and *cf.* Roaf and Galbraith 1974) or, perhaps more likely, barter or exchange between inter-regional trade networks (Masry 1974). Whilst scientific analyses have demonstrated that much of the 'Ubaid sherds found in the lower Gulf do originate from southern Mesopotamia (Méry and Schneider 1996,

2000), there has been little discussion of potential resources which may have been traded in the opposite direction northwards to Mesopotamia.

Exploitation of fish and other marine resources (Cartwright 1994, 1998), as well as date palms (Beech and Shepherd 2001), would have clearly been of great importance in the past, as is still the case today for many of the coastal inhabitants of Eastern Arabia. The people living in this general area were well known to a number of early authors, explorers and visitors who often described them as being the '*ichthyophagi*' or 'fish-eaters' due to the staggering quantities of fish which they and even their livestock consumed

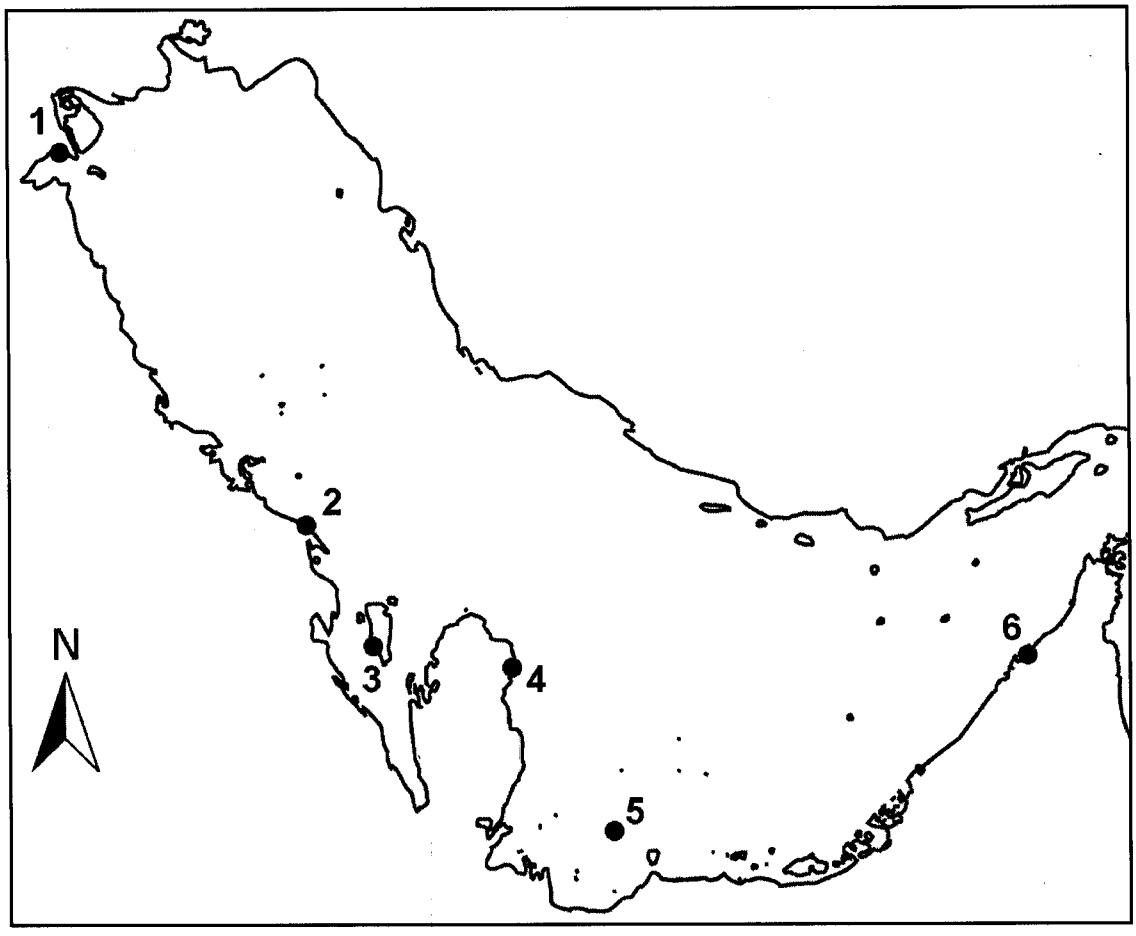

FIGURE 1. *Location of early prehistoric sites with fish bone assemblages in the Arabian Gulf. 1. Site H3,* Kuwait; *2.* Dosariyah, *Saudi Arabia; 3.* Al Markh, Bahrain; *4.* Khor P, Qatar; *5.* Dalma *island, United Arab Emirates; 6.* Umm al Qaiwain, *United Arab Emirates.*

(for a recent review of the historical evidence, *cf.* Donaldson 2000). One should remember though that most of these historical accounts were written by Europeans who were probably remarking more on this dramatic contrast with their own diet.

So what available evidence is there for which types of fish were consumed on these early prehistoric coastal sites? Detailed information is currently available for fish bone assemblages from six sites. Four of these sites have been studied by the present author: site H3 in Kuwait (fig.1, no.1), Dosariyah on the coast of Saudi Arabia (fig.1, no.2), site DA11 on Dalma Island in the western Abu Dhabi region of the United Arab Emirates (fig.1, no.5), and sites 1 and 2 at Umm al Qaiwain in the United Arab Emirates (fig.1, no.6). In addition, two already published sites are also considered which have quantitative information avail-

able for comparison. These are the sites of J19 at Al Markh in Bahrain (fig.1, no.3; Roaf 1974, 1976; von den Driesch and Manhart 2000) and Khor P in Qatar (fig.1, no.4; Desse 1988).

After discussing the composition of the fish assemblages at the various sites, the relative size of the fish caught will then be discussed, based on reconstructing the original size of the fish by comparing archaeological material with fish bones from modern fishes of known length. Species and common names utilised in this paper follow the taxonomy used by Carpenter *et al.*(1977). A more detailed description of the zooarchaeological methods utilised to record and analyse these fish bone assemblages is provided in Beech (2001). The work carried out in the course of the gestation of this paper would not have been possible without the help and co-operation of a number of individuals and organisations (see acknowledgements).

SITE H3, KUWAIT

Site H3 is located at 29°38'30"N 48°09'02"E, on Jazirat Dubaij, a 4 km long bedrock promontory extending westwards from the Jal Az-Zor escarpment situated in the Sabiyah region on the north coast of Kuwait Bay (fig. 1, no.1). The site was first discovered by Dr. Fahad al Wohaibi, the former director of the National Museum of Kuwait. Excavations at the site during 1998-99 by Dr. Harriet Crawford and Dr. Robert Carter (Institute of Archaeology, University College, London), in conjunction with colleagues from the National Museum of Kuwait, have identified an 'Ubaid 2/3 period coastal site (Crawford *et al.* 1999; Crawford 2000).

The site consists of a number of well preserved stone structures with up to a metre of deposits, abundant pottery and lithics, and evidence of the manufacture of shell beads. At least five separate stone structures can be seen at the surface within an area of about 100 m x 80 m. Three trenches were made during the excavation: area A (on top of the mound), area B (on the west side of the mound) and area F (a deep sounding adjoining the SE corner of area A, at the edge of a fox-hole dug during the Gulf War).

The bones discussed here are just those from these initial two seasons of excavation (1998-9). The material recovered from the spring 2001 season (Carter in press; Crawford 2001) is currently being analysed by the author. Non-fish remains recovered from the site included small quantities of sheep/goat (both sheep and goat being present), as well as a few fragments of cattle. However, fish remains formed 58% of the total faunal assemblage by weight (1689g of fish bone versus 1,221g of mammal bone, of which only 253g were identifiable mammal bone fragments). A single chela from a swimming crab (*Portunus*) was also noted (Peter Hogarth, pers. comm.).

A total of 6451 fish bone fragments (1623g) was recovered by >4 mm mesh sieving on the excavation. Out of these, 1018 (16%) were identifiable to class, family, genus or species level (Table 1). A total of ten families including at least fourteen genera were represented. These included: requiem sharks (*Carcharhinus* spp.), sawfish (Pristidae), eaglerays (Myliobatidae), unknown shark or ray, sea catfish (*Arius* spp.), flatheads (*Platycephalus* spp.), groupers (Serranidae), scads (*Decapterus* spp.), queenfish (*Scomberoides* spp.), jacks/trevallies (Carangidae), emperors (*Lethrinus* spp.), seabream (*Acanthopagrus* spp.), king soldierbream (*Argyrops spinifer*), haffara/goldlined seabream (*Rhabdosargus* spp.), indeterminate seabream (Sparidae) and tuna/mackerel (Scombridae).

The most frequent families represented were requiem sharks, sea catfish, groupers, jacks and primarily seabream. This range of taxa suggests that most fish were probably caught in shallow coastal waters. The presence of tuna, albeit in small numbers, is worth remarking upon. This species can no longer be caught in Kuwait Bay at the present day, and in fact much of Kuwait's tuna landings originate entirely from its southernmost waters (Mohsen Al-Husainy, pers. comm.). This may indicate that there has been substantial environmental change in Kuwait Bay. Kuwaiti waters are notably turbid at the present day largely due to increased sedimentation from the Shatt Al-Arab.

A notable feature of the H3 fish bone assemblage was the excellent preservation of 65 sea catfish (*Arius* spp.) otoliths. These varied in size from

TAXON	COMMON NAME	KUW	DOS -S	DOST -1	DOST -5	DOST -7	ALM -J19	KHORP	DA11	UAQ 92-3
Alopiidae: *Alopias* sp.	Thresher Shark	0	0	0	0	0	0	0	5	0
Carcharhinidae: *Carcharhinus* spp.	Requiem Shark	88	39	29	0	11	11	1	277	0
Sphyrnidae: *Sphyrna* spp.	Hammerhead Shark	0	0	0	0	0	17	0	44	0
Pristidae, indet.	Sawfish	14	9	9	1	0	11	0	22	0
Rhinobatidae, indet.	Guitarfish	0	0	0	0	0	3	0	0	0
Dasyatidae, indet.	Stingray	0	0	1	0	0	3	0	0	0
Rajiidae, indet.	Ray	0	0	2	0	0	0	0	0	0
Myliobatidae, indet.	Eagleray	10	0	22	0	52	0	0	18	0
Chondrichthyes, indet.	Shark/Ray/Skate	136	3	5	2	0	0	0	629	0
Clupeidae, indet.	Herring/Sardine	0	0	0	0	0	1436	0	0	6
Ariidae: *Arius* sp.	Sea Catfish	74	0	18	0	8	5	1	3	0
Atherinidae, indet.	Silversides	0	0	0	0	0	16	173	0	0
Belonidae, indet.	Needlefish	0	0	0	0	0	1	0	844	0
Platycephalidae, indet.	Flathead	5	0	0	0	1	4	0	0	1
Serranidae: *Epinephelus* spp.	Grouper	11	11	1	3	12	0	0	208	0
Serranidae, indet.	Grouper	148	4	9	2	20	601	5	477	1
Carangidae: *Carangoides* spp.	Jack	13	6	0	1	14	21	0	8	3
Carangidae: *Decapterus* spp.	Scad	21	0	0	0	0	0	0	0	0
Carangidae: *Gnathanodon speciosus* (Forsskål, 1775)	Golden Trevally	0	0	0	0	1	6	0	9	3
Carangidae: *Megalaspis cordyla* (Linnaeus, 1758)	Torpedo Scad	0	0	0	0	0	0	0	3	0
Carangidae: *Scomberoides* spp.	Queenfish	3	0	0	0	0	1	0	6	0
Carangidae: *Trachurus indicus* Nekrasov, 1966	Arabian Scad	0	0	0	0	1	0	0	0	0
Carangidae, indet.	Jack/Trevally	114	0	1	3	19	0	5	74	6
Leiognathidae, indet.	Ponyfish	0	0	0	0	0	5	0	0	0
Gerreidae, indet.	Mojarra	0	0	0	0	0	249	0	0	0
Lutjanidae, indet.	Snapper	0	0	0	0	0	16	0	1	11
Haemulidae: *Pomadasys* spp.	Grunt	0	0	0	0	0	1	0	0	1
Haemulidae, indet.	Grunt	0	0	0	0	0	4	0	1	0
Lethrinidae: *Lethrinus lentjan* (Lacepède, 1802)	Redspot Emperor	0	0	0	0	0	0	0	0	65
Lethrinidae: *Lethrinus* spp.	Emperor	14	0	1	1	3	267	0	128	66
Sparidae: *Acanthopagrus* spp.	Seabream	1	0	0	1	8	1024	0	35	0
Sparidae: *Argyrops spinifer* (Forsskål, 1775)	King soldierbream	20	2	55	3	9	22	0	3	0
Sparidae: *Crenidens crenidens* (Forsskål, 1775)	Karanteen Seabream	0	0	0	0	0	7	0	0	0
Sparidae: *Diplodus sargus kotschyi* (Steindachner, 1876)	Onespot Bream	0	0	0	0	0	451	0	0	0
Sparidae: *Rhabdosargus* spp.	Haffara/Goldstriped Seabream	18	2	72	3	118	1621	0	174	168
Sparidae, indet.	Seabream	307	10	853	42	406	10441	670	1389	835
Mugilidae, indet.	Mullet	0	0	0	0	0	13	0	0	0
Scaridae, indet.	Parrotfish	0	0	3	0	2	0	0	8	0
Sphyraenidae: *Sphyraena* spp.	Barracuda	0	0	1	0	0	23	0	2	33
Scombridae: *Euthynnus affinis* (Cantor, 1849)	Kawakawa/ Little Eastern Tuna	0	0	0	4	1	2	0	15	0
Scombridae: *Thunnus* spp.	Tuna	0	0	0	0	0	0	0	5	0
Scombridae (Thunninae)	Tuna	0	0	0	0	0	0	0	195	0
Scombridae: *Scomberomorus* spp.	Spanish Mackerel	0	0	0	0	0	0	0	3	1
Scombridae, indet.	Tuna/Mackerel	21	72	10	46	2	0	0	13	7
Siganidae: *Siganus* spp.	Rabbitfish	0	0	0	0	0	11	0	0	0
TOTAL		**1018**	**158**	**1092**	**112**	**688**	**16293**	**855**	**4599**	**1207**

TABLE 1. Fish bones recovered from early prehistoric coastal sites in the Arabian Gulf. Figures represent number of identified specimens. For a full explanation of the quantification methods employed see Beech (2001), Desse (1988), and von den Dreisch and Manhart (2000). Key to site codes: KUW = site H3, Kuwait; DOS-S = Dosariyah (surface deposits); DOS-T1 = Dosariyah (trench 1); DOS-T5 = Dosariyah (trench 5); DOS-T7 = Dosariyah (trench 7); ALM-J19 = Site J19, Al Markh, Bahrain; KHORP = site Khor P, Qatar; DA11 = site DA11, Dalma Island, U.A.E.; UAQ92-3 = Sites 1+2, Umm al Qaiwain, U.A.E.

some quite small examples to some large specimens, which must be from mature adult fish. The majority of them however clustered between a maximum width of 10-12 mm and 8-10 mm in height. This fish was also represented by a small number of neurocranial fragments which could be identified on the basis of their characteristic granular texture. A few vertebrae were also recognised as belonging to sea catfish. These were surprisingly few compared to the number of fish represented by the otoliths. This bias is probably due to differential survival and preservation, as sea catfish otoliths are quite bulbous in shape and perhaps survive better than other skeletal elements. There is also some evidence from the most recent excavation season at H3, which suggests that they may have been deliberately collected as 'blanks' for making beads (Beech *in prep.*).

The diagnostic anatomical elements which could be assigned to particular size classes mostly came from small to medium-sized fish, with comparatively few large or very large specimens. Out of these recorded diagnostic elements, 58% were from fish smaller than 30 cm in length, 78% were less than 40 cm and 92% were less than 50 cm in length. Analysis of the size of the vertebrae confirmed the picture obtained from the diagnostic elements, namely that most of the fish were small-to-medium in size with only a few larger specimens. The only taxa with large vertebrae were sawfish, groupers and tuna.

DOSARIYAH, SAUDI ARABIA

The Dosariyah site is located at 26°55'18"N 49°44'39"E, in the al Dikaka area, 12 km south of the coastal town of Jubail in the Eastern Province of Saudi Arabia (fig. 1, no.2). The site itself is located 1.5 km inland from the present day Gulf coast. It was first discovered by Burkholder (1972) who noted that it consisted of two exposed areas, the larger of which was over 100 m long, situated between white sand dunes. In total the site covered an area of approximately 1.6 km. More than 1,000 painted early-middle 'Ubaid type sherds were found on the surface, along with a number of unpainted, straw-tempered coarse red sherds. This makes it the largest and most extensive of the 'Ubaid coastal settlements in north-eastern Arabia. The lithic assemblage recovered from the surface included large numbers of flint awls, scrapers, knives, flakes and arrowheads. These all typologically resembled Qatar Group D. A number of polished stone celts and grinding stones were also collected as well as a pressure-flaked knife, two beads and a few obsidian blades.

Fragments of plaster, some with reed-impressions, suggested the remains of houses built of plant material (?palm fronds) and plaster. It has been pointed out by a number of authors that one plaster fragment discovered at a height of 5.5 m above the present day sea-level may indicate a possible change in sea-level which may have affected the site (Burkholder and Golding 1971; Potts 1990: 44). Masry (1974) noted the presence of a small mound nearly 3 m high at the centre of the site. The surface of the site was packed with shell fragments, which in some places were up to 30 cm deep. Large quantities of painted and plain Haji Mohammed-Standard 'Ubaid pottery were recovered. A gridded surface collection was carried out and this collected a number of stone implements including side scrapers and tanged and barbed arrow-heads made of tabular flint, hand axes, grinding stones and many lime plaster fragments. Four excavation trenches were made.

Unfortunately, precise details of the retrieval methods used to recover the faunal remains from these trenches are not available. It seems likely that the surface material was largely collected by hand and that some sieving was carried out during the excavation of trenches, judging by the relative size of bone fragments. This may have been using a ca. 5 mm mesh.

Significant quantities of fish bones were recovered in trenches 1, 5, 6 and 7 at Dosariyah during Abdullah Masry's excavations in 1968. All the faunal material was subsequently transported back to the USA for analysis, and Dr. Melinda Zeder (then of the Department of Anthropology in Michigan, now of the National Museum of Natural History, Smithsonian Institution, Washington DC) undertook analysis of the mammalian remains from the site (Zeder 1974). The present author made a one week research visit to Washington DC to study

this collection in October 1999.

Mammalian remains identified by Zeder included cattle, sheep/goat, gazelle, equid, canid and hare (Masry *op. cit.*). Caprids formed the most numerous mammal group at the site, based on bone counts. However, Zeder noted that the ratio of fish bone to mammal bone was 2 grams fish to 1 gram mammal, suggesting that fish played an important role in the subsistence of the inhabitants of Dosariyah. At Dosariyah 60% of the weight of the assemblage comprised fish remains (Masry 1974, 235). Other non-fish remains identified at Dosariyah included three chelae from swimming crabs, *Portunus* (Peter Hogarth, pers. comm.).

DOSARIYAH - SURFACE DEPOSITS (DOS-S)

A total of 172 fish bone fragments were collected from the surface of Dosariyah, of which 141 (92%) were identifiable to at least family, genus or species level. Six families were represented, including at least seven genera. The following families were present: requiem sharks, sawfish, groupers, jacks/trevallies, seabream and tuna (Scombridae - Thunninae). The most frequent families represented were tuna followed by requiem sharks, only small quantities of other fishes being present.

Most of the remains were vertebrae, although some cranial elements from groupers, jacks and seabream were noted. The size of these diagnostic cranial elements indicated that small seabream between 10-40 cm were present, as well as large jacks (*Carangoides* spp.) between 50-90 cm and groupers (*Epinephelus* spp.) between 40-90 cm. Analysis of the size of vertebrae in surface deposits at Dosariyah also indicated that large requiem sharks, sawfish and tuna were also present. The fact that no vertebrae smaller than 12 mm in diameter were recorded suggests that there has been a recovery bias in the collection of this material.

DOSARIYAH - TRENCH 1 (DOS-T1)

2720 fish bone fragments were collected from trench 1 at Dosariyah, of which 1092 (40%) were identifiable to the level of family, genus or species. Thirteen families were represented, including at least fourteen genera. The following families were present: requiem sharks, sawfish, stingrays (Dasyatidae), rays (Rajidae), eaglerays (Myliobatidae), sea catfish (Ariidae), groupers, jacks/trevallies, emperors, seabream, parrotfish (Scaridae), barracuda (Sphyraenidae) and tuna/mackerel (Scombridae).

The most frequent families represented were seabream with only smaller quantities of other taxa being present. Seabream were mostly represented by cranial elements, relatively few vertebrae being recorded. *Rhabdosargus* and *Argyrops spinifer* were the common genera of seabream present. Examination of the size classes of the diagnostic elements revealed that these nearly all came from small individuals between 10-30 cm in length. The only larger fish present were a large grouper (90-100 cm), medium-sized (50-60 cm) and large-sized (90-100 cm) parrotfish, and a large tuna (80-90 cm). Analysis of the size of vertebrae broadly confirmed this picture but demonstrated that medium to large sized requiem sharks and sawfish were also present. The fact that some quite small vertebrae were present suggests that it is likely that dry sieving, perhaps using a ca. 5 mm mesh was used during the excavation.

DOSARIYAH - TRENCH 5 (DOS-T5)

243 fish bone fragments were recovered from trench 5, of which 112 (46%) were identified to the level of family, genus or species. Six families were represented, including at least eight genera. The following families were present: sawfish, groupers, jacks/ trevallies, emperors, seabream and tuna. Seabream and tuna were among the most frequent families represented, the former again being mostly represented by cranial elements, with relatively few vertebrae being noted. *Acanthopagrus*, king soldierbream (*Argyrops spinifer*) and haffara/goldstriped seabream (*Rhabdosargus* spp.) were all represented amongst the seabream. Most of the remains were from small fish sized between 10-30 cm. The only larger fish present

were groupers sized between 60-90 cm, jacks sized between 80-100 cm and two tuna, sized 80-90 and 100-110 cm respectively. Examination of the size of vertebrae showed that most of them belonged to tuna, with large sawfish and shark also present.

DOSARIYAH - TRENCH 7 (DOS-T7)

1277 fish bone fragments were recovered from trench 7, of which 688 (54%) were identified to the level of family, genus or species. Ten families were represented, including at least fourteen genera. The following families were present: requiem sharks, eaglerays, sea catfish, flatheads, groupers, jacks/trevallies, emperors, seabream, parrotfish and tuna. Seabream appear to have been the most frequent family exploited, followed by groupers and jacks/trevallies. Only a very small quantity of tuna was noted.

Both cranial and trunk (vertebrae) elements were recorded from all the major families. *Carangoides* was the most commonly observed genus amongst the jacks/trevallies, followed by golden trevally (*Gnathanodon speciosus*) and pompano (*Trachinotus*). Seabream genera included *Acanthopagrus*, king soldierbream and haffara/goldstriped seabream, the latter genus being the most common.

Analysis of the size class data from diagnostic elements suggested that the species of flathead present was between 40-50 cm, suggesting that it probably belongs to the Indian flathead (*Platycephalus indicus*). Groupers were sized between 30-90 cm, most falling in the upper part of the range and belonging to *Epinephelus* spp. The jack/trevally diagnostic elements all originated from medium to large sized fish between 50-120 cm. Most of the emperor and seabream diagnostic elements came from small fish sized between 10-30 cm. Two parrotfish (Scaridae) dentaries were noted from medium-sized 50-70 cm individuals. An articular from a kawakawa/little eastern tuna (*Euthynnus affinis*) came from a 70-80 cm individual. The size of the fish vertebrae in trench 7 confirmed the presence of large groupers, jacks (including the genus *Carangoides*), small seabream and medium-sized tuna.

DOSARIYAH - SUMMARY

A contrasting picture was obtained from the different excavation areas at Dosariyah. Whereas the surface deposits were largely composed of bones from tuna and requiem sharks, seabream dominated in trench 1 with relatively small amounts of tuna, trench 5 contained both seabream and tuna in moderate quantities, and trench 7 was largely comprised of seabream, groupers and jacks/trevallies. Although the seabream were mostly small fish (10-30 cm), some quite large individuals of groupers, jacks, parrotfish and tuna were also noted. There was a hint in the general surface deposits as well as within trenches 1 and 7 that sharks and eaglerays were more common during the later occupation phase at the site.

SITE J19, AL MARKH, BAHRAIN

The largest fish bone assemblage analysed to date from this period is that from site J19 at Al Markh in Bahrain (von den Driesch and Manhart 2000). This site is located on the south-west coast of Bahrain (fig. 1, no. 3). The recovery of material on the excavation was carried out initially using a 4 mm sieve (Roaf 1974, 1976). Some of the deposits in the lower levels at site J19 were recovered by wet sieving using a plastic fly-screen mesh of about 1.5 mm. The resulting fractions were subsequently divided into >5 mm, 1.5-5 mm and <1.5 mm. Only the >5 mm bones were taken back to Germany for subsequent analysis, and a very small proportion of the <5 mm bones.

The Al Markh assemblage was dominated by seabream (Sparidae), which formed 83% of all those bones identifiable to family. The most common genera represented amongst these remains were goldstriped/haffara seabream (*Rhabdosargus* spp.), closely followed by *Acanthopagrus*. Other genera represented in smaller quantities included porgy (*Diplodus* spp.), king soldierbream (*Argyrops spinifer*) and karanteen seabream (*Crenidens crenidens*). Significant quantities of the clupeid, Bloch's gizzard shad (*Nematolosa nasus*) were also

observed. Undoubtedly this reflected the fine recovery methods used on the excavation, including wet sieving, which helped to retrieve many small bones. Other fishes represented in decreasing quantities included groupers (Serranidae), emperors (*Lethrinus* spp.), mojarras (Gerreidae) and ponyfish (Leiognathidae), jacks/trevallies (Carangidae), including the genera *Carangoides*, *Gnathanodon* and *Scomberoides*, barracuda (*Sphyraena* spp.), hammerhead shark (Sphyrnidae), silversides (Atherinidae), snappers (Lutjanidae), mullets (Mugilidae), requiem sharks, sawfish (Pristidae), rabbitfish (*Siganus* spp.), grunts (Haemulidae), sea catfish (*Arius* spp.), flatheads (*Platycephalus* spp.), guitarfish (Rhinobatidae), stingray (Dasyatidae), sardines (*Sardinella* spp.), kawakawa/eastern little tuna (*Euthynnus affinis*) and needlefish (Belonidae).

Most of the fish remains came from the lower levels at J19. The upper layers appeared to contain slightly different proportions of the commonly occurring fishes. Groupers, and also possibly jacks/trevallies and emperors, all appeared to be more common than in the lower layers, although seabream were still evidently being caught. However, such differences may be due to poor sample size in the upper layers as well as taphonomic factors.

QATAR

Several archaeological sites in Qatar have been investigated dating to the 5th-4th millennium BC. One of the sites investigated on the west coast of Qatar is Rā's Abaruk. A survey carried out by G.H. Smith, as part of wider survey of archaeological sites in Qatar (de Cardi 1973), discovered a so-called 'fish processing complex' at a locality named site 4. The site consisted of a sunken hearth with clear evidence of burning, with associated fish remains. Fish bones were described as being present but unfortunately no analysis of these remains was included in the report (Smith 1978: 80-106).

Two sites have been examined at Al Khor, located on the north-east coast of Qatar (fig. 1, no.4). At Khor FB it is reported that both silversides (Atherinidae) and seabream (Sparidae) were represented. The remains consisted almost exclusively of otoliths from these species, with very few vertebrae being noted (Desse 1988). A preliminary study of these otoliths revealed no obvious seasonal preference, although it is suggested that more fishing may have been carried out during the winter period (Desse 1988: 79). At site Khor P notable quantities of seabream and silverside otoliths were also recovered, as well as numerous loose teeth from seabream, some otoliths from jacks/ trevallies (Carangidae) and groupers (Serranidae), and a few fish vertebrae, including a single shark/ray/skate vertebra (Desse 1988: 161-2).

On the south-east coast of Qatar a further site was investigated by the same team of French archaeologists who worked at Khor. This was the site of Shagra. Here, the small assemblage included predominantly vertebrae from small shark/ray/skates (Chondrichthyes), as well as some cranial fragments and otoliths from groupers and seabream. It was reported that analysis of the growth rings of the fish vertebrae from Shagra showed that the fish were caught throughout the year and not during any particular season (Desse 1988: 226). Although it is noted that systematic sieving was carried out across the whole site at Khor FB, Khor P and Shagra, the precise mesh size is not stated. It seems likely from the finds that a fine mesh screen ca 3-4 mm may have been used to recover the material.

DALMA ISLAND, UAE

Dalma is an island located at 24°30'38"N 52°18'37"E, some 29.5 km north-west of the island of Sir Bani Yas and 80 km from the eastern coast of Qatar in the western Abu Dhabi region of the UAE (fig. 1, no. 5). The island measures 9 km from north to south and 5 km from east to west, rising to 98 m at its centre. Dalma has a modern population of some 6,000-7,000 inhabitants. A permanent population existed on the island during the more recent historical period supported by the presence of freshwater wells. The main settlement, also called Dalma, is located towards the southern tip of the island. The island was

traditionally an important centre for the pearl trade (Lorimer 1908-15). An initial brief archaeological reconnaissance of Dalma was carried out by Harter *et al.* (1979).

In 1992 the Abu Dhabi Islands Archaeological Survey (ADIAS) carried out the first comprehensive field survey of the island (King 1998). This work demonstrated a much longer history of settlement of the island than had previously been suspected. The discovery of 'Ubaid pottery on the surface of site DA11 showed that settlement on the island dated at least as far back as the 5th millennium BC. The site lies within the compound of the Jama'iyya nahda li-imrāt al-Ẓubyaniyya (the Abu Dhabi Women's Association) in Dalma town.

Excavations at the site in 1993-4 revealed that settlement traces covered an area of about 175m x 150 m. Two sample transects were placed across the site, and the top *ca.* 5 cm of the surface was systematically sieved by each metre square through a 4 mm mesh (Shepherd-Popescu and Beech, *in prep.*). The particular concentrations of bone, flint, pottery, shell and various small finds such as beads in the NW corner of the compound guided the placement of two test trenches. These established that archaeological deposits were at least 1 m to 1.5 m in depth (Flavin and Shepherd 1994).

Subsequently a short fieldwork season directed by the author and Joe Elders in 1998 continued the excavation in both these test trenches. Additional stratified material for environmental analysis as well as radiocarbon samples were taken. This work led to the exciting discovery of earlier phases of occupation and traces of two house structures (Beech and Elders 1999; Elders and Beech 1998). Two AMS radiocarbon dates were subsequently obtained on carbonised date stones from the site[1].

Large quantities of fish bones were recovered during the initial sieving of the surface layers, as well as during the excavation of the two test trenches. This paper is only concerned with the material excavated during the 1993-4 seasons. Retrieval of bones was carried out using 4 mm mesh rocking sieves. Non-fish remains identified at Dalma included sheep/goat, gazelle, dolphin/porpoise, dugong, turtle and Socotra cormorant (Beech 2000, 2001). However, fish remains formed the bulk of the faunal assemblage by weight (91%), followed by marine turtle (5%), terrestrial mammal (3%), marine mammal, crabs and bird (all <1%).

A total of 17,858 fish bone fragments were recovered from the site during the 1993-4 seasons, of which 4,599 (26%) were identified to family, genus or species level (Table 1). Sixteen families were represented, including at least 23 genera. The following families were present: thresher sharks (Alopiidae), requiem sharks (Carcharhinidae), hammerhead sharks (Sphyrnidae), sawfish (Pristidae), eaglerays (Myliobatidae), sea catfish (Ariidae), needlefish (Belonidae), groupers (Serranidae), jacks/ trevallies (Carangidae), snappers (Lutjanidae), grunts (Haemulidae), emperors (Lethrinidae), seabream (Sparidae), parrotfish (Scaridae), barracudas (Sphyraenidae) and tuna/mackerel (Scombridae).

Requiem sharks, needlefish, groupers, jacks, emperors, seabream and tuna all seemed to be important groups of fish which were exploited. Genera and species represented amongst the jacks included *Carangoides*, golden trevally (*Gnathanodon speciosus*), torpedo scad (*Megalaspis cordyla*) and queenfish (*Scomberoides* spp.). Seabream were mostly represented by *Rhabdosargus* followed by *Acanthopagrus*, with only small quantities of king soldierbream (*Argyrops spinifer*). Most of the scombrid remains belonged to the kawakawa/little eastern tuna (*Euthynnus affinis*), with small quantities of longtail tuna (*Thunnus* spp.), and Spanish mackerel (*Scomberomorus* spp.)

Analysis of the size of the diagnostic elements from Dalma demonstrates that both small and large fish were present throughout the sequence. Needlefish ranged from 40-80 cm in size, groupers from 30-90 cm, jacks/trevallies from 30-90 cm, emperors from 10-40 cm, seabream mostly between 10-40 cm, parrotfish from 30-50 cm, and tuna from 70-80 cm.

Closer inspection of the size of all the vertebrae from Dalma demonstrates the importance of smaller fish at the site. Large numbers of small vertebrae belonging to sharks/rays/skates (Chondrichthyes), needlefish (Belonidae) and seabream (Sparidae) were noted. Four particularly

large caudal vertebrae from a thresher shark (Alopiidae) were recovered in the surface layers. The general size of some of the requiem shark vertebrae indicated that some were probably from medium-large sized individuals. Examination of the size distribution of grouper vertebrae confirmed that mostly larger fish were present. In the case of jacks/trevallies, mostly small to medium sized fish were recorded. The barracuda vertebra was from quite a small individual. Tuna vertebrae came from medium to large individuals. The Spanish mackerel vertebrae all came from a medium-sized individual.

Requiem sharks, needlefish, groupers, jacks, emperors, seabream and tuna all seemed to be important groups of fish exploited at Dalma. Both small and large fish were caught, with a particular reliance on smaller seabream (10-40 cm) and large groupers (50-80 cm). Fishing for larger pelagics like tuna and Spanish mackerel appeared to be more common during the early phases at the site. The surface layers, as at Dosariyah, contained mostly vertebrae from sharks.

UMM AL QAIWAIN, U.A.E.

Sites UAQ1 and 2 (also referred to as UAQ92-3), are located at 25°33'36"N 55°34'47"E, towards the northern border of Umm al Qaiwain emirate (fig. 1, no.6), north of the well-known archaeological site of Ed Dur. In 1991 the coastline road leading northwards to Ras al Khaimah cut through a large dune composed of midden and aeolianite deposits, and a fine bifacial arrowhead along with several flint flakes were collected from the surface of the site. In 1992 Carl Phillips and Phil Treveil (both then of the Institute of Archaeology, University College, London) excavated two 0.5 m squares through the midden at UAQ1. This sampling exercise was authorised by the Diwan of Umm al Qaiwain, and was carried out under the aegis of the European Expedition to Ed Dur.

The fieldwork confirmed that the deposits were only a few centimetres thick and repeated survey of the midden recovered a number of 'Ubaid type sherds (Phillips, in prep.). The site appeared to be very similar to a nearby site investigated by the French Archaeological Mission (Boucharlat *et al.* 1991b), who designated it as site 69. Subsequently this site was examined by Margarethe and Hans-Peter Uerpmann who renamed it Al Madar (Uerpmann and Uerpmann 1996). At Al Madar it is reported that the bone remains consisted of small vertebrae and otoliths from emperors and seabream (Uerpmann and Uerpmann 1996: 134). On the nearby site of Akab island, it was also noted that fish remains were common at the specialised dugong butchery site, but no further details are provided (Prieur and Guerin 1991).

Two further 0.50 m square trenches located at either end of a 5 m baseline were excavated by Carl Phillips on the landward side of UAQ1 on the summit of the neighbouring dune. This was named UAQ2. Subsequent excavation established that much more extensive and well-compacted deposits were preserved here (Phillips, *in prep.*). An upper layer of shells was underlain by a layer of sterile sand, which lay upon a further, second layer of shells. Excavation down to ca. 60 cm uncovered a further layer of sterile sand overlaying another shell layer.

The second trench (in square 3) identified a similar sequence of deposits but at the base of these stratified midden deposits was an ash-rich deposit containing 'Ubaid painted sherds, mammal and fish bones, as well as a human skull. The trench was subsequently expanded to permit excavation of a number of burials. The stratigraphic sequence over the entire area was uniform. Up to four distinct shell horizons was interspersed with sterile sand layers. Beneath these layers was an ash-rich deposit which included a number of distinct hearths concentrated in a 4 m x 2 m area where the human remains were located. The remains of at least 42 individuals were recovered during the excavation. Nine individuals were recognised in their original burial position but for the most part the bones were uncovered as a mass of disarticulated and partially disarticulated human remains (Phillips, in prep.).

A few fish bones were recovered amongst the shell layers which clearly post-date the burials but the majority of the vertebrate faunal remains were found in the underlying ash-rich layers, particu-

larly in the hearths surrounding the burials. Many of the bones are burnt and it is possible that they may represent the remains of funerary meals (Phillips *in prep.*). A good proportion of most of the excavated layers was dry sieved using a 1 mm mesh. The remainder of the layers were dry sieved using 4 mm mesh. Non-fish remains recovered included small quantities of sheep/goat and cattle (Chris Mosseri-Marlio, pers.comm.). Numerous crab remains were also recovered from this site. These largely consisted of chelae from swimming crabs (*Portunus*), with moderate quantities of the mangrove crab (*Scylla*). Other recognisable remains included some xanthid chelae and a few fragments of another species, possibly *Calappa* (Peter Hogarth, pers. comm.).

6743 fish bone fragments were recovered from the Umm al Qaiwain excavations, of which 1207 (18%) were identifiable to the level of family, genus or species (Table 1). Ten families were represented: herrings/sardines/shads (Clupeidae), flatheads (Platycephalidae), groupers (Serranidae), jacks/trevallies (Carangidae), snappers (Lutjanidae), grunts (Haemulidae), emperors (Lethrinidae), seabream (Sparidae), barracudas (Sphyraenidae) and tuna/mackerel (Scombridae). Only five of these families were present in the upper midden deposits: herrings/sardines/ shads, snappers, grunts, emperors and seabream. *Carangoides* and golden trevally (*Gnathanodon speciosus*) were genera present amongst the jacks/trevallies. *Rhabdosargus* was the principal seabream recorded. Scombrid remains included both Spanish mackerel (*Scomberomorus* spp.) and tuna. Seabream were the most ubiquitous remains in both the upper midden and lower deposits. Those anatomical elements which could be attributed to particular size classes all came from small fish which were mostly sized 10-30 cm. The only medium-sized taxon present was the golden trevally (*Gnathanodon speciosus*), three cranial elements coming from an individual sized about 40-50 cm. The vertebra size data confirmed that predominantly small fish were present. The herring/sardine/shad (Clupeidae) vertebrae present in both the upper and lower deposits were very small in size. It is salutary to note that if sieving had not been carried out using a 1 mm mesh then the presence of these fish would undoubtedly have been missed. A small number of vertebrae came from small to medium-sized jacks and emperors. All of the barracuda vertebrae present in the lower deposits were quite small. This may be because they are from juvenile or sub-adult individuals, or it may be that the bones are from one of the smaller species occurring in the region. The size of the vertebrae suggested individuals of less than 60 cm length compared with modern comparative material. One of the two barracuda otoliths was complete enough to measure. The specimen had a maximum breadth vs. height of 8.8 mm x 4.4 mm. This otolith looked morphologically closest to a specimen of yellowtail barracuda, *Sphyraena flavicauda*, although it could only be compared against comparative specimens of *S. jello*, *S. putnamiae* and *S. qenie*. The Spanish mackerel and tuna vertebrae present all came from individuals less than a metre in length based on comparisons with reference examples.

One of the human burials (burial 1) contained three tuna specimens, a dentary plus a caudal and ultimate caudal vertebra. The dentary came from an extremely large individual of more than 120 cm. On the basis of its size, it is more likely that this belongs to *Thunnus* rather than *Euthynnus*. This was the largest fish found at the entire site and it may be significant that it was deliberately selected for inclusion with the burial. It is worth noting that the two tuna vertebrae also present in the same burial were also the largest specimens out of all the tuna vertebrae represented at the site, having a maximum width of 14 mm.

Of particular note at the Umm al-Qaiwain site was the recovery of otoliths from pinkear emperors (*Lethrinus lentjan*). Four were collected from the upper midden deposits, and 61 in the lower deposits. A pilot study was carried out on these otoliths to section them to check for their growth rings and to determine the possibility that this particular species might have been caught seasonally (Beech 2001). This revealed that most of the fish were less than four years old and had been caught before they had become sexually mature. Preliminary work on the seasonal timing of when they had been caught suggested that more fish

were caught during the summer than the winter months. This may coincide with known spawning aggregations of this species which take place in both the Red Sea and Arabian Gulf between April to July (Beech 2001: 226).

OTHER SITES

A number of other broadly contemporary sites exist within the Arabian Gulf, and in its neighbouring territory in the Gulf of Oman. Unfortunately the material from these sites is largely unstudied or unpublished.

The fish bones from Abu Khamis, located on the Saudi Arabian Gulf coast, have not yet been studied. This material was also collected in the late 1960s by Abdullah Masry during the course of his study of inter-regional interactions in NE Arabia (Masry 1974). Masry noted that fish bones formed 85% of the total weight of bone from the site. Melinda Zeder examined the small collection of mammalian remains from the site and identified the presence of gazelle, sheep/goat, carnivore, equid and cattle or equid (Zeder 1974). A preliminary examination of the fish assemblage was made by the author during a research visit made in October 1999 to the Smithsonian Institution Natural History Museum, Washington D.C., where the collection is housed. This revealed that shark/ray/skates (Chondrichthyes), jacks/ trevallies (Carangidae) and tuna/mackerel (Scombridae) were all common, with groupers (Serranidae) and seabream (Sparidae) also present within the assemblage. The method of recovery of this material is not clear although it seems likely that a combination of both hand retrieval and some sieving was carried out.

In the Gulf of Oman, pelagic tuna/mackerel (Scombridae) were numerous at the 4th millennium BC site of RH5 at Qurum (Biagi and Nisbet 1989; Biagi *et al.* 1984), indicating that some fishing was carried out in the open seas off the Omani coast. This material has recently been examined by Margarethe Uerpmann who confirms that tuna (Scombridae – Thunninae) and jacks/trevallies (Carangidae) occurred in significant numbers there (M. Uerpmann, pers. comm.). This was also the case for the Early Bronze age settlement at site RJ-2 at Rā's al Jinz (Cleuziou and Tosi 2000: 42).

CONCLUDING REMARKS

Until recently it was puzzling to know why there was only sparse evidence on these early prehistoric sites within the Arabian Gulf for fisheries based on pelagic fish like tuna/mackerel and some of the larger jack/trevallies. The initial sites which were investigated, like Al Khor in Qatar (Desse 1988), Al Madar near Umm al-Qaiwain in the U.A.E. (Uerpmann and Uerpmann 1996) and Al Markh in Bahrain (von den Dreisch and Manhart 2000), were all characterised by the presence of predominantly small fish such as seabream. The general assumption was therefore made that fishing was largely carried out in shallow coastal waters, probably using nets and tidal traps. At Al Markh only two kawakawa/little eastern tuna (*Euthynnus affinis*) vertebrae were noted amongst the more than 16,000 identified fish bone fragments. The fact that systematic dry sieving was carried out at Al Markh, as well as wet sieving of some of the lower levels, probably accounts for the fact that a greater list of taxa, and particularly of smaller fish, was obtained here than at the other sites. Other important fishes represented on all these sites included groupers and emperors. Many of these, judging from their relative size, were also caught in shallow coastal waters on and near to coral reefs.

The evidence from the Gulf of Oman, however, suggested a different picture in that fishing in offshore waters appears to have been already practiced by the 4th millennium BC. The distribution of shell fish hooks indicates that offshore fishing for larger fish was clearly carried out on the Omani coast (Beech 2001). It is curious that no shell hooks have been published to date from within the Arabian Gulf. Perhaps this suggests that less deep water fishing was carried out in the Gulf? Or, is it simply the case that such fishing was so highly seasonal within the Gulf that there was less chance of such objects being lost or discarded on archaeological sites, and subsequently discovered on excavation? Certainly the waters in many parts of the Arabian Gulf are very shallow, con-

trasting with the deeper waters off much of the Omani coast. It is only possible to catch, for example, tuna and mackerel in certain areas within the Gulf for a limited seasonal window during the year. In 1998 more than 50% of all narrow-barred Spanish mackerel *(Scomberomorus commerson)* caught in the waters around Dalma Island were made during the month of November. Almost 79% of the total annual catch of this species was made between October and November (Mr. Asad Shahin, Dalma Co-operative Fisheries Office, pers. comm.).

This new zooarchaeological study of fish bone assemblages from site H3 in Kuwait, Dosariyah in Saudi Arabia, and Dalma island and Umm al-Qaiwain in the U.A.E. clearly demonstrates that fishing did sometimes take place in deeper offshore waters for larger pelagic species. Some locations were probably deliberately targeted at certain times of year for their abundant quantities of fish. The influence of the Indian monsoon and well known upwelling off the coast of Ra's al Hadd on the Omani coast has already been noted to dramatically influence the concentration of fish stocks at certain times of year (Cartwright 1994, 1998; Cleuziou and Tosi 2000: 41). Tuna, in particular, are known to come close to shore and island masses at certain times of year. Alverson (1963) is of the view that the availability of more food in the vicinity of islands than the surrounding seas, is a possible reason for the aggregation of tuna. The early inhabitants occupying the Saudi Gulf coastline at Dosariyah, as well as those on Dalma, may well have taken advantage of the marked seasonal occurrence of these pelagic species as they passed on their migratory passage through to the deeper waters of the central Gulf. Traditional preservation methods like salting, sun-drying and smoking could all have been employed to save the surplus catch for the lean part of the year, or for goods to be subsequently traded. The author witnessed traditional drying of longtail tuna *(Thunnus tonggol)* still being carried out as a seasonal activity on Dalma in March 1998.

At the beginning of this paper there was a quotation from Karen Frifelt about the possible seaborne relations between the people of the Gulf and their Mesopotamian counterparts (Frifelt 1989: 415). The recent discovery of 'Ubaid reed/bitumen boat remains, as well as a ceramic model boat, at site H3 in Kuwait provides supporting evidence for the early development of maritime trade in the region (Carter, in press). Such boats could also clearly have been utilised for longer fishing trips into deeper offshore waters. A tantalising discovery amongst the food offerings at Ur in southern Mesopotamia was that of several tuna vertebrae (Ellison *et al.* 1974). These marine fish must have been introduced to the site, and it is possible that this hints at the wider trade of dried fish and other goods from the people of the Gulf in exchange for southern Mesopotamian goods such as pottery and beads. The trade in tuna to the interior of the Arabian Peninsula during the Iron age is already well attested (Beech 2001; Beech, Hogarth and Phillips in press). It now seems that these early Neolithic coastal communities in the Gulf were capable not only of fishing within their own 'backyard', using basic traps and nets for small fish like seabream, but were just as proficient at fishing in deeper waters for larger fish such as tuna, like their southern neighbours on the Gulf of Oman coast.

Although the importance of fishing for tuna is already clear from later periods within the Arabian Gulf (e.g. Badstober 2000; Beech 1998, 2001; van Neer and Gautier 1993; von den Driesch 1994), this is the first substantial evidence of early Neolithic communities exploiting such resources. This adds to our growing knowledge and appreciation of the Neolithic communities of the Gulf (Uerpmann and Uerpmann 2000; in press).

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NOTE

[1] AMS radiocarbon dating of two carbonised date stones *(Phoenix dactylifera)* from site DA11 on Dalma Island produced the following dates: sample ref. AA-32031, context 4, a redeposited sand layer just below the present day ground surface: 5830 +/- 55 radiocarbon years b.p. (4670 +/- 130 cal BC, 100%). Sample ref. AA-32032, context 15, a burnt layer located about 80 cm below the present day ground surface and 25 cm above the floor level of one of the house structures: 6165 +/- 55 radiocarbon years b.p. (5120 +/- 170 cal BC, 98.8%). Both samples were processed by the Scottish Universities Research and Reactor Centre (SURRC) radiocarbon laboratory at the University of Glasgow who, in conjunction with the University of Arizona AMS facility, performed the dating. Calibrations have been made using the University of Washington, Quaternary Isotope Laboratory, Radiocarbon Calibration Program, Rev. 4.0 1998, using the datasets derived from Stuiver *et al.* (1998). The decadal atmospheric calibration curve is used throughout. Calibrated age ranges are presented calculated with 2 sigma errors from the probability distributions. The relative area under the probability distribution is given in brackets after the age range. These particular date stones are amongst the earliest examples ever found within Arabia (Beech and Shepherd 2001).

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