At the dawn of Arabian fisheries: Fishing activities of the inhabitants of the Neolithic tripartite house of Marawah Island, Abu Dhabi Emirate (United Arab Emirates)

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Abstract

This paper presents the results of a study of nearly 8000 fish bones from MR11 Area A, a Neolithic stone build house located on Marawah Island, United Arab Emirates. Radiocarbon dating indicates that the site was inhabited from the first half of the 6th to the mid-5th millennium BC, making it one of the oldest Neolithic occupation sites in the whole of the Arabian Gulf. Initial excavations between 2003-4 revealed a single room and then more recent excavations in 2016-17 uncovered two adjacent structures which proved to be a tripartite house. Examination of the fish remains from this particular site allows both a spatial and diachronic analysis. Archaeo-ichthyological studies can determine the role of fisheries within the subsistence strategies of past societies and the fishing techniques they adopted. This study provides important evidence regarding coastal and island lifestyle during the Neolithic. It outlines the predominance of small coastal fish such as grunts, emperors, and seabreams in the faunal assemblage. It thus suggests that fishing was essentially carried out in the surrounding shallow waters where soft-bottoms and seagrass meadows predominate. Non-selective fishing techniques probably involved the use of small-mesh devices such as beach seines and coastal barrier traps.

Keywords: Ancient fishing; Archaeo-ichthyology; Marawah; Neolithic; Arabian Gulf; Eastern Arabia

Introduction

Environmental settings

Marawah Island lies about 15 km off the main coastline of the Emirate of Abu Dhabi, measuring about 4 km from North to South by 14 km from East to West. The island is surrounded by the Arabian Gulf waters to the north and by the Khor al-Bazm to the south (Figure 1). Marawah Island is composed of several low limestone outcrops linked by unconsolidated marine deposits (Evans et al., 2002). By the Early Holocene, the marine transgression is estimated to have been at least *c.*2-3 m above the actual modern-day sea level (Sanlaville & Dalongeville, 2005), suggesting that the island appeared as a small archipelago at that time. While the tidal range is low in the southern Arabian Gulf (between 0.2 m and 1.5 m), the foreshore slopes are quite gentle and thus expose wide bare areas during ebb tide. Intertidal zones contain a wide diversity of marine habitats and life forms. The nearest seabed is shallow and characterised by fringing reefs and tidal ridges frequently occupied by seagrass (mostly *Halodule univervis* and some *Halodule ovalis*) and macroalgae beds (*Rhizoclonium tortuosum, Chaetomorpha gracilis*, and *Cladophora coelothrix*). Sparse coral patches are essentially composed of *Porites* species. Shorelines are dominated by sand beaches and a few mangrove stands of *Avicennia marina*. Since 2007, the Marawah Marine Biosphere Reserve covers a protected area of 425 000 ha, and is home to representative natural habitats and wildlife with biodiversity significance such as dugongs and marine turtles.

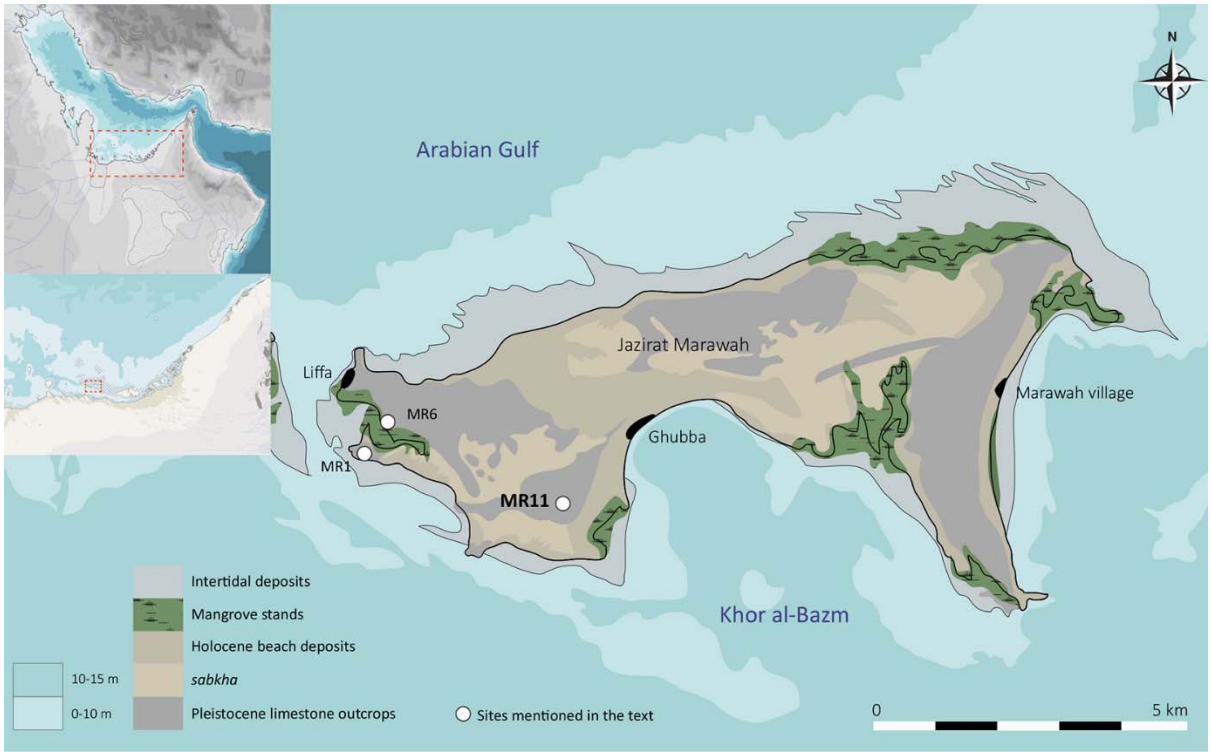


Figure 1. A map of Marawah Island showing the location of the sites mentioned in the text.

Archaeological settings

The Prehistoric occupation at Marawah is documented by a few surface sites where several lithic tools and debitage were found. MR11 (24°16'33''N; 53°15'41''E) was first discovered during a survey campaign conducted in 1992 by the Abu Dhabi Islands Archaeological Survey (ADIAS) project (King, 1998). The site consists of a group of seven stone mounds located on the top of a limestone platform in the south-western part of the island. At MR11.6 (re-designated as Area A), new campaigns of excavations undertaken by the Department of Culture and Tourism of Abu Dhabi between 2003 and 2016 have revealed a unique tripartite stone built house dating back to the Neolithic (Beech et al., 2005; Beech et al., 2016).

The occupation layer is thin and directly settled on the natural limestone bedrock (Phase 1). The material culture includes several lithic tools such as flint tile knives, arrowheads, and debitage. Beads and other personal ornaments such as buttons in pearl oyster shell have also been found. It is interesting to note that Marawah and Delma (UAE) are the only two Neolithic sites from the Gulf region where the remains of plaster vessels were found – suggesting a production specific to the southern UAE. This vessel is often decorated with painted geometric patterns which seem to be inspired by 'Ubaid pottery wares. Room 1 from the tripartite house has provided the remains of an almost complete Mesopotamian pot whose stylistic attribution can be assigned to an Ancient 'Ubaid phase (Méry et al., 2016), supported by radiocarbon dates as early as the first half of the 6th millennium BC (SUERC-3612: 6750 +/- 40 BP, 5725-5617 cal. BC 2σ and SUERC-3608: 6675 +/- 40 BP, 5562-5526 cal. BC 2σ [1]). In Phase 2, the structure hosted several burials, but the associated levels are quite disturbed. It is likely that the domestic occupation did not persist as the passageway between Room 1 and Room 2 was closed to install a burial. The latest levels are associated to the collapse of the structure (Phase 3). The final occupation was identified just below the modern-day ground surface, outside the tripartite house. It was radiocarbon dated to the mid-5th millennium BC (SUERC-1182: 5630 +/- 50 BP, 4554-4351 cal. BC 2σ).

Faunal remains were collected from the three different phases. These are mostly composed of marine shells and fish bones. The main shellfish consumed are sunset clams (*Asaphis violascens*), crowned turban shells (*Lunella coronata*), and pearl oysters (Pteriidae). It reflects the exploitation of various soft and rocky bottoms situated in the intertidal zone and below. The faunal assemblage also includes a few marine turtle, terrestrial (gazelle or sheep/goat) and marine mammal (dugong and dolphin) remains. A number of small rodent and bird bones as well as eggshell fragments were also found in certain contexts. It suggests ephemeral re-occupations of the site by wildlife (Beech et al., 2005: fig. 14-15).

Material and methods

All the excavated sediments were systematically dry-sieved using a 4 mm mesh screen. A fine sieving (1 mm) was also conducted in a small hearth (Context 63) associated with Phase 1 to test for the presence of charcoals and microfauna. It provided the remains of small planktivorous fish such as sardines (Clupeidae), anchovies (Engraulidae), and silversides

[1] Calibration according Calib 7.1. Intcal 13 (Reimer et al. 2013)

(Atherinidae). It highlights the importance of fine sieving at archaeological sites whose economies were greatly oriented toward fishing. Sun-dried or used to prepare fermented sauces, small fish often have a great place in the diet of coastal societies.

The bone preservation at MR11 is quite good in comparison to other Neolithic sites from coastal Arabia where calcite or salt encrustations are regularly observed. However, because these encrustations tend to harden the bones, their relative absence at MR11 led to accentuate the fragmentation. Anatomical and taxonomic identifications were conducted according to the methods of comparative anatomy, using two osteological collections of Arabian Gulf fish specimens: M. J. Beech's personal collection during a two-month visit to Abu Dhabi in 2017 and the collection of the National Natural History Museum of Paris in 2017-18. NISP stands for the 'number of identified specimens', MNI for the 'minimum number of individuals', and WISP for the 'weight of identified specimens'. MNI quantifications are calculated according to the combination method: the frequency of bones is combined with laterality and size/weight estimations (Chaplin, 1971). We estimated the average fresh weights of fish after visual comparisons of archaeological bones with reference specimens (Wheeler & Jones, 1989: 141).

Results

A total of 7536 fish bones fragments were retrieved and recorded of which 2786 could be identified to the level of family, genus, or species (Table 1). A total of 4 families of cartilaginous fish and 23 families of bony fish are represented at Marawah including bamboo-sharks (Hemiscylliidae), requiem-sharks (Carcharhinidae), sawfish (Pristidae), stingrays (Myliobatiformes), anchovies (Engraulidae), sardines (Clupeidae), sea catfish (Ariidae), mullets (Mugilidae), silversides, needlefish (Belonidae), flatheads (Platycephalidae), groupers (Serranidae), sillagos (Sillaginidae), jacks and trevallies (Carangidae), snappers (Lutjanidae), mojarras (Gerreidae), grunts (Haemulidae), threadfin breams (Nemipteridae), emperors (Lethrinidae), seabreams (Sparidae), drums (Sciaenidae), goatfish (Mullidae), grunters (Terapontidae), parrotfish (Scaridae), rabbitfish (Siganidae), barracudas (Sphyraenidae), and tuna (Scombridae). This included at least 37 genera and 43 species.

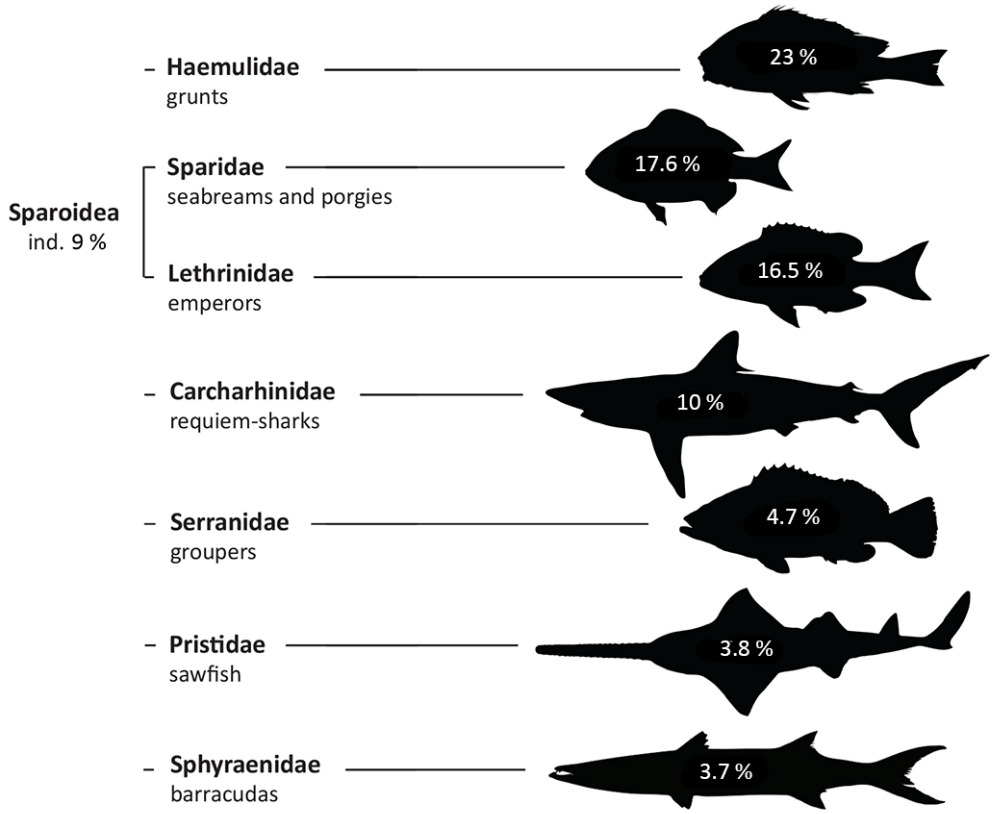


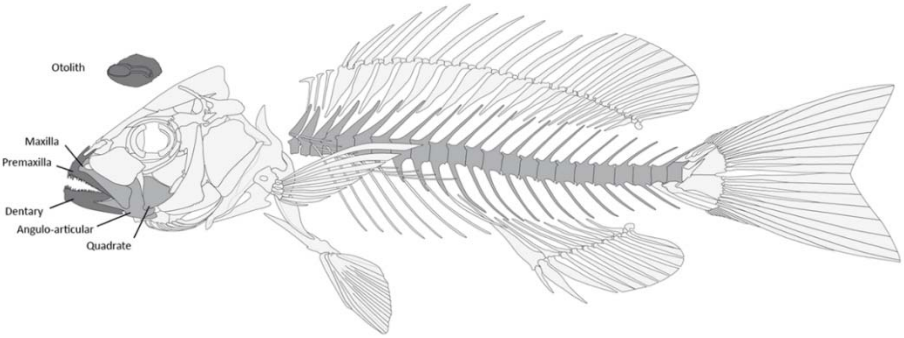
Figure 2. Proportions of the main families identified at MR11 Area A. NISP = 2786; other fish taxa = 11.8%.

According to NISP, the assemblage is mainly dominated by grunts (23%), seabreams (17.5%), emperors (16.5%), requiem-sharks (10%), groupers (5%), sawfish (4%), and barracudas (4%) (Figure 2). The superfamily Sparoidea (i.e. sparoid fish) includes Nemipteridae, Lethrinidae, and Sparidae. Grunts are essentially represented by the striped piggy and emperors by the spangled emperor (*Lethrinus nebulosus*). Seabreams are dominated by the haffara seabream (*Rhabdosargus haffara*) and by species belonging to the *Acanthopagrus* genus. Groupers mostly belong to the *Epinephelus* genus. In most cases, both vertebrae and teeth of requiem-sharks and sawfish generally do not allow identification to species level. Almost all the specimens of emperors and seabreams caught are small-sized fish comprised between 100 and 400 grams (from 20 to 25 cm in length) (Figure 3 C). Striped piggies (*Pomadasys stridens*) are roughly estimated between 50 and 150 grams (*c*. 18-22 cm in length). Besides, groupers, jacks and trevallies generally weighed between 1 and 2 kg (from 40 to 60 cm in length). It is likely that the sharks and sawfish caught were essentially small specimens as the diameter of the vertebrae rarely exceeded 1 cm in width.

All the main anatomical elements belonging both to the skull and the backbone are represented in the assemblage. Because significantly harder and thus generally better preserved, jaw bones (i.e. dentaries, premaxillae, and maxillae), vertebral centra and otoliths were mostly recorded (Figure 3 A-B). Indeed, a large number of otoliths were recovered at the site (NISP = 1066 – *c.* 30% of the total NISP). Otoliths are calcified structures located in the inner ear of teleost fish and are generally very diagnostic to species (Figure 4 n°1-4). Most of

the otoliths identified belong to striped piggies, spangled emperors, haffara seabreams, and groupers. In the absence of butchery marks, it is likely that fish were directly brought to the site in a relatively complete form. Likewise, the preferential dispatching of fire marks on the less fleshy parts of the skeleton (e.g. opercle series, spines and external tips of the jaw bones) suggests that whole fish were probably grilled on coals. However fire marks remain rare on the bone assemblage (only 4% of the global NISP).

A



B

	General		Serranidae		Haemulidae		Lethrinidae		Sparidae		Sphyraenidae	
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Maxilla	67	1.9%	7	5.3%			34	7.4%	21	4.3%		
Premaxilla	197	5.6%	19	14.5%	1	0.2%	44	9.6%	120	24.5%		
Dentary	147	4.2%	12	9.2%	1	0.2%	17	3.7%	105	21.5%		
Angulo-articular	85	2.4%	5	3.8%			27	5.9%	29	5.9%	5	4.8%
Quadrate	48	1.4%	5	3.8%			21	4.6%	11	2.2%		
Otolith	1066	30.1%	48	36.6%	634	99.1%	117	25.4%	78	16%	13	12.5%
First vertebra	80	2.3%	2	1.5%	4	0.6%	24	5.2%	19	3.9%	23	22.1%
Precaudal vertebra	326	9.2%	16	12.2%			106	23%	63	12.9%	20	19.2%
Caudal vertebra	514	14.5%	2	1.5%					9	1.8%	42	40.4%
Ind. Teleostei vertebra	357	10.1%										
Ind. Chondrichthyes vertebra	450	12.7%										
Other determinated	200	5.7%	15	11.5%			70	15,2%	34	7%	1	1%
Total determinated	3537		131		640		460		489		104	
Ind. fragment	3999											

C

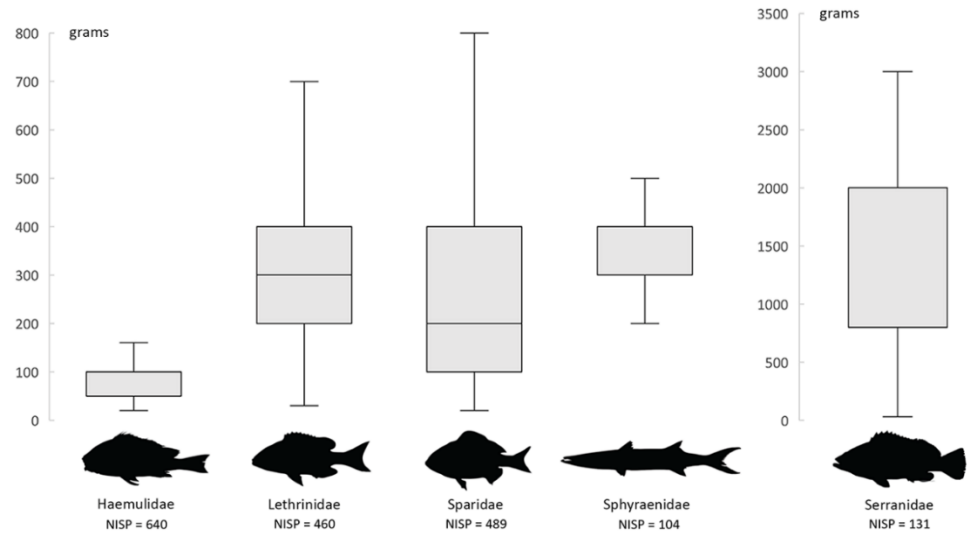


Figure 3. A. Anatomical representation of the fish bones from MR11 Area A (bony fish skeleton modified from Coutureau & Béarez, 2012); **B.** Distribution of anatomical elements for some of the main taxa identified. **C.** Box plots of fresh weights for the main taxa identified (based on estimations according to visual comparisons with reference specimens).

Discussion

Fishing grounds and techniques

The majority the fish taxa identified at MR11 could be caught in the vicinity of the site, in the surrounding shallow waters (Al-Lamy et al., 2012).

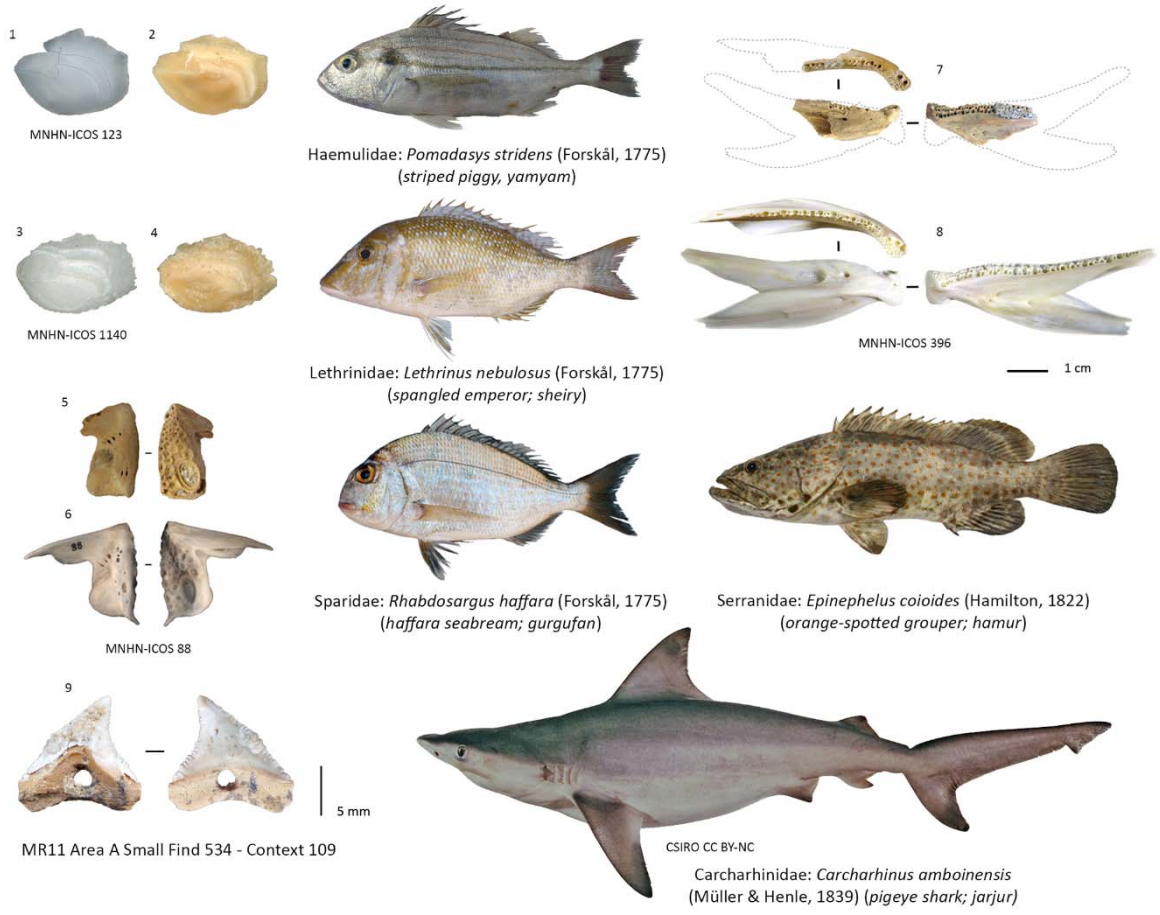


Figure 4. Sample of remains belonging to bony fish (Teleostei) from MR11 Area A compared to analogue bones from the MNHN osteological reference collection, and corresponding live pictures of the species (© Lidour & Béarez): **1–2.** Right sagittae of striped piggy, *Pomadasys stridens*; **3–4.** Right sagittae of spangled emperor, *Lethrinus nebulosus*; **5-6.** Right premaxilla of haffara seabream, *Rhabdosargus haffara*; **7-8.** Right dentary of orange-spotted grouper, *Epinephelus coioides*; **9.** A tooth of a pigeye shark, *Carcharhinus amboinensis.* As they are quite similar, the pigeye shark and the bull shark (*Carcharhinus leucas*) are often confused. Note the hole drilled in the tooth, suggesting its use as a personal adornment.

While the ecology of the striped piggy remains very sketchy in the Arabian Gulf, it is likely that small specimens should be encountered in seagrass meadows and mangroves according to local fishermen and divers that we interviewed. This is consistent with the ecology of other

species of grunts (Weinstein & Heck, 1979). Small emperors mainly inhabit sheltered water environments such as lagoons and mangroves, especially over seagrass beds (e.g. Kanashiro, 1998). Several small species of seabreams are widely distributed in the Arabian Gulf, such as the Arabian yellowfin seabream (*Acanthopagrus arabicus*), the Gulf seabream (*Acanthopagrus sheim*) and the haffara seabream (Iwatsuki, 2013). They form a substantial part of regional landings as they are abundant in inshore waters, in particular over soft bottomed areas. While essentially mentioned as reef fish, certain species of groupers such as the orange-spotted grouper (*Epinephelus coioides*) are often encountered in turbid waters, among estuaries and mangroves in particular (Sheaves, 1995). Others species identified such as small barracudas (*Sphyraena* sp.), snappers (*Lutjanus* sp.), sillagos, silversides, and anchovies are also commonly well associated to seagrass beds and mangroves (Thollot, 1996). Requiem-sharks are relatively common in coastal environments in UAE, including the spot-tail shark (*Carcharhinus sorrah*) and the milk shark (*Rhizoprionodon acutus*) which are the commonest species caught (Jabado et al., 2015). Small sawfish are often encountered inshore, especially over sandy patches and seagrass beds (Jabado et al., 2017). A few vertebrae were identified as belonging to bamboo-sharks (*Chiloscyllium* sp.) thanks to their radial asterospondylic structure (White, 1937: pl. 29, i). The arabian bamboo-shark (C*hiloscyllium arabicum*) is abundant in UAE waters, in particular over shallow coral reefs and seagrass beds (Jabado et al., 2018). A drilled shark tooth (Small Find #534) was found in Context 109 in Room 2 (Figure 4 n°9). The tooth belong to a pigeye shark (*Carcharhinus amboinensis*) recognizable with a distinctive angulation on its mesial side. While drilled shark teeth are well attested during the Neolithic in Oman, the specimen found at Marawah is the only known example for this period in the Arabian Gulf. Charpentier et al. (2009) have suggested that single hole teeth were used as pendants rather than as projectile points which is the case of the bi-perforated teeth (Santini, 2002).

The exploitation of a wide spectrum of small fish in shallow waters suggest the use of non-selective techniques such as beach seines and coastal barrier traps. A few notched pebbles were found at MR11. These could be interpreted as sinkers for small nets. According to Heard-Bey (1986: 175), small seines were traditionally used by UAE fishermen within techniques such as *idfarah* (set on foot) and *yal* (set from a small boat). Simple fish traps probably also existed in Eastern Arabia during the Neolithic (Cleuziou & Tosi, 2007: 53). The traditional *hadra* traps consists of semi-permanent intertidal fences supported by rows of stones disposed perpendicular to the shoreline. The V shape is a funnel which encloses fish at the falling tide. Many other regional variants of barrier traps exist such as the *meskar* (stone dams), and the *sakkar/iskar* (net stakes or baulk nets). Tidal traps are able to catch a wide range of inshore fish including emperors, seabreams, grunts as well as small specimens such as sardines, silversides, and anchovies (Abou-Seedo, 1992; Beech, 2004: 45-46; al-Baz et al., 2013). As the identification and the dating of intertidal features is hard, the possible remains of fishing traps detected on the Abu Dhabi coastline (Beech, 2003) cannot clearly be attributed to the Neolithic period. While the use of baited cage traps (similar to the traditional *gargur*) was recently suggested to catch sea catfish at as-Sabiyah (Kuwait) and groupers at Delma (Beech, 2010; Lidour & Beech, 2019), it is quite unlikely that sharks, rays, and very small fish were caught by this way in Marawah. Evidence of open-water fishing are quite elusive since only a few remains belonging to pelagic taxa have been identified in the assemblage (NISP Scombridae = 19). While tuna schools are encountered in the open-sea, single individuals could be caught in shallow waters, close to the shore. Because the open-waters are far off Marawah Island and thus hard to access, fishing was thus limited to the surrounding grounds.

Spatial distribution and phasing

The taxonomic spectrum is similar between the rooms, while we can note some slight variations (Figure 5 A). The proportions of grunts and barracudas are significantly higher in Room 2 and those of sparoid fish in Rooms 1 and 3. Only a few contexts located outside the tripartite house have been excavated. They essentially provided otoliths which are belonging to grunts, emperors, seabreams, and groupers. Since otoliths are hard structures, it is likely that they are more resistant to weathering outside the stone built house than the other fish remains. In Shagra (Qatar), Desse (1988: 164) also suggested that the absence of fish bones outside of the stone structure was due to taphonomic bias. Because mostly grunts were identified from otoliths in our study (Figure 3 B) – unlike the other main taxa – their prevalence in certain contexts could be directly correlated to the better preservation of otoliths. The distribution of the main families throughout the phasing sequence confirms the predominance of grunts, emperors and seabreams throughout the site occupation (Figure 5 B). However, there is a striking increase in the proportion of grunts which is from 18% in Phase 1 to 25% in Phase 2, and to 35% in Phase 3. Since Phase 2 and 3 are not consistent with a domestic occupation strictly speaking, we presume that the faunal remains they provided originate from anthropogenic layers disrupted by the collapse of the structure. As some of these rubble deposits were probably exposed on surface for a while, here too, taphonomic bias cannot be excluded. According to our personal investigation of osprey diet on Marawah Island, it is not likely that numerous otoliths were derived from fish consumption by raptors after the site was abandoned.

Seasonality

The majority of fish identified could have been caught all year round in the vicinity of the site (e.g. grunts, emperors, seabreams, groupers, and cartilaginous fish). Several recent archaeo-ichthyological studies suggest that fishing could have been potentially carried out during a great part of the year as certain environments such as mangroves and reefs stay productive long enough (Beech, 2004: 201-207; Lidour et al., 2018; Lidour & Beech, 2019). Further investigations are however necessary to bring to light a possible sedentary lifestyle on the coast during the Neolithic (e.g. Cavulli & Scaruffi, 2013; Mashkour et al., 2016). The large number of otoliths found at the site encourage schlerochronological investigations in the future.

Site comparisons

MR1 is situated on a limestone outcrop distant about 3 km from MR11 on the south-western coast of the island (Figure 1). The material surface is mainly composed of lithic industries such as arrowheads which confirm a Neolithic occupation (Charpentier, 2004). While the site was not yet properly excavated, a few fish bones were studied from locus MR1.54 (Beech, 2004: 124-125): two sawfish vertebrae and a seabream premaxilla were recorded. It is likely that the fishing techniques at MR11 and MR1 were quite similar. Several other archaeological sites

were surveyed on Marawah Island – most of them date back to the Islamic period. The comparison of their faunal assemblages is quite hard because of the small number of remains they provided. Small needlefish, emperors, seabreams, and scads (small carangids) were among the most common fish identified. It indicates the local perseverance of the simple and non-selective fishing techniques already adopted by the island inhabitants during the Neolithic. A number of parrotfish remains were identified at MR6.1 (Early Islamic), suggesting the exploitation of coral grounds (Beech, 2004: 125-126).

As early as the 8th millennium BC, the inhabitants of Natif 2 Cave (Dhofar, Sultanate of Oman) probably already used seines to catch small sardinellas and anchovies (Charpentier et al., 2016). Likewise, during the 6th and 5th millennium BC, the fisheries from Bahrain (al-Markh J19) and Qatar (Khor P, FB, Shagra) are also characterised by the great occurrence of small planktivorous fish like sardines and silversides (Desse, 1988; Von den Driesch & Manhart, 2000), which suggest the use of small-mesh devices along the shorelines. It is likely that small seines and barrier traps were the oldest devices used to fish in Eastern Arabia before the development of more advanced techniques such as cage trapping, luring and net setting in open-waters from boats as presumed in the fisheries of Dosariyah (Saudi Arabia), Delma, and Akab (UAE) (Uerpmann & Uerpmann, 2018; Lidour & Beech, 2019; Lidour et al., 2019). Firing arrows, spearing, and harpooning may have also been utilised according to ethnographic records (e.g. Serjeant, 1992) but such methods are not yet clearly evidenced during the Neolithic in Eastern Arabia. Overall, the fish fauna identified at MR11 Area A fits within the majority of the other Neolithic assemblages known in the Arabian Gulf where significant quantities of seabreams, emperors, groupers, and cartilaginous fish were also reported.

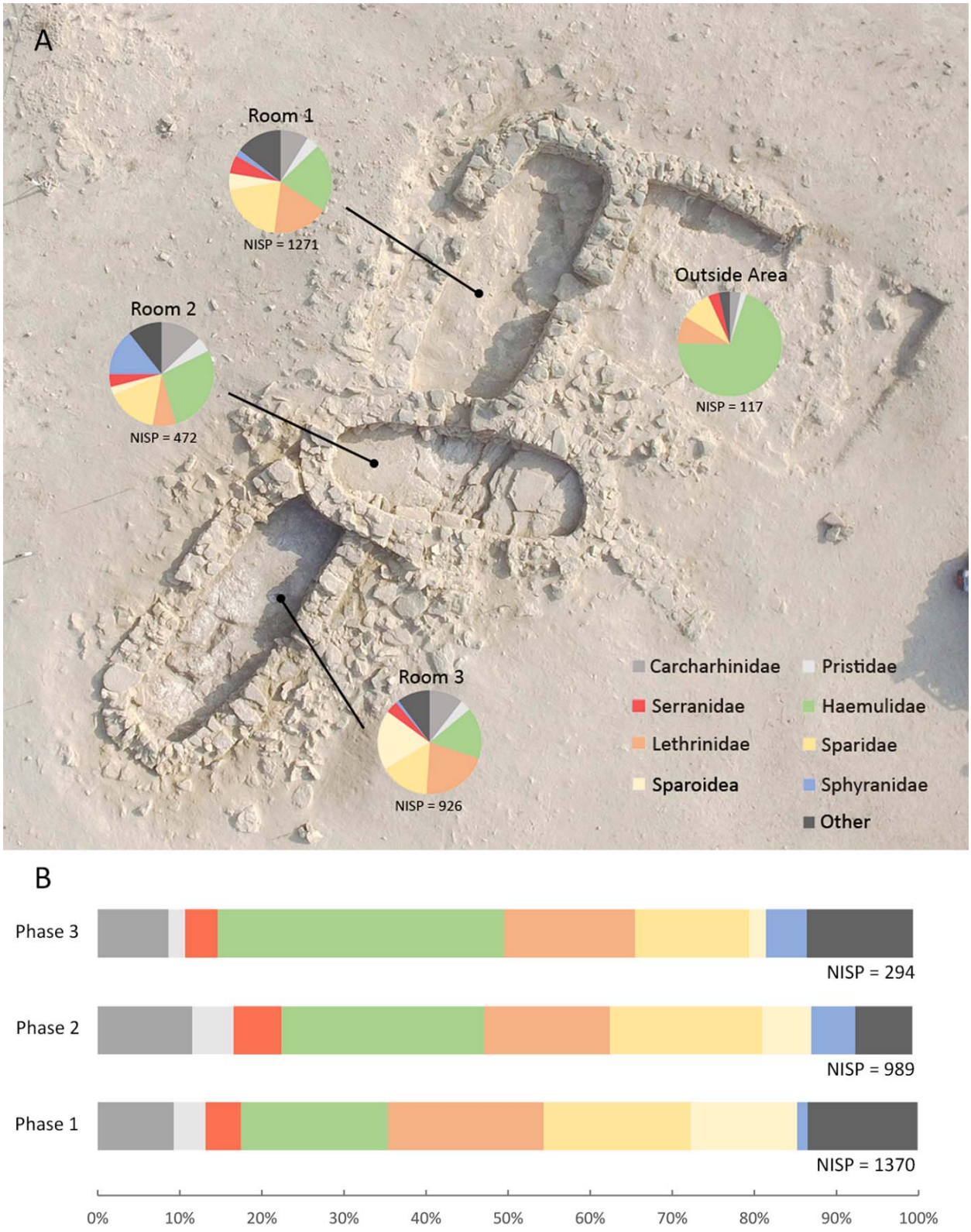


Figure 5. A. Spatial distribution of the most common fish families identified at MR11 Area A; **B.** Frequencies of the most common fish families identified throughout the phasing.

Conclusion

The present study suggests that the oldest fishing activities documented in the Arabian Gulf were exclusively carried out in shallow coastal environments such as seagrass beds and mangroves with non-selective techniques (beach seines and tidal barrier traps). This opportunistic exploitation of the surrounding waters is well documented all along the Neolithic at sites situated in the Arabian Gulf where small seabreams and emperors constitute the major fish landings. The present study also outlines the importance of small grunts, which could be essentially identified by their otoliths. Fine sieving regularly points to the presence of sardines, anchovies and silversides. In the future, fine sieving (1 or 2 mm mesh) should be systematically undertaken in order to better evaluate the role of these small fish in ancient fisheries.

Since 2017, the excavations at MR11 have been extended to further Neolithic stone build houses located in the vicinity of Area A. These have also provided numerous fish remains which are currently under study. Comparative analyses will give us a better understanding of the organisation of what appears to be an ancient fishermens village. It seems that as far back as the Neolithic period, fish constituted a major part of the diet and a significant source of animal protein and lipid for the whole of Eastern Arabia.

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Table 1. Table of identified fish from MR11 Area A, quantifications in NISP, MNI and WISP.

Family	Genus	Species	NISP	MNI	WISP (g)
Hemiscylliidae	*Chiloscyllium*	*Chiloscyllium* sp.	6	6	0.711
Carcharhinidae	*Carcharhinus*	*Carcharhinus amboinensis*	1	1	0.05
		Carcharhinus sp.	10	4	2.064
	ind.	ind.	266	30	31.374
Pristidae	ind.	ind.	106	27	12.309
Dasyatidae	ind.	ind.	3	2	0.756
ind. Myliobatiformes			66	20	2.854
ind. Chondrichthyes			11	1	2.301

	Total determinated Chondrichthyes		**458**	**90**	**50.118**
	Total Chondrichthyes		**469**	**91**	**52.419**
Engraulidae	*Stolephorus*	*Stolephorus* sp.	1	1	0.007
	ind.	ind.	19	2	0.013
Clupeidae	ind.	ind.	6	2	0.011
Ariidae	*Netuma*	*Netuma bilineata*	1	1	0.87
		Netuma sp.	1	1	0.32
	ind.	ind.	6	6	1.642
Mugilidae	ind.	ind.	3	3	0.107
Atherinidae	*Atherinomorus*	*Atherinomorus lacunosus*	23	15	0.299
Belonidae	*Tylosurus*	*Tylosurus* sp.	5	5	0.248
	ind.	ind.	13	9	0.064
Platycephalidae	*Platycephalus*	*Platycephalus indicus*	11	4	1.139
	ind.	ind.	2	1	0.21
Serranidae	*Cephalopholis*	*Cephalopholis hemistiktos*	1	1	0.055
		Cephalopholis sp.	2	2	0.025
	Epinephelus	*Epinephelus coioides*	7	6	1.144
		Epinephelus sp.	103	66	49.112
	ind.	ind.	18	13	2.474
Sillaginidae	*Sillago*	*Sillago sihama*	13	10	0.546
Carangidae	*Alepes*	*Alepes vari*	1	1	0.075
		Alepes sp.	1		0.159
	Carangoides	*Carangoides* sp.	12	5	2.159
	Caranx	*Caranx* sp.	1	1	0.251
	Gnathanodon	*Gnathanodon speciosus*	14	11	4.952
	Scomberoides	*Scomberoides commersonnianus*	3	3	0.382
		Scomberoides sp.	1	1	0.111
	Selar	*Selar* sp.	2	1	0.001
	ind.	ind.	26	9	9.25
Lutjanidae	*Lutjanus*	*Lutjanus malabaricus*	1	1	0.01
		Lutjanus sp.	34	18	1.34
Gerreidae	*Gerres*	*Gerres longirostris*	2	2	0.105
		Gerres sp.	2	1	0.08
Haemulidae	*Diagramma*	*Diagramma pictum*	4	3	0.4
	Plectorhinchus	*Plectorhinchus* sp.	1	1	0.06
	Pomadasys	*Pomadasys stridens*	625	407	33.795
		Pomadasys sp.	9	6	0.211
	ind.	ind.	1		0.033
Nemipteridae	*Scolopsis*	*Scolopsis* sp.	1	1	0.013
Lethrinidae	*Lethrinus*	*Lethrinus borbonicus*	4	3	0.189
		Lethrinus lentjan	2	1	0.29
		Lethrinus microdon	1	1	0.07
		Lethrinus nebulosus	105	88	7.906
		Lethrinus sp.	348	81	30.648
Sparidae	*Acanthopagrus*	*Acanthopagrus arabicus*	37	24	11.4
		Acanthopagrus berda	1	1	0.02

		Acanthopagrus bifasciatus	10	5	9.578
		Acanthopagrus sheim	1	1	0.142
		Acanthopagrus sp.	75	56	22.454
	Argyrops	*Argyrops spinifer*	1	1	0.035
	Rhabdosargus	*Rhabdosargus haffara*	137	92	22.46
	ind.	ind.	227	41	20.431
ind. Sparoidea			251	6	12.25
Sciaenidae	ind.	ind.	4	1	0.021
Mullidae	ind.	ind.	1	1	0.005
Terapontidae	*Terapon*	*Terapon* sp.	3	2	0.104
Scaridae	*Scarus*	*Scarus* sp.	4	3	0.32
Siganidae	*Siganus*	*Siganus* sp.	17	10	0.313
Sphyraenidae	*Sphyraena*	*Sphyraena putnamae*	1	1	0.033
		Sphyraena sp.	103	40	6.158
Scombridae	*Euthynnus*	*Euthynnus affinis*	16	5	18.008
ind. Thunnini			3	3	7.062
ind. Perciformes			86		5.175
ind. Teleostei			4653	1	411.367
	Total determinated Teleostei		**2328**	**1087**	**281.57**
	Total Teleostei		**7067**	**1088**	**698.112**
	Grand Total		**7536**	**1179**	**750.531**

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