Bonn. zool. Beitr.	Bd. 50	H. 3	S. 227–247	Bonn, Dezember 2002

Animal exploitation in medieval Siraf, Iran, based on the faunal remains from the excavations at the Great Mosque (seasons 1966–1973)

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Abstract. The faunal assemblage originating from excavations at the Great Mosque in the ancient port of Siraf comprises approximately 25,000 bones and bone fragments of at least 159 different animal species of mammals, birds, reptiles, fish and molluscs. The material covers the time span from the 4th to the 16th century AD. The paper describes these species with special emphasis on their economic importance for human diet.

Key words. Archaeozoology, faunal exploitation, Persian Gulf.

Introduction

Archaeological excavations at the ancient port of Siraf, situated at the Iranian coast of the Persian Gulf, were carried out by the British Institute of Persian Studies in collaboration with the Archaeological Service of Iran under the direction of D. Whitehouse. They lasted seven seasons from 1966 until 1973. During this project huge quantities of animal bone finds and of shells were recovered. This faunal assemblage filled 25 large wooden packing cases measuring approximately 2.00 x 1.00 x 1.50 m when it arrived at the Institute of Palaeoanatomy in Munich in spring 1997 for analysis. It is estimated that these boxes contained more than 200,000 bone and shell fragments. Every person who is involved in archaeozoology will understand that the scientific investigation of such a huge quantity of material demands very much time and the complete study will take many years. Due to the fact that the bone material does not consist only of remains of domestic animals and other terrestrial vertebrates, as are usually found in prehistoric and early historic sites, but it also includes a great variety of remains of animals living in the sea such as marine mammals and reptiles, fish and marine molluscs, the study of which will be very laborious, especially with regard to the fish remains.

To begin with, we decided to analyse first a well defined group of material related to one distinctive building structure investigated in the excavations, namely the Great Mosque which was designated by the excavators as Site B (Whitehouse 1968–1974).

History and environment of Siraf

Whitehouse in his interim reports on the excavations (1968–1974) and elsewhere (eg 1975) discussed the historical significance of the ancient port, its history and its environment. The following short paragraphs are based on his investigations.

For more than two centuries after c 800 AD, the ancient port of Siraf played an important role in the maritime trade between the Persian Gulf, the Far East and

Africa. It prospered greatly under the Abbasid caliphate. Goods from Chinese, Indian and African ports arrived by sea via the Persian Gulf, where the entrepôts of al-Basrah and Siraf became notoriously rich. After al-Basrah had been destroyed by various events, Siraf continued to thrive, and the period c. 950-75 was probably the richest in its entire history. In 977 the city suffered an earthquake and began to decline. Some of the merchants had moved to Oman. According to historical records, Siraf fell into complete ruin in the eleventh century. Its fall took place against a background of widespread recession and unrest. The eleventh century was a period of profound political change (for more detail see Whitehouse 1974; 1975, 263 ff.).

Despite the upheavals of the eleventh century, parts of the city survived and were rebuilt. Siraf "was far from being a 'ghost' city; the bazar was open, the Friday Mosque still stood and the masons' workshops continued to satisfy a prosperous, if small, clientele" (Whitehouse 1975, 267).

Several geographers and voyagers have left descriptions of the city, Iştakhrī (writing shortly before 950) provides the fullest surviving account. Despite the position of the city in the hottest part of the coast and the scarcity of drinking water, fruits and vegetables, all of which had to be brought from the plain of Jamm, Siraf was a prosperous city with imposing buildings. According to Iştakhrī, the merchandise which passed through Siraf includes aloes, ambergris, camphor, gemstones, bamboo, ivory, ebony, paper, sandalwood and other perfumes, drugs and spices. The city was an important market for pearls and among its own products were linen napkins and veils (Whitehouse 1968, 3).

Whitehouse (1972, 67) wrote: "At 350 m. beyond the eastern defences stands a group of eroded middens of oyster shells. The middens are at the top of the beach, just above the high water mark. It is tempting to regard the middens as the debris of pearl fishing, for Iştakhrī comments on the pearls marketed at Siraf in the tenth century and Tūsī, writing in the thirteenth century, states that pearls were fished at Shilau (= the post-medieval successor of Siraf). It should be noted, however, that shell middens occurred in fourteenth to sixteenth-century contexts at Sites A and F and that we found oyster middens in the post-medieval levels at Site J. Clearly, therefore, shellfish were consumed at Shilau and it would be premature to regard an oyster midden as positive proof of pearling".

The site of Siraf extends along the edge of a shallow bay, the ends of which are low sandy spits. The bay, which faces south, is 4 km across. Immediately inland is a rugged sandstone ridge. In this part of Fars, the hinterland consists of a series of long mountainous ridges roughly parallel to the coast. The ridges, which are precipitous and reach heights of more than 1500 m within 20 km off the sea, are broken only occasionally by passes, making communication between the coast and the interior extremely difficult. At the ancient port itself the first low ridge begins less than 500 m from the beach, leaving only a narrow habitable strip.

Rugged mountains dominate the interior, on the coast the soil potential is classified as having "severe to extreme limitations" (Dewan & Famouri 1968) and the average rainfall is less than 300 mm a year. Today, arable land in the vicinity of the ancient city is very limited as it was the case in ancient times (see Fig. 1 in Whitehouse 1974). Investigations by members of the excavation team in the surroundings of the city

have shown, that erosion has taken place in the last millennium and that the soil cover was considerably more extensive in the period of Siraf's great prosperity. Whitehouse (1974, 5) concluded that some 700 ha of land in the vicinity of Siraf may well have been cultivated in the period of maximum prosperity. At least 72 % of this area (just over 500 ha) may have been irrigated. It is assumed that this potential was still inadequate for the needs of the city and basic foodstuffs had to be imported.

The Great Mosque or Site B

The remains of a large building, consisting of pier bases and tumbled walls, were excavated in Site B. The excavation revealed a mosque, which, in its final form, consisted of a rectangular courtyard flanked by double arcades on three sides, with an arcade five bays deep on the fourth, or qibla, side (Whitehouse 1968, Fig. 5; 1969, 41, Fig. 2). In 1967/68 the footings of small buildings, considered as shops, were found on the north-west, north-east and south-east of the mosque. The structures are flimsily built, with plaster partitions and paved or plaster floors. Few, if any, would have supported an upper storey. The partitions are without openings and each room is entered from the street. All rooms are small, the largest measuring barely 3 x 2 m internally. Several rooms contain ovens and it is clear that the structures are the small lock-up shops and workshops of a bazar (Whitehouse 1970, 8). Later excavations revealed that the bazar extended further to the east, designated by the excavators as Site C.

The Great Mosque consists of several successive buildings. In the season of 1969–70 it was shown that the earliest mosque was built shortly after 803-04. It rested on a platform 2 m high, filled with earth and rubble. During the third and fourth seasons this platform was explored revealing the remains of a Sasanian fort. The function of the Sasanian settlement is clear; for it the port Gur was the most important Sasanian city in the south-western Fars. Siraf, in short, was one of a series of ports in the Persian Gulf, providing the Sasanians with a profitable share of the maritime trade which carried luxury goods from the entrepôts of Ceylon and South India to the markets of Western Asia and the Mediterranean Sea (Whitehouse 1972, 87).

The faunal assemblage was separated into the following chronological units according to an e-mail communication from David Whitehouse to Michael Roaf.

Period 1a began probably in the 4th century AD or the early Sasanian period. It ended in the late Sasanian or early Islamic period resp. at the end of the 6th or in the 7th century AD.

Period 1b began before 725-775 AD and ended at latest in the middle of the 9th century AD.

Period 2 began immediately after the end of Period 1b (perhaps as early as about 825 AD) and ended immediately before Period 3 (perhaps about 1025 AD). Insufficient quantities of faunal remains were recovered from Period 2 layers, since during this phase the floor of the mosque were kept clean and there was no major rebuilding.

Period 3 lasted from c 1050 until 1275/1325 AD.

Period 4 existed between the late 13th or early 14th century and the 16th century AD.

Composition of the faunal assemblage

The faunal assemblage collected during the excavations in the Great Mosque and adjacent areas consists of remains of mammals, birds, reptiles, fish and molluscs (Table 1). 24,646 bones and shells have been examined so far. The majority of the material derives from the slaughter house, the kitchen and/or from fish processing. Therefore, most of the finds are fragmentary and the percentage of unidentifiable bones and shells is high especially regarding the fish bones (Table 1).

The faunal remains are distributed in different percentages in the various periods. Period 1b delivered the most abundant material making up 11,668 bone and shell remains, Period 4 yielded only 778 specimens. As can be seen from Table 1, the majority of the bones derives from domestic animals (app. 60%), mostly from sheep and goat (Table 2). The next most abundant animal group is represented by fish, followed by the group of molluscs. Hunting of wild mammals and birds was of minor significance during the whole occupation time of the site. In mammals an increasing percentage through the different periods can be observed, while in fish and molluscs the contrary is the case. It seems that the exploitation of the sea became less important in the course of time. Besides the animal groups listed in Table 1 some egg-shells of ostrich, pincers of crustaceans, shells of sea urchins and fragments of corals have been found.

Table 1a: Animal groups identified.

	Period 1a Number	%	Period 1b Number	%	Period 3 Number	%	Period 4 Number	%
Domestic Animals	3075	48.1	6818	64.2	2742	67.4	508	69.7
Wild Mammals	9	0.1	22	0.2	59	1.4	2	0.3
Wild Birds	16	0.2	19	0.2	14	0.3	2	0.3
Reptiles	36	0.6	35	0.3	11	0.3	–	–
Fish	2259	35.3	2805	27.1	1018	25.0	187	25.7
Molluscs	997	15.6	918	8.6	227	5.6	30	4.1
Sum of Identified	6392	100	10617	100	4071	100	729	100

Table 1b: Unidentified animal groups.

	Period 1a Number	%	Period 1b Number	%	Period 3 Number	%	Period 4 Number	%
Unidentified Mammals	525	31.7	18	1.7	14	16.9	4	8.1
Unidentified Fish	1043	62.5	853	81.2	56	67.5	41	83.7
Unidentified Molluscs	95	5.7	180	17.1	13	15.7	4	8.2
Sum of Unidentified	1654	100	1051	100	83	100	49	100
Total	8046	–	11688	–	4154	–	778	–
Unidentified in % of Identified	29.6	–	9.0	–	2.0	–	6.3	–

Animal husbandry and significance of livestock for human diet

Domestic species present include horse, donkey, cattle, sheep, goat, camel, pig, dog, cat, chicken and the hybrid of horse and donkey, the mule (Table 2). As already said, the overwhelming bulk is made up of bones of sheep and goat which show increasing percentages in the course of the time (Period 1a: 87.6%, Period 1b: 95.0%, Period 3: 95.7%, Period 4: 96.5%). During the whole occupation time of Site B, goats were more frequent than sheep, an observation which is in accord with the overall poor environmental conditions of the region and should be applicable also for the other excavated areas. One can assume that small ruminants were not brought to the city from far away but were raised in the vicinity or in the interior plains. The ratio of sheep to goat is as follows: Period 1a: 1:9, Period 1b: 1:10, Period 3: 1:2, Period 4: 1:5. This numeric comparison demonstrates that sheep-keeping became more important in the later phases, when the number of people living in the city had decreased.

Table 2: Taxonomic quantification of domestic animals.

	Period 1a	Period 1b	Period 3	Period 4
Horse	–	2	5	2
Horse and / or Mule	6	2	4	–
Donkey	7	6	–	–
Cattle	163	130	44	9
Sheep	42	160	230	21
Sheep / Goat	2307	4920	1914	371
Goat	346	1394	479	98
Camel	10	22	5	2
Pig	129	27	2	–
Dog	9	24	27	1
Cat	5	58	11	3
Chicken	51	73	21	1
Sum	3075	6818	2742	508

In the earliest period, cattle and pig make up 5.3 and 4.2% of the sample of the domestic animals. The importance of both species decreased dramatically over time, and pig disappears completely from the list of domestic species in Period 4. The few pig bones recorded for the two earlier Islamic periods – Period 1b and Period 3 – may be attributed to the fact, that either in these times not all people living in the city complied with the Islamic rule of not eating pig meat or that there lived some non-Islamic merchants for whom some pigs were raised and slaughtered (or that these bones derive from the earlier occupation levels). All in all, the unfavourable environmental conditions with lack of grass and water forced the farmers to minimise the number of cattle and pigs.

Bones of horses, mules and donkeys are scarce, because these animals were seldom slaughtered for their meat. Similarly dog and cat meat did not contribute to the human diet. Both latter domestic species were attracted by the great masses of fish which were processed and sold in the bazar (see below). Concerning the camel, most of the bones are so fragmentary that we feel unable to make a decision about

Table 3: Bone weight quantities of livestock (g).

	Period 1a Absolute	%	Period 1b Weight	%	Period 3 Weight	%	Period 4 Weight	%
Cattle	3,720	17.2	1,905	4.4	673	2.0	139	4.4
Sheep/Goat	16,066	74.3	39,808	92.8	31,697	96,2	2,771	87,9
Camel	383	1.8	650	1.5	211	0.6	55	1.7
Pig	1,175	5.4	150	0.3	20	0.06	–	–
Equids	275	1.2	370	0.9	338	1.0	186	5.9
Sum	21,619	100	42,883	100	32,939	100	3,151	100

the species identification for the majority of them, that is to say whether the bones belong to the one humped and/or two humped camel. Only in 8 better preserved bones we were able to attribute them with certainty to the dromedary (7 from Period 1b, 1 from Period 3). Chicken bones are more abundant than camel bones but due to their overall small size the consumption of chicken meat played a minor role in the diet of the citizens.

Bone weight counts of the domestic stock are given in Table 3. As bone weight correlates directly to body weight, the percentages of the bone weights reflect the value of each animal or animal group in the human diet. More than 74% in Period 1a, over 90% in Periods 1b and 3 and almost 88% in Period 4 of the meat consumed derived from small ruminants. All the other domestic animals played a minor role as meat suppliers, the only exception to this statement is in Period 1a when almost 20% of the meat still came from cattle.

It can be assumed that the animals whose meat was eaten have been slaughtered in or near the bazar and their carcasses dismembered afterwards for meat consumption. Not all the meat was prepared and eaten by the people living and working around the Great Mosque, but a part of it was certainly sold in the bazar. This was the case especially during Period 1b and can be seen from the fact that the sheep/goat material from this period contains more than the two to three times as many metacarpi and metatarsi than "meat-rich" bones like humeri or femora. The foot bones were dismembered after the slaughter and remained in the site whereas the meat-rich part of the carcass was sold.

While in cattle we have evidence for all age groups (Table 4) sheep and goats with an age of less than one year were seldom slaughtered. The preferred slaughter age

Table 4: Cattle. Age distribution based on maxillary and mandibular teeth.

Age groups	Period 1a	Period 1b	Period 3	Period 4
3 to 6 months	1	1	–	–
6 to 18 months	1	–	2	–
$2^1/_2$ to 3 years	1	2	1	–
3 to 5 years	1	1	–	1
> 5 years	2	–	1	1

was between 1 and 4 years, when the animals were still young and their flesh tasty (Table 5). It seems that slaughter practices have not changed greatly over time.

Cattle bred and exploited in Siraf were small and slenderly built animals. Their milk and meat production was certainly low. Due to lack of measurements for Periods 1b to 4 we could not prove whether the size of the cattle decreased over time. A clearer picture emerges from the bones of sheep and goat. Here several complete metapodials allow the estimation of the height of the withers of the animals.

Goat, Period 1a: female 56.4–66.2 cm. (n=4) mean 60.8 cm.; Period 1b: female 53.8–61.3 cm. (n=6) mean 58.8 cm., male 70.7 cm.; Period 3: female 62.6–64.5 cm. (n=3) mean 63.3 cm., male 69.2 and 73.5 cm.

Sheep, Period 3 60.4–71.0 cm. (n=8), mean 61.5 cm.

The greater mean of the shoulder height of female goats in Period 3 is not significant because of the low number of complete metapodials available. Thus there is no evidence that goats were not of the same size at every period.

Like the cattle also the horses, donkeys, pigs, cats and chicken were of small body size. Dogs were typical of the feral, stray dogs of the Middle and Far East, and were medium-sized animals.

Table 5: Sheep / Goat. Age distribution based on maxillary and mandibular teeth.

Age groups	Period 1a	Period 1b	Period 3	Period 4
≤ 3 months	3	1	1	1
3 to 6 months	6	7	3	1
6 to 12 months	9	12	7	–
1 to 2 years	35	76	38	10
2 to 4 years	36	126	65	18
≥ 4 years	11	17	14	1
Sum	100	239	130	31

Wild mammals

Wild mammals include three species of marine origin which can be caught by accident in fishing nets or are hunted with harpoons. The seacow is the most frequent species amongst them. Seacow or dugong, which is now becoming quite rare in the Persian Gulf, is a large marine mammal occurring all along the coasts of the warm parts of the Indian Ocean from East Africa to Australia and in the adjacent western parts of the Pacific Ocean. It must have been common in the Gulf in prehistoric times, because its bones are found in almost every coastal site (eg Hoch 1979, Uerpmann & Uerpmann 1994, von den Driesch 1998). Their meat is still occasionally found in the fish markets in the southern Gulf area (Uerpmann & Uerpmann 1994, 421). How-ever, the comparatively low number of dugong and dolphin remains at Siraf indicates that hunting of sea-mammals was not a major activity of the ancient inhabitants.

The same statement can be made for the terrestrial wild mammals. The meat of hunted mammals was brought only occasionally into Site B. May perhaps other quarters of the city yield higher percentages of wild terrestrial mammals. *Gazella* is

the most frequent wild mammal, apart from the rat, which cannot be considered as a hunted species. We were not able to identify morphologically from which species of gazelle the bones are. Probably they all belong to the Persian gazelle, *Gazella subgutturosa*, the most common gazelle species of Iran. But, as it is possible that gazelles might have been brought from elsewhere by ship, the identification must remains open.

Noteworthy is the presence of three bones of the Striped hyaena (1 in Period 1a, 2 in Period 1b, see Table 6). These are not the remains of animals which perished after the occupation of Site B. The bones in question carry cut-marks and have been butchered. The hyaena is not an animal of prestige, from whom one wants to receive a trophy, like the fur of a leopard. Desse & Desse-Berset (2000, 91) describe a series of hyaena bones found at Julfar (8th to 17th century AD) in Ras al-Kaimah/U.A.E. They suggest that the presence of such an animal may be explained by pharmocological and magical practices. The authors cite medieval Arabic medical texts, saying that the flesh of a hyaena helps against gout and joint-pains. It is possible that the presence of the hyaena bones in Site B have the same background. We cannot prove this.

Table 6: Wild mammals. Taxonomic quantification.

	Period 1a	Period 1b	Period 3	Period 4
Sea cow, *Dugong dugong*	1	6	4	1
Common dolphin, *Delphinus delphis*	–	5	1	–
Bottle-nosed dolphin, *Tursiops truncatus*	–	1	–	–
Wild goat, *Capra aegagrus*	2	–	–	–
Mesopotamian fallow deer, *Dama mesopotamica*	1	–	–	1
Gazelle, *Gazella* sp.	3	1	3	–
Striped hyaena, *Hyaena hyaena*	–	1	2	–
Leopard, *Panthera pardus*	–	1	–	–
Wild cat, *Felis silvestris*	–	1	1	–
Rat, *Rattus* sp.	2	6	48	–
Sum	9	22	59	2

Wild birds and reptiles

The avifauna represented in Site B (Table 7) is not very numerous, but more diverse than in most other prehistoric faunal assemblages from the Gulf region. In many sites in the Gulf, eg in Qala'at al-Bahrain (Uerpmann & Uerpmann 1994, 1997) or in Shimal, Ras al-Khaimah (von den Driesch 1998), the most numerous groups of bird bones are those of cormorants. Diving cormorants were often caught by chance during fishing with nets. But in those cases when cormorants formed the majority of the bird remains, a possible explanation for the significant numbers of cormorants could be the exploitation of a breeding colony. In Siraf only a single bone from a

Table 7: Birds. Taxonomic quantification.

	Period 1a	Period 1b	Period 3	Period 4
?Cormorant, *Phalacocorax carbo*	1	1	–	–
Mallard, *Anas platyrhynchos*	–	1	–	–
Rock partridge, *Alectoris chukar*	5	4	13	1
Whimbrel, *Numenius phaeopus*	1	–	–	–
Herring gull, *Larus argentatus*	1	10	1	1
Black-headed gull, *Larus ridibundus*	–	1	–	–
Hemprich's gull, *Larus hemprichii*	3	–	–	–
Gull-billed tern, *Gelochelidon niloticus*	–	1	–	–
Arctic tern, *Sterna paradisea*	1	–	–	–
White-cheeked tern, *Sterna repressa*	–	1	–	–
Rock pigeon, *Columba livia*	4	–	–	–
Sum	16	19	14	2

cormorant was found which gives no further indication for such a practice. But there is a series of bones of sea birds which fly along the coastal waters and search frequently for fish. Sea gulls, for example, follow fishing boats looking for fish offal thrown overboard. They could have been caught occasionally. All in all, it is more likely that seabirds were brought to Site B to use their feathers rather than to eat their meat. This is not applicable to the rock partridge, whose flesh is very tasty and which was hunted near the city and could have been eaten by the merchants living in the bazar.

Remains of reptiles contain at least two species of marine turtle and one species of tortoise (Table 8). Specific identification of the turtle bones was difficult, because our comparative material does not comprise all the species which occur in the waters of the Gulf. Not withstanding this fact we are convinced that the identification of the majority of the bones as belonging to the green turtle, *Chelonia mydas*, is correct. It is possible that a third species, listed as unidentified turtle, namely the hawksbill turtle, *Eretmochelys imbricata*, may be present. There is no doubt that turtles, like sea birds, were caught together with the fish.

Table 8: Reptiles. Taxonomic quantification.

	Period 1a	Period 1b	Period 3	Period 4
Tortoise, *Testudo* sp.	3	3	1	–
Green turtle, *Chelonia mydas*	28	31	10	–
Loggerhead turtle, *Caretta caretta*	–	1	–	–
Unidentified sea turtle	5	–	–	–
Sum	36	35	11	–

Fishes

The fish bone material from the Great Mosque in Siraf has produced the largest number of fish species ever identified in a prehistoric or early historic site situated around the Gulf (Table 9). At least 53 different fish species have been identified so far. Due to the high degree of fragmentation, many of the remains could only be

Table 9: Fish. Taxonomic quantification.

	Period 1a	Period 1b	Period 3	Period 4
Family Sphymidae, Hammer-head Sharks				
Sphyrna zygaena	2	–	–	–
Family Carcharhinidae, Requiem Sharks				
Carcharhinus sp.	5	6	7	–
Unidentified Shark	3	1	2	–
Family Pristidae, Sawfishes				
Pristis sp.	–	1	2	–
Family Myliobatidae, Eagle Rays				
Aetobatus narinari	–	2	–	–
Family Ariidae, Sea Catfishes				
Arius thalassinus	73	109	2	6
Family Chirocentridae, Wolf Herrings				
Chirocentrus dorab	–	1	–	–
Family Belonidae, Gar-Fishes				
Ablennis hians	2	–	–	–
Family Mugilidae, Gray Mullets				
Mugil sp.	4	3	–	–
Family Sphyraenidae, Barracudas				
Sphyraena sp.	30	24	7	–
Sphyraena jello	1	–	1	–
Family Scombridae, Mackerels				
Unident. Scombridae	130	108	177	12
Auxis thazard	–	1	6	–
Euthynnus sp.	76	34	177	5
Euthynnus affinis	–	5	147	–
Katsuwonus pelamis	15	25	23	1
Sarda sp.	2	–	–	–
Scomeromorus commerson	43	60	40	1
Thunnus sp.	191	288	235	17
Thunnus albacares	20	18	14	–
Family Carangidae, Jacks				
Unident. Carangidae	318	237	22	11
Alectis indicus	1	10	–	–
Carangoides fulvoguttatus	1	4	–	–
Carangoides chrysophrys	25	40	1	–
Decapterurus sp.	3	14	1	–
Decapterurus russelli	2	–	–	–
Megalaspis cordyla	5	4	–	1
Scomberoides commersonnianus	26	44	–	3
Trachinotus blochii	1	4	–	–
Trachurus sp.	1	–	–	–
Serioloa dumerili	5	5	4	–
Family Rachycentridae, Kingfish				
Rachycentron canadum	3	6	–	–
Family Serranidae, Groupers				
Unident. Serranidae	5	10	–	–
Cephalopholis sp.	2	1	1	–
Epinehpelus sp.	120	99	32	8
Family Lutjanidae, Snappers				
Lutjanus sp.	48	44	3	2
Lutjanus coccineus	–	1	–	–
Pinjalo pinjalo	1	–	–	–
Family Nemipteridae, Pseudo-Snappers				
Nemipterus tolu	1	–	–	–
Family Haemulidae, Sweetlips				
Pomadasy sp.	–	–	–	1
Pomadasys argyreus	276	571	39	54
Plectorhynchus sp.	–	1	–	–
Family Lethrinidae, Emperors				
Lethrinus sp.	100	85	7	4
Lethrinus nebulosus	–	3	–	3
Family Sparidae, Seabreams				
Unident. Sparidae	38	41	8	–
Acanthopagrus sp.	42	13	12	3
Acanthopagrus berda	16	37	–	–
Acanthopagrus bifasciatus	1	–	2	–
Argyrops spinifer	481	755	28	56
Diplodus sp.	1	–	–	–
Diplodus noct	–	1	4	–
Rhabdosargus sarba	8	17	1	–
Family Sciaenidae, Croakers				
Unident. Sciaenidae		–	–	–
Argyrosomus sp.	4	3	1	–
Otolithes sp.	–	1	–	–
Family Mullidae, Goatfishes				
Pseudupeneus sp.	–	–	2	–
Family Platacidae, Batfishes				
Platax teira	14	22	1	1
Family Drepanidae, Sicklefishes				
Drepane sp.	–	1	–	–
Drepane longimana	8	1	–	–
Drepane punctata	3	3	1	–
Family Labridae, Wrasses				
Cheimerius nufar	2	–	–	–
Family Scaridae, Parrotfishes				
Scarus sp.	2	2	1	–
Scarus gibbus	1	–		–
Scarus harid	–	2	–	–
Scarus ghobban	–	–	1	–
Family Echeneidae, Suckerfishes				
Echeneis naucrates	–	–	1	–
Family Balistidae, Triggerfishes				
Abalistes stellaris	–	1	1	–
Family Cyprinidae, Carps				
Rutilus frisii	1	–	–	–
Sum	2259	2805	1018	187

identified to genus or to family level. Better preserved vertebrae and other skeletal elements having distinctive features, which can be used to distinguish different species of fish, made determination to species level possible. The latter are chiefly the bones of the viscerocranium – premaxillaries, maxillaries, dentals, etc. –, but include some characteristic parts of the neurocranium, such as otoliths, basioccipitals, vomers, etc.

A big help in the identification of the fish bones was the fact that the ichthyo-material from Site B contains a large quantity of so-called swollen bones or hyperostoses. Excess ossification of bone is not uncommon in fishes and many earlier workers have drawn attention to this phenomenon in the different groups (see von den Driesch 1994). A first description of a fish with swollen bones was given by Bell in 1793 in a specimen belonging to the species *Platax teira* (Fig. 1). The form of the hyperostoses and their location in the skeleton varies from one species of fish to another, but all develop idiosyncratically in the different species. Bone proliferations occur in distinct parts of the neurocranium, mostly in the frontal and occipital bones, but also in parts of the pectoral girdle and the neural and haemal processes of the vertebrae. Although, despite all explanations, the true and essential causes of hyperostosis remain unknown, it seems that they are relatively harmless neoplasms which, even though they can develop greatly in size and weight, apparently do not influence the vitality of the individual (Weiler 1973, 475). Only the swimming speed of the specimen can be affected.

The variety of fish where these bone tumors have been observed is enormous. In some species they appear regularly as is the case with *Pomadasys argyreus* (Figs 4,5), *Argyrops spinifer* (Fig. 2) and with the two species of *Drepane* (Fig. 3), to speak of the material discussed here. As these bones have a good recovery rate, the minimum number calculated for the different species affected is high (Table 10), because almost every typically swollen frontal or occipital bone stands for one individual.

Other fish species do not develop hyperostoses, but are quite frequently recorded. This is the case with the tunas and other fish species belonging to the family

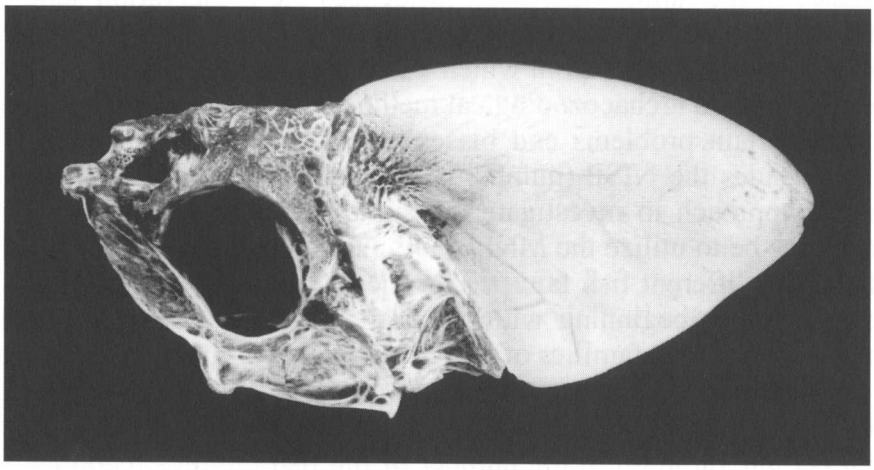

Fig. 1. Hyperostotic Supraoccipitale of *Platax teira*. Length of the fish 42 cm. Specimen Pt3 from the comparative collection of the Institute of Palaeoanatomy.

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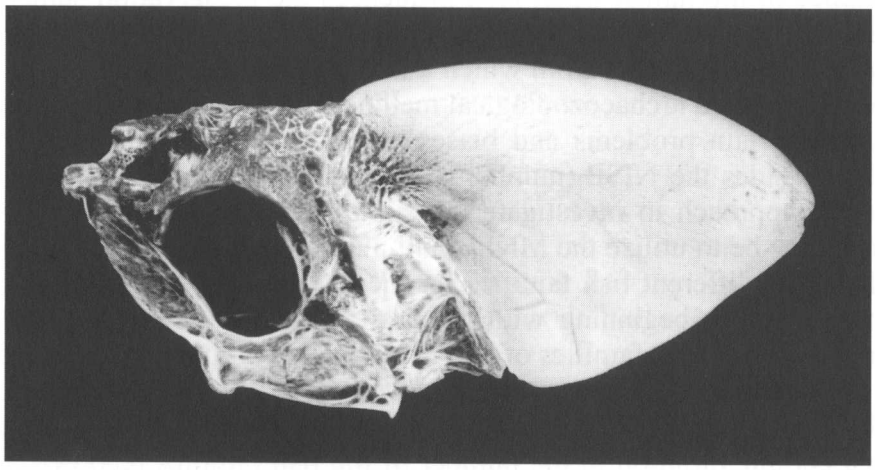

Fig. 1. Hyperostotic Supraoccipitale of *Platax teira*. Length of the fish 42 cm. Specimen Pt3 from the comparative collection of the Institute of Palaeoanatomy.

Table 10: Significance of fish families according to MNI.

Period 1a		Period 1b		Period 3		Period 4	
Sparidae	261	Sparidae	385	Scombridae	101	Haemulidae	42
Haemulidae	156	Haemulidae	349	Haemulidae	34	Sparidae	20
Carangidae	143	Scombridae	204	Sparidae	25	Scombridae	13
Scombridae	120	Carangidae	196	Carangidae	24	Carangidae	8
Serranidae	45	Ariidae	71	Serranidae	13	Serranidae	6
Lethrinidae	41	Serranidae	70	Carcharhinidae	8	Ariidae	4
Ariidae	37	Lethrinidae	41	Sphyraenidae	5	Lethrinidae	3
Sphyraenidae	20	Lutjanidae	23	Lethrinidae	5	Lutjanidae	1
Lutjanidae	17	Platacidae	18	Lutjanidae	3	Platacidae	1
Platacidae	8	Sphyrraenidae	16	Pristidae	2		
Carcharhinidae	6	Carcharhinidae	8	Ariidae	2		
Drepanidae	6	Rachycentridae	5	Scaridae	2		
Sciaenidae	4	Sciaenidae	4	Sciaenidae	1		
Scaridae	3	Drepanidae	4	Mullidae	1		
Sphyrnidae	2	Scaridae	3	Platacidae	1		
Belonidae	2	Myliobatidae	2	Drepanidae	1		
Mugilidae	2	Mugilidae	2	Echencidae	1		
Rachycentridae	2	Pristidae	1	Balistidae	1		
Labridae	2	Chirocentridae	1				
Nemipteridae	1	Balistidae	1				
Cyprinidae	1						

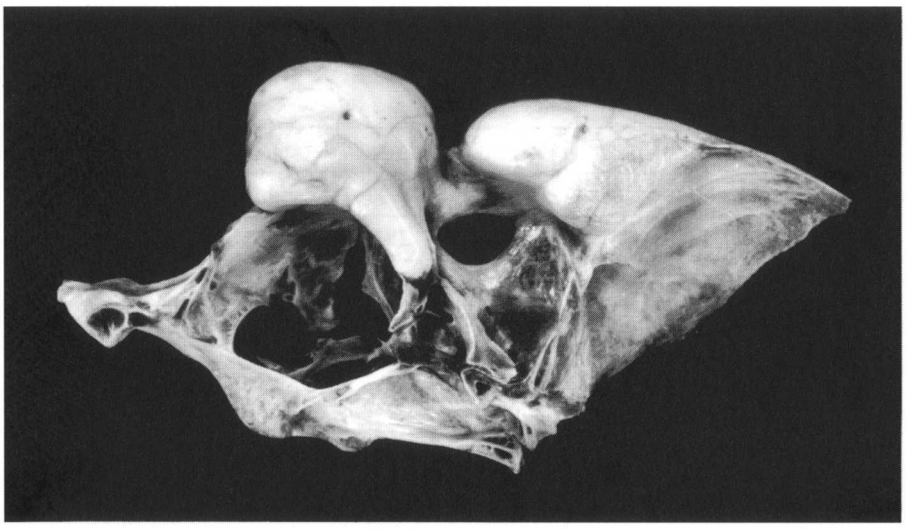

Fig. 3. Hyperostotic Supraoccipitale and Frontale of *Drepane punctata*. Length of the fish 42 cm. Specimen Dp1 from the comparative collection of the Institute of Palaeoanatomy.

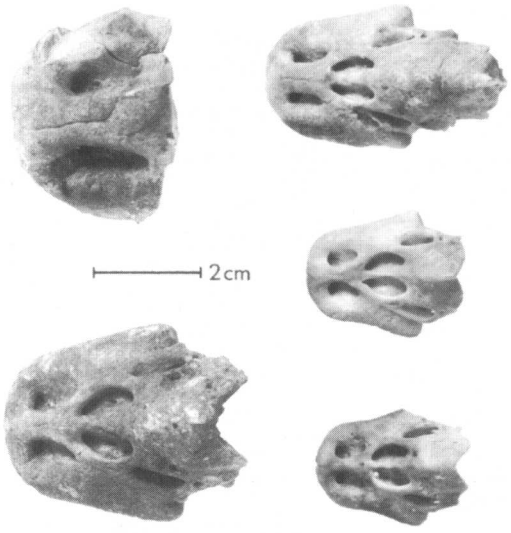

Fig. 4. Size groups of hyperostoic Fronatalia *of Pomadasys argyreus* from site B in Siraf. Above left with cut mark.

investigated the same fishing grounds were exploited. Noteworthy is the fact that fish species living in coral reefs, such as parrotfishes, are scarce (Table 9). The majority of the fishes found at the site are either pelagic forms (eg Scombridae, Carangidae) or live in coastal and shallow waters (eg Haemulidae, Sparidae).

We also measured the weight of the fish bones, in order to estimate approximately the amount of fish meat consumed. The absolute and relative catching weights (corresponding to the living weights) of the 8 major fish groups are given in Table 11. The catching weights of the fish were calculated by multiplying the bone weight counts by a factor derived from comparing the live weights and the weights of the skeletons of fish specimens of the osteological reference collection. The following conclusions can be drawn from Table 11: the four major fish groups evidenced by the MNI show more or less the same sequence when compared with the catching weights. While in Periods 1a and 1b the percentages of the different families does not vary significantly, in Period 3 most of the catching weight comes from tunas and mackerels (75%), whereas in Period 4 the most significant fish group is made up of *Pomadasys* (63.0%). The next four most important groups yielded more or less similar sequences to those derived from the MNI.

The significance of a fish group in the economy depends on the size of the fishes. A method which was used to reconstruct the typical size of fish at the site was to

Table 11: Absolute and relative "calculated catching weights" (g) of the eight major fish groups.

	Period 1a		Period 1b		Pereiod 3		Period 4	
Fish group	weight	%	weight	%	weight	%	weight	%
Sparidae	21776.6	21.9	36669.0	25.7	2398.3	5.7	2029.6	17.9
Pomadasys	27825:6	28.0	50178.3	35.2	5651.2	13.5	7161.5	63.0
Scombridae	21763.6	21.8	28684.8	20.1	31412.1	75.0	1157.6	10.2
Carangidae	19550,0	19.7	18823.1	13.2	1603.8	3.8	705.8	6.2
Serranidae	4809.1	4.8	3400.0	2.4	615.2	1.5	184.8	1.6
Lethrinidae	1980.4	2.0	3008.9	2.1	32.1	0.1	94.6	0.8
Sphyraenidae	614.3	0.6	896.9	0.6	141.3	0.3	–	–
Lutjanidae	1150.0	1.2	1070.3	0.7	43.8	0.1	25.0	0.2
Sum	99469.6	100	142731.3	100	41897.8	100	11358.9	100

measure the maximum width of the corpus of all vertebrae. This method has the advantage of including taxa for which diagnostic cranial elements were not preserved. For those fish groups which are essentially represented by skull elements, eg *Argyrops* and *Pomadasys*, size reconstruction was carried out by comparing these skull bones with those of fish in the osteological collection whose size is known. Table 12 documents the reconstructed sizes of the most numerous fish species caught. Although there is evidence for smaller specimens, the majority of the distinct fish species represent large individuals, which demonstrates that the fishermen frequented those fishing grounds where they could obtain adult and big fish (see below).

As already stated, in all important fish groups the number of skull elements greatly surpasses the number of vertebrae, even when one regards all the unidentified vertebrae. This leads to the conclusion that a part of the catch brought into Site B was butchered, the heads were taken off and the bodies sold in the bazar. Many of the neurocrania of *Pomadasys* show cut-marks (Fig. 5). Thus it is most likely that the bazar housed a fish market.

Fig. 5. Two skulls of *Pomadasys argyreus*, a with, b without hyperostosis. a Pa2 (52 cm), b Da3 (40 cm) from the comparative collection of the Institute of Palaeoanatomy.

Molluscs

Another impressive group of marine animals from Site B is made up of shells of gastropods, bivalves and cephalopods. The variety is enormous. Besides large species in which each individual contains a significant amount of meat and which therefore were probably collected for their food value, a series of smaller shells have been found. These were probably used as "beads" for jewellery or as gaming counters than as food. Consequently most of the olive shells in the material, *Oliva bulbosa*, a cylindrical, short-spired glossy shell with a wide variety of patterns,

Table 12: Variation of the size (cm) of the fishes most frequently caught.

	Period 1a	Period 1b	Period 3	Period 4
Argyrops spinifer	15–60 mean: 40 MNI: 189	15–80 mean: 45 MNI: 340	30–60 mean: 42 MNI: 14	30–50 mean: 35 MNI: 6
Acanthopagrus	15–60 mean: 40 MNI: 30	20–50 mean: 35 MNI: 20	15–45 mean: 30 MNI: 6	25–35 mean: 30 MNI: 3
Pomadasys argyreus	15–70 mean: 45 MNI: 144	20–85 mean: 50 MNI: 325	25–70 mean: 45 MNI: 19	20–80 mean: 45 MNI: 37
Tunas & mackerels	20–100 mean: 70 MNI: 89	20–130 mean: 80 MNI: 153	35–120 mean: 80 MNI: 75	30–90 mean: 65 MNI: 8
Caranx & Carangoides	40–80 mean: 60 MNI: 39	35–80 mean: 65 MNI: 51	40–70 mean: 50 MNI: 5	60 MNI: 1
Epinephelus	20–150 mean: 70 MNI: 41	20–160 mean: 75 MNI: 64	30–80 (150) mean: 65 MNI: 12	35–75 (150) mean: 50 MNI: 6
Lethrinus	20–60 mean: 43 MNI: 41	20–60 mean: 40 MNI: 41	20–25 mean: 22 MNI: 5	45–50 MNI: 2
Arius	20–100 mean: 45 MNI: 37	20–100 mean: 45 MNI: 71	40–65 MNI: 2	40–80 mean: 55 MNI: 4
Sphyraena	20–150 mean: 80 MNI: 20	25–150 mean: 100 MNI: 16	30–130 mean: 70 MNI: 5	

are perforated to serve as pendants. The same is true of many other small species. Small members of the genus *Cypraea* were used in ancient times as gaming pieces. We are not able to determine precisely which were used for which purpose, but the working and utilisation of the empty shell does not exclude the previous use of its meat.

Fishing and collecting of molluscs was certainly not done in the framework of sea-fishing activities. Other persons were occupied with this job. Many species live in shallow waters and were collected there, others in deeper waters, from where the animals were obtained by diving or with nets. The latter is applicable to the real pearl producing mollusc: *Pinctada margaritifera*, which was the most frequent shell species identified in the sample (Table 13). Considering the historical records mentioned by Whitehouse (1972, 67) describing Siraf as a place of pearling and pearl trade, one might suggest, that the *Pinctada*-shells are the remains of pearl fishing. Normally the shells were opened at sea and thrown away. But *Pinctada margaritifera* was used for mother of pearl also. This may be possible. But as these shells were found together with a great variety of other molluscs, it is more reasonable to assume that they are food remains.

Table 13: Molluscs, taxonomic quantification.

	Period 1a	Period 1b	Period 3	Period 4
GASTROPODA				
Family Trochidae, top shells				
Trochus sp.	27	133	–	–
Trochus erythreus	2	–	–	–
Euchelus atratus	1	–	–	–
Monodonta nebulosa	2	–	–	–
Family Turbinidae, turban shells				
Turbo sp.	1	–	–	–
Family Neritidae, nerites				
Nerita sp.	1	1	–	–
Nerita albicilla	7	3	–	–
Family Turritellidae, turret shells				
Turritella terebra	7	2	–	–
Family Architectonicidae, sundial shells				
Architectonia sp.	2	–	–	–
Architectonica perspectiva	1	2	1	–
Family Planaxiidae, cluster winkles				
Planaxis sulcatus	–	5	–	–
Family Modulidae, modulus shells				
Modulus tectum	51	43	3	–
Family Cerithiidae, ceriths				
Cerithium sp.	–	21	–	–
Cerithium caerulium	3	3	–	–
Family Strombidae, conch shells				
Strombus decorus persicus	89	30	5	2
Lambis truncata sebae	–	1	–	–
Tibia insulaechorab	64	59	21	5
Family Cypraeidae, cowries				
Cypraea sp.	63	54	20	–
Cypraea caurica	3	2	1	–
Cypraea turdus	13	8	3	1
Cypraea caputserpentis	–	1	–	–
Cypraea grayana	2	84	–	–
Cypraea arabica	3	4	–	–
Cypraea moneta	–	2	–	–
Cypraea annularis	41	2	–	–
Cypraea chinensis	–	1	–	–
Family Naticidae, moon shells				
Natica sp.	1	–	–	–
Neverita didyma	2	2	–	–
Polinices tumidus	–	1	1	1
Family Bursidae, frog shells				
Bursa spinosa	6	4	2	–
Family Ficidae, fig shells				
Ficus subintermedius	1	1	–	–
Family Muricidae, murexes				
Hexaplex kuesterianus	60	40	11	–
Truncolariopsis sp.	–	3	–	–
Family Thaididae, rock shells				
Purpurea rudolphi	–	1	–	–
Family Buccinidae, whelks				
Babylonia sp.	–	–	1	–
Family Fasciolariidae, tulip shells				
Fusinus sp.	–	2	–	–
Fusinus leptorhynchus	–	–	3	–
Family Olividae, olives				
Oliva bulbosa	27	14	12	1
Family Conidae, cones				
Conus sp.	3	2	1	–
Conus textile	–	2	–	–
Conus biliosus	–	1	–	–
BIVALVIA				
Family Arcidae, ark shells				
Anadara sp.	8	2	–	–
Anadara ehrenbergi	6	2	2	–
Anadara uropigimelana	1	–	–	–
Barbatia helbingii	3	2	–	–
Family Mytilidae, mussels				
Mytilus sp.	2	–	–	–
Family Pteriidae, pearl oysters				
Pinctada margaritifera	225	213	82	14
Pteria sp.	–	1	–	–
Family Pectinidae, scallops				
Chlamys sp.	3	3	3	–
Chlamys squamosa	–	4	–	–
Chlamys lemniscata	–	1	–	–
Family Spondylidae, thorny oysters				
Spondylus sp.	22	16	2	1
Spondylus marisrubri	3	5	1	–
Family Tridacnidae, giant clams				
Tridacna sp.	–	1	–	–
Family Carditidae				
Cardita bicolor	–	1	–	–
Family Cardiidae, cockles				
Trachycardium sp.	28	14	9	1
Trachycardium lacunosum	2	–	2	–
Laevicardium sp.	6	5	–	–
Laevicardium papyraceum	1	–	–	–
Fragum sp.	–	1	–	–
Family Psammobiidae, gari clams				
Asaphis deflorata	10	3	1	–
Family Glycymerididae, bittersweet clams				
Glycymeris sp.	–	1	–	1
Glycymeris livida	–	1	–	–
Glycymeris violacescens	–	1	–	–
Family Veneridae, venus shells				
Circe callipyga	186	97	28	1
Amiantis umbonella	–	3	2	–
CEPHALOPODA				
Family Sepiidae, cuttlefish				
Sepia pharaonis	1	3	9	1
Sum	997	918	218	30

Concluding remarks

Regarding the history of Siraf and its importance as an entrepôt during the Sasanian period (Period 1a) and during early Islamic times (Period 1b), one would have expected that the wide trade relations of this city might also have been reflected in the faunal assemblage. Besides some fragments of ostrich egg shells, which could have been brought from Arabia or Africa, and besides the single shell of *Tridacna*, which does not occur in the Persian Gulf, there is no clear evidence amongst the faunal remains for the introduction of "exotic" animals. Although the animal remains from Site B have provided a wealth of information about herding, hunting and fishing and yielded a great variety of species exploited, all the many species identified could have been bred, hunted and caught close to the site.

The inhabitants of Siraf subsisted both on terrestrial and on marine resources. Their economy was based on domestic animals, primarily on the herding of sheep and goats. Besides stock breeding, fishing of marine mammals, turtles, fish and shellfish were necessary activities in the ancient port in order to satisfy the demands of the human population for food. Due to the climatic conditions which limited stock breeding to a certain extent, the exploitation of the sea developed as a significant branch of the economy.

In our analysis we have found changes of the composition of the faunal assemblage. The material dated to Period 1a (Sasanian period) and into Period 1b (the period reflecting the highest prosperity of the port) delivered the greatest variety of animal species with at least 133 different species present. In Period 3, when Siraf had lost much of its importance, the species diversity is much smaller, and we have only identified 72 different species. In Period 4 there are only 39 species left. We are aware of the problem that these differences in species variety are also influenced by the unequal numbers of bones in the different complexes, but the impoverishment of the animal economy can also be seen by a dramatic change in the composition of the mammal bones. As pointed out, the importance of cattle and pig keeping decreased rapidly after Period 1a. Besides Islamic rules responsible for the taboo against the eating of pig meat, the poor environmental conditions with lack of grass and water forced the animal breeders to minimise the numbers of cattle and pigs. Only sheep and goats were adapted to this particular environment. They were kept in great numbers and their percentages increased over time. Because goats are browsers and can survive with food of lower quality, the fact that during the whole occupation time of Site B goat bones outnumber sheep bones fits well with the overall environmental conditions.

With reference to the fish, all species identified still occur today in the waters of the Gulf. At least 465 fish species originating from 101 different fish families are known. The bulk of them, namely 45 %, are made up by 211 species from 13 different families. 9 of these 13 families are also present in the assemblage collected in and around the Great Mosque. Today the following frequencies of the 9 most important fish families are recorded:

1. Carangidae
2. Lutjanidae
3. Haemulidae
4. Clupeidae
5. Serranidae
6. Sparidae
7. Carcharhinidae
8. Sciaenidae
9. Scombridae

Members of the family Clupeidae have not been identified in Siraf. This might be due to taphonomic problems. Herrings are all small fishes with paper-thin bones and are often eaten whole by humans or by scavengers like dogs and cats.

Compared with the recent frequencies of the different fish families (listed above), the fish material from Site B shows a different numerical sequence in which the Haemulidae and Sparidae were the most frequently recorded fish families. This demonstrates that the fishermen obviously exploited the same fishing grounds in order to obtain these tasty fishes. With regard to the scombrids, the presence of three species – *Euthynnus affinis, Katsuwonus pelamis* and *Scomeromorus commerson* – which are known today to undertake seasonal migrations and do not spawn in the Gulf (Nellen 1973; FAO 1974; Wheeler & Jones 1989, 328 f.), suggests that either these fishes were not caught during the whole year or that the Siraf fishermen also exploited the waters outside the Gulf.

There are two fish species which support the latter suggestion: *Platax teira* and *Pomadasys argyreus*. The former species, recorded in Site B in fairly great numbers (Table 9), is not mentioned by FAO (1974) and Kuronuma & Abe (1986) as occurring in the Persian Gulf today. The latter species, one of the most abundant in Site B, is also not mentioned by FAO (1974), but according to Kuronuma & Abe (1986) it is in the Gulf. When one compares the fish lists published from other prehistoric and early historic settlements situated around the Gulf, it becomes clear, that *Pomadasys argyreus* is either absent or very unfrequently represented (eg von den Driesch 1998, table 3; von den Driesch & Manhart 2000, table 2). In contrast *Pomadasys argyreus* (syn. *Pomadasys hasta*) has been found in masses in Balakot (3rd millennium BC), situated in Pakistan at the northern coast of the Gulf of Oman (Meadow 1979), from which many of the specimens had developed hyperostoses (Meunier & Desse 1994) like the specimens from Siraf. When one presumes that this situation was similar in ancient times it is perfectly possible that fishing for the port of Siraf was carried out as well outside the Persian Gulf.

Acknowledgements

The authors thank Dr. Whitehouse for providing them with the necessary archaeological data including the dating of the osteological material. They are also thankful to Prof. M. Roaf who helped them to a better understanding of the archaeology of the ancient site and who revised the English.

Zusammenfassung

Das vorgestellte Tierknochenmaterial entstammt archäologischen Ausgrabungen in der Großen Moschee in der alten Hafenstadt Siraf, an der Iranischen Küste des Persischen Golfs gelegen. Siraf war seit der Sassanidenzeit (ab dem 4. Jh. n. Chr.), besonders aber während des 9. und 10. Jahrhunderts, ein Umschlaghafen für Waren aus China, Indien und Afrika. Zeitgenössische Reisende beschreiben Siraf als reiche, blühende Stadt, bis sie Ende des 10. Jahrhunderts von einem Erdbeben zerstört wurde und dann allmählich zerfiel. Danach (12. bis 16. Jh. n. Chr.) lebten nur noch wenige Menschen dort. Die Tierknochen, mehrheitlich Speiseabfälle, kommen aus einem Bazar, der die Moschee an drei Seiten umgab.

Entsprechend der Lage der Stadt am Meer ist die nachgewiesene Fauna reichhaltig. Sie umfaßt Wild- und Haussäugetiere, Vögel, Reptilien, Fische und Mollusken. Haussäugetiere sind am häufigsten vertreten, gefolgt von Fischen und Mollusken, während Wild (Land- und Meeressäugetiere sowie Vögel und Land- und Meeresschildkröten) nur einen unbedeutenden Teil des Fundguts ausmachen. In dem schmalen Landstreifen, der der Stadt für Feldanbau und

Haustierhaltung zur Verfügung stand, denn es erheben sich nur 500 m von der Küste entfernt schroffe Gebirge, konnten am besten kleine Wiederkäuer gedeihen. Sie stellen den weitaus größten Anteil. Rinder waren in der ältesten Phase noch relativ häufig, nehmen dann aber im Laufe der Benutzung des Platzes an Zahl drastisch ab. Schweine verschwinden im Laufe der Zeit völlig von der Liste der Haustiere, was sicherlich nicht nur ökologische, sondern auch religiöse Gründe hat.

Ein großer Teil des Nahrungsbedarfs für die Bevölkerung wurde durch Fisch gedeckt. Obwohl eine artenreiche Fischfauna nachgewiesen werden konnte (insgesamt mind. 53 Arten), stehen zwei Spezies mit Abstand im Vordergrund: eine Süßlippenart, *Pomadasys argyreus*, und eine Meerbrassenart, *Argyrops spinifer*. Beide gehören zu den begehrten Speisefischen und beide zeichnen sich im Fundgut durch hyperostotisch veränderte Schädelknochen aus. Häufig wurden im Bazar verschiedene Arten von Thunfischen angelandet. Auch die Gehäuse- und Schalenreste größerer Molluskenarten sind als Essensreste zu deuten. Es gibt jedoch eine ganze Reihe kleiner Arten, deren Gehäuse als Schmuck Verwendung fanden.

Insgesamt ist im Laufe der Benutzung des Fundplatzes eine Verarmung der Fauna festzustellen, was auch mit den historischen und archäologischen Erkenntnissen übereinstimmt. Es gibt wenig Hinweise auf die Einfuhr von „Exoten". Immerhin bedeutet z. B. die Anwesenheit von *Pomadasys argyreus*, der heute im Golf kaum noch vorkommt, dass die Fischer von Siraf auch außerhalb des Persischen Golfes Fischzüge unternahmen.

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