

**THE ANIMAL ECONOMY OF ANCIENT DILMUN
IN THE LIGHT OF FAUNAL REMAINS FROM EXCAVATIONS AT
SAAR AND QALA'AT AL-BAHRAIN**

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There is basic agreement about the location of the land called Dilmun in ancient Mesopotamian texts: In the beginning the term seems to have described most of the south-west coast of the Irano-Arabian Gulf, but around 2000 BC it apparently meant only the island of Bahrain. Its geographical position in the central part of the southern Gulf made it important for the ancient sea trade. Goods from Mesopotamia were exchanged there with those coming from India (Meluha) and the Oman Peninsula (Magan). Life on Bahrain took advantage of the favourable ecological conditions on the island. Especially the north is sort of a natural oasis due to an underground supply of Pleistocene water, carried over from the Arabian Peninsula through deep aquifers. Therefore it is not surprising that the ancient sources report on Dilmun's exports of dates and other garden products to Mesopotamia. Archaeological finds of Mesopotamian objects as well as imported goods belonging to the Harappa culture of the Indus Valley, the Umm-an-Nar culture of the Oman Peninsula, and from Iran underline the role of Dilmun within the ancient trade networks as described in the written sources of around 2000 BC¹.

It can safely be assumed that Dilmun could only play this role because life there was based on a stable and productive subsistence economy. About the animals involved, fairly detailed information was gained through the evaluation of faunal remains from archaeological sites. The following considerations are based on studies of animal bone finds from Qala'at al-Bahrain², a tell-site on the north coast of the island, and from Saar³, a somewhat smaller settlement in the north-western part of the island not directly located on the coast today.

Qala'at al-Bahrain is a large mound on the north coast of Bahrain, which is thought to have been Dilmun's capital, often called Dilmun itself. The bones are from the old Danish excavations beginning in the 50's. They derived from two areas, namely a long trench called "Excavation 520", in the north-west, and a more squarish area in the

¹ For an overview see Potts DT. *The Arabian Gulf in Antiquity*, vol. I-II. Oxford: Clarendon Press, 1990.

² Uerpmann M & Uerpmann H-P. Animal bone finds from Excavation 520 at Qala'at al-Bahrain. In: Hojlund F & Andersen HH. *Qala'at al-Bahrain. Vol.1. The Northern City Wall and the Islamic Fortress*. JASP 30: 1:1994: 417-444. Uerpmann M & Uerpmann H-P. Animal bones from Excavation 519 at Qala'at al-Bahrain. In: Hojlund F & Andersen HH. *Qala'at al-Bahrain. Vol.2. The Central Monumental Buildings*. JASP 30: 2: 1997: 235-264. Van Neer W & Uerpmann M. Fish remains from Excavation 520 at Qala'at al Bahrain. In Hojlund & Andersen, *Qala'at al-Bahrain*, vol. 1, 445-454. Desse-Berset N. La peche est au but du jardin.....Deux iles, hier et aujourd'hui. *Anthropozoologica* 21: 1995: 7-19

³ Dobney KM & Jaques D. Preliminary report on the animal bones from Saar. *AAE* 5/2: 1994: 106-120 and Brian Irving in Crawford HEW, Killick RG & Moon JA. *The Dilmun Temple at Saar. Bahrain and its archaeological inheritance*. London: Kegan Paul International, 1997. The present authors started to work on new material from the site in 1997. In 1999 more material was studied which partly included finds already studied by the earlier authors. A detailed publication of the zooarchaeological data is in preparation.

centre called "Excavation 519". Excavation 519 revealed monumental architecture interpreted as a palace, while "small scale private architecture"⁴ was encountered in Excavation 520 near the coastal edge of the tell.

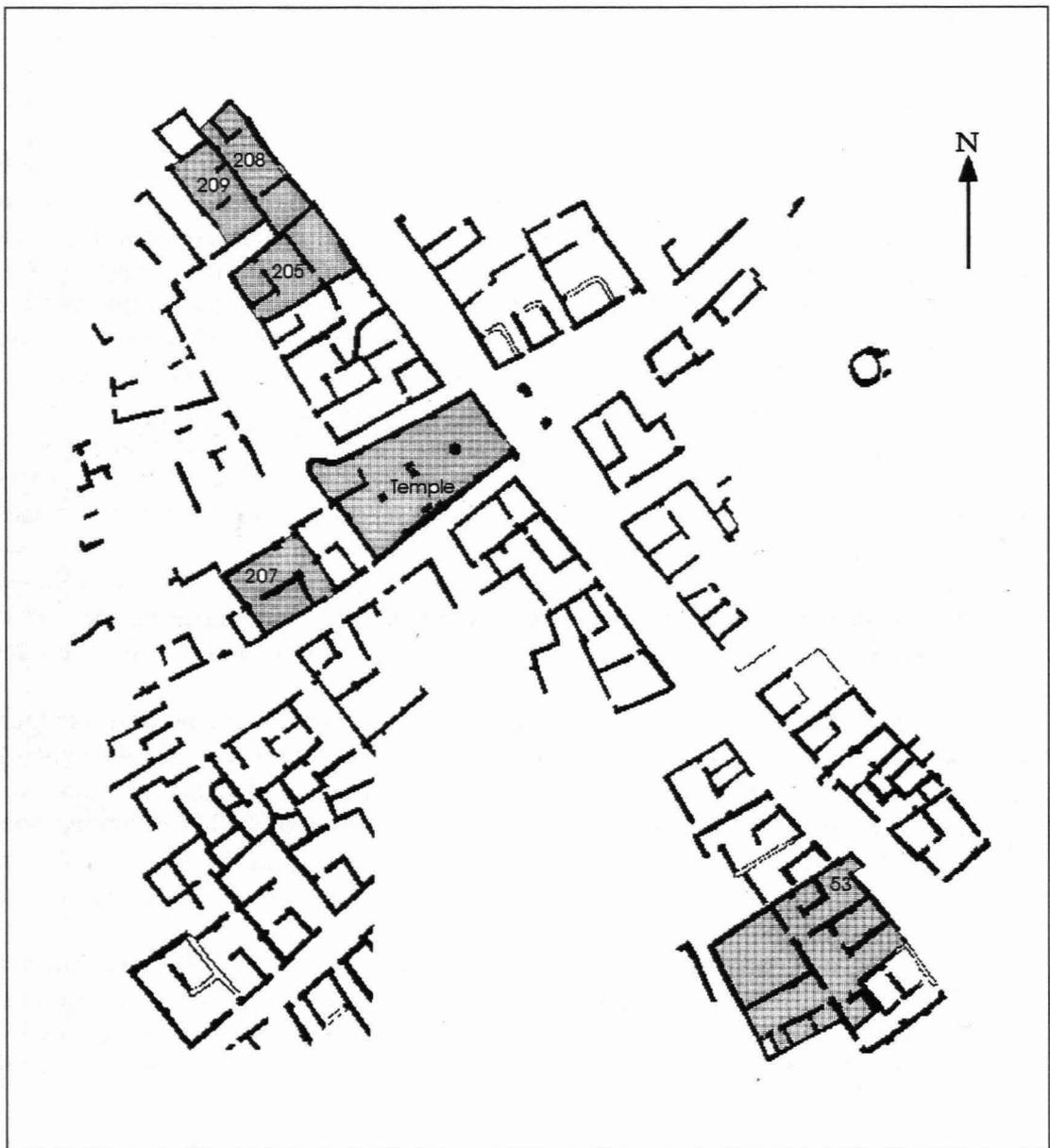


Fig. 1: Plan of Saar (after Killick et al. 1997:Fig. 1).
Areas from where faunal remains were studied for this paper are marked

Phases I and II of these excavations represent the Dilmun time, whereas the younger phases extend up to Islamic times and the Portuguese fortress, which is the dominant feature visible today. Around 2000 BC a stratified society seems to have lived there, as is indicated by the planned and partly monumental architecture. It is estimated that about 3000 people lived in Qala'at al-Bahrain at the beginning of the 2nd millennium.

⁴ Hojlund & Andersen, Qala'at al-Bahrain vol.1 and 2.

Table 1: Fish species found at Qala'at al-Bahrain and Saar

	Qala'at		Saar			General presence ⁷
	519	520 ⁵	House 205	House 207	House 208 ⁶	
	n%	n%	n%	n%	n%	
-CARCHARHINIDAE	1.4	0.6				+
-SPHYRNIDAE	0.4	0.3				
-unidentified sharks	0.2					
-PRISTIDAE	0.7	0.03				+
-RHINOBATIDAE		0.9	1.7			+
-RHYNCHOBATIDAE		0.1				
-MYLIOBATIDIDAE	0.2					+
-UNIDENTIFIED CHONDRICHTHYES	0.5			0.9		
-CLUPEIDAE			0.2			+
-ARIIDAE	0.2	0.6				+
Arius spec.	0.2	0.6				+
-BELONIDAE			0.3			
-PLATYCEPHALIDAE			0.2			
-SERRANIDAE	29.0	35.9	20.0	15.8	6	+
Epinephelus spec.	29.0	35.9	20.0	15.8	6	+
-RACHYCENTRIDAE	0.2					+
Rachycentron canadus	0.2					+
-CARANGIDAE	17.1	14.8	8.2	10.4	2	+
Scomberoides spec.	1.4	0.9	0.2	0.3	0	+
Seriola dumerili	1.0	0.1	0.2	0.0	0	+
Carangoides chrysophrys	0.9	0.8	0.3	0.1	0	+
Carangoides spec.	1.7	0.8	0.3	0.1	0	+
Caranx spec.	0.1		0.2			
Gnathodon speciosus	6.3	1.6	4.1	5.9	1	+
Alectis indicus		0.03				+
Trachinotus blochii	0.1	0.03				+
-GERREIDAE						
-HAEMULIDAE	0.1					+
Diagramma spec.	0.1					
-SPARIDAE	14.1	15.5	14	23.4	8	+
Acanthopagrus spec.	3.2	1.3	1	0.5	1	+
Rhabdosargus spec.	4.6	2.2	3	10.3	2	+
Argyrops spec.	2.0	5.7		0.5		+
-LETHRINIDAE	33.3	30.6	57	47.4	84	+
Lethrinus spec.	33.3	30.6	57	47.4	84	+
-SCIAENIDAE	0.1					
-SCARIDAE						+
-EPHIPPIDAE				0.1		+
-SIGANIDAE	1.0		3	1.6	0.4	+
-SPHYRAENIDAE	1.0	0.1	0.2	0.3	0.1	+
Sphyraena spec.	0.1	0.1	0.2	0.3	0.1	+

⁵ After Van Neer & Uerpmann 1994, Fish remains from excavation 520: Tab. 1, 445.

⁶ Percentages for houses 205 and 208 are based on samples and therefore rounded to the nearest full number.

⁷ Present in other contexts of Saar. As thousands of fish bones from Saar could not yet be studied, the species list of this site may eventually be much longer than listed here.

-SCOMBRIDAE	0.6	0.6	0.2			+
THUNNINAE	0.2	0.03	0.2			+
Euthynnus spec.	0.2	0.03	0.2			+
Thunnus spec.		0.2				
SCOMBEROMORINAE		0.1				
Total fish bones (%)	100.0	100.0	100.0	100.0	100.0	
Total fish bones (n)	1227	2899	497	1188	919	

Saar was excavated by the London-Bahrain Expedition from 1990 to 1999⁸. It is located about 10 km south-west of Qala'at al-Bahrain. Being a smaller (2,25 ha as compared to about 25 ha at Qala'at) and more rural township it was nevertheless carefully planned. The plan (Fig. 1) shows a central temple, a main street and several side-streets. The uniformity of the houses and their installations is striking. Our studies of the faunal remains concentrated on houses 205, 207, and 208. For comparison materials from houses 53, 209, and from the temple, as well as measurable bones from other areas were included.

The most striking feature of the bone finds from Qala'at al-Bahrain and particularly from Saar was the enormous proportion of fish bones, which by far outnumbered the mammal and other vertebrate remains. Marine resources have always played a major role in the diet of the people on the Arabian Gulf coast. At Qala'at the sampling methods did not regularly involve sieving. Therefore a great deal of smaller fish bones was probably missed by the excavators. Nevertheless, even the hand-picked fish bones made up more than half of the weight of the bone finds. Retrieval conditions were different at Saar, because sediments were sieved. Apparently this mainly influenced the amount of fish bones. At Saar the fish bones make up 88% of the total bone weight. Because of the difference in excavation techniques it is not correct, however, to directly compare quantities of mammalian and fish bones between the two sites. Quantitative comparisons must be restricted to the comparable classes of bone finds.

With regard to fish there are differences between the sites in species composition and size distributions, but these are also not uniform between different houses at Saar (Table 1). For houses 205 and 208 the percentages are based on samples, while the finds from house 207 and those from Qala'at al-Bahrain were analysed completely. Numerically the emperors or *Lethrinidae*, locally called 'shari' and highly esteemed as food fish, were the most frequent fish in all complexes. Their percentage was, however, generally higher at Saar. Especially the inhabitants of house 208 seem to have been very fond of emperors. This is not only expressed in the number of finds but also in a preference for particularly large fish. The preferred length was between 37,5 and 47,5 cm (standard length, SL), whereas in house 207 emperors of about 35 cm were the most abundant size class. At Qala'at 519 the general size of the emperors was similar to those of house 208. As expected, the remains of small fish are missing at Qala'at, which is probably due to the sampling procedures.

Second in numerical importance were the groupers or *Serranidae*. In terms of weight they were at least in Qala'at al-Bahrain more important than the emperors, because many bone finds represent big fish with a length larger than 50 cm. Most of these large groupers represent the species *Epinephelus coioides*, the Arabic 'hamoor',

⁸ See Killick, R et al. 1997, London-Bahrain Archaeological Expedition: 1994 and 1995 excavations at Saar, Bahrain. AAE 8, 86-98, and Crawford, Killick & Moon 1997, The Dilmun Temple at Saar... for further references.

which till today is one of the most important fishes on the markets of the Arabian Gulf coast. At Qala'at al-Bahrain the lack of small fish could be explained with the recovery techniques. At Saar, however, the small groupers would have been found because sediments from the houses were sieved. The big size of the fish-hooks found both at Saar and Qala'at is probably a better explanation for the prevalence of large specimens.

Large fish are also found at both sites within the group of the trevallies, jacks or kingfishes (*Carangidae*). Most common was the golden trevally, *Gnathanodon speciosus*, which is still an esteemed food fish in the region today. When interpreting the size of the fish found at the sites, it should be kept in mind that the species dealt with above generally provide more than 1 kg of flesh and often up to 5 kg and more per individual. In a hot climate this always indicates a larger number of consumers participating in a meal based on such a fish. Fish sizes are therefore rough parameters for household group sizes, which should be considered when observing differences as between the emperors of houses 207 and 208.

Smaller fish are found among the seabreams (*Sparidae*) and the rabbitfish (*Siganidae*). Seabreams had a certain importance at the sites, but ranged low in terms of the provided flesh. Rabbitfish are highly esteemed in Bahrain today. They seem not to have been important in the past. However, this might at least partly be due to the fragility of the bones. The other fish families listed in Table 1 had strong enough bones to survive if they had been of any economic importance. Barracudas, tuna fish, and mackerels obviously were not often eaten at Saar or Qala'at al-Bahrain⁹. The lack of tunas might indicate that mainly coastal fishing was practised, probably with traps and nets, but certainly also with hook and line.

The remains of turtles (mainly *Chelonia midas*), cormorants (mainly *Phalacrocorax nigrogularis*), dolphins (cf. *Tursiops truncatus*), and seacows (*Dugong dugon*) must also be mentioned when dealing with the marine resources exploited by the inhabitants of ancient Dilmun. At Qala'at al-Bahrain their remains are quite numerous, while at Saar only their presence can be attested. If this really mirrors their economic role there is questionable, because the bones of these large animals (with the obvious exception of the cormorant, which in fact is the most frequent of these species at Saar) may not have been carried all the way from the coast to the settlement, while their meat may well have been appreciated there.

Other minor sources of marine food were crabs and cuttlefish. Their remains were found in small numbers among the bone finds. The molluscs from Saar and Qala'at al Bahrain were studied independently¹⁰. It is difficult to relate the importance of shellfish to that of the vertebrates, and no remarks on this important source of protein and other nutrients can be made here.

Interesting observations on the deposition of fish remains were made in houses 205 and 207 of Saar, where large portions of skeletons were embedded in floor layers. Obviously the waste products of fish meals were tolerated in the living space. Close conjunctions of partial skeletons of different species might imply that meals sometimes consisted of various fish and more than one individual at a time.

⁹ The large amount of barracuda bones reported by Crawford, Killick & Moon 1997 (table on p. 80-81 and p. 82) for the Saar temple seems to be due to an error. Very few barracuda bones were seen in our samples.

¹⁰ For Saar: Glover E 1995, Molluscan evidence for diet and environment at Saar in the early second millennium BC. AAE 6: 157-179. For Qala'at al Bahrain: Cataliotti-Valdina J 1994, Les Coquillages. In: Hojlund & Andersen, Qala'at al-Bahrain, vol. 1: 455-458.

Neither a positive nor a negative correlation could be found between the amounts of fish and mammal bones in the different houses of Saar. Larger amounts of fish bones could be accompanied by many or none mammal bones and vice versa. There was also no clear-cut separation according to fragment sizes, except for the observation that floor levels rarely contained large pieces of bone. Many mammal bones come from obvious rubbish deposits which often also included animal carcasses. Several new born or infantile sheep were disposed of there as complete skeletons.

When comparing between Saar and Qala'at al-Bahrain, the retrieval of mammal bones does not really seem to have been affected by the different excavation techniques: There is not much difference between the mean weights of the identified mammal bones of the two sites. The majority of the mammalian remains at both sites derives from domestic animals. Wild species are rarely represented, although at Saar the proportion of hunted animals is significantly higher than in Qala'at. Probably this is due to the geographical position of Saar, which gave direct access to the more arid central and southern parts of the island, where the wild ungulates would have been much more abundant than in the more populated northern area. In addition the north may have been almost cut off from the rest of the island by a deep inlet reaching towards Saar from the east coast as indicated by a preliminary geological survey of the Saar area carried out in spring 1999 by G. Evans and P. Bush. The position of Saar at some sort of bottle-neck between the two parts of the island may have added to the increased availability of wild game at this site.

The most frequently hunted game animal at both sites was the gazelle. From Saar there is a small number of better preserved finds. According to the male horn-cores and some features of the postcranial skeleton only the goitered gazelle, *Gazella subgutturosa*, was present in Bahrain. As horn-cores of females are lacking, one might assume that the females of the indigenous population were hornless, which would bring them closer to the Iranian population of this species (*Gazella subgutturosa subgutturosa*) rather than to the Arabian rheem (*Gazella subgutturosa marica*) where the females have well developed horns.

The Arabian oryx, *Oryx leucoryx*, also occurred at both sites, the better preserved remains again coming from Saar, including some of the straight long horn cores found in both sexes. The rare bone-finds of camels, *Camelus dromedarius*, from Saar and Excavation 519 at Qala'at are also counted among the wild animals, because there is no conclusive evidence for the domestication of this animal before the middle of the 2nd millennium.

Carnivore remains are very rare at both sites. From Saar there is a humerus fragment, for which the respective bone of a panther (*Panthera pardus*) is the best match. Single cat bones in the size range of the wild cat, *Felis silvestris*, and of the sand cat, *Felis margarita*, were found at Qala'at al-Bahrain. The fox, *Vulpes vulpes*, is also represented with a single fragment from Saar only. Obviously neither the hunting of carnivores nor the defence against them was an important part of the daily life at Dilmun.

The only carnivore represented with a numerable sample of bone finds is the grey mongoose, *Herpestes edwardsi*. As a co-inhabitant of the settlements it may have had an important economic role as a pest control. In addition to this medium sized mongoose there existed also the smaller gold-spotted mongoose, *Herpestes auropunctatus*. Its remains were found in the lower levels of Qala'at al-Bahrain and at

Saar¹¹. This smaller species seems to have disappeared from Bahrain soon after the Dilmun time, probably because its ecological niche was taken by the grey mongoose, which was favoured by its partly semi-domestic status. The necessity of some control over unwanted commensals is underlined by the presence of rat bones (probably *Rattus rattus*) and rodent gnaw-marks on mammal and fish bones at Saar.

On the whole, wild animals played no significant role with regard to the subsistence of the ancient inhabitants of the studied sites. Most of the red meat – as opposed to the white flesh of fish – which was consumed both in Qala'at al-Bahrain and in Saar, was produced by domestic animals.

Cattle, sheep, and goat made up the bulk of the mammal bones. At Qala'at al-Bahrain cattle had the same importance as the small ruminants (based on bone weights), increasing from Phase I to Phase II. At Saar, cattle produced only about one third of the mammalian meat. Correspondingly, the small ruminants were more important at Saar.

The standard of cattle husbandry at Qala'at seems to have been high judging by the size of the animals. They were comparable in size to contemporary animals in Mesopotamia. There is pictorial evidence that both the humped zebu and hump-less taurine cattle occurred in the southern Gulf area, but osteological evidence is limited. At Saar cattle seem to have been somewhat smaller, but the evidence is not very conclusive, because the number of measurable bones is low. A large part of the measurements had to be taken on phalanges, which do not permit the exclusion of younger animals that might not have reached their final size. Anyhow, cattle do not seem to have had the same importance in Saar than in Qala'at al-Bahrain. Therefore it is possible that the difference in body size reflects a certain negligence towards cattle breeding at Saar.

Raising and maintaining large cattle in an arid environment did probably require special management. The intentional planting of fodder or the additional feeding with dry fish can be imagined as forms of special care for the cattle population of Qala'at al-Bahrain. This is even more likely as cattle were also used as draught animals. There are morphological alterations resulting from labour on some distal metacarpals and on phalanges¹². The respective bones are from adult specimens of both sexes. Correspondingly, the age profile reconstructed from the cattle remains of Qala'at al-Bahrain 520 shows a surplus of older animals. This is not evident at Excavation 519 of Qala'at and at Saar, where the cattle bones mainly reflect the consumption of beef obtained from younger animals. Nevertheless, a few phalanges from Saar also show alterations probably caused by the use of the animals for labour.

Comparing the distribution of skeletal elements of cattle between the two excavations at Qala'at al-Bahrain reveals an important difference between the areas. From 519, which concerns the centre of the settlement with the official buildings, there are more bones reflecting a higher meat-value, i.e. ribs, scapulae, humeri, femora, whereas in 520 those with less meat-value are more frequent, that is skull parts, mandibles, loose teeth, and foot bones.

The study of the much more frequent remains of sheep, *OVIS*, from both sites revealed interesting differences with regard to the respective animal economies. The evaluation of the measurements of sheep bones from Qala'at al-Bahrain indicates that

¹¹ According to its dimensions the mongoose skull depicted by Dobney & Jaques 1994 in fig. 16 represents a goldspotted mongoose rather than a grey mongoose. Nevertheless the larger form was also present among the finds studied by these authors and is included in the faunal list under the term 'small cat'.

¹² Uerpmann & Uerpmann 1994, Animal bone finds from excavation 520: 427

there existed the same large breed of sheep as in Mesopotamia. The demography of the sheep of Qala'at, as reflected by the age profile and the proportion of sexes, is pointing to a careful husbandry of this species. In a generally desertic environment this certainly required professional management and special feeding strategies. Sheep maintenance may have been tied to higher positions in the social stratification of the ancient inhabitants of Qala'at al-Bahrain, as it is known for Mesopotamia from cuneiform texts.

At Saar, the majority of the sheep bones do not come from this large breed. Comparison of the size indices between the two sites (Fig. 2) clearly indicates that a smaller breed was kept there. The larger race was only of secondary importance. The size-index curve for the sheep of Saar has two peaks. The more important one is outside the combined curve for the sheep of Qala'at al-Bahrain and indicates the numerical dominance of the small sheep at Saar. The second peak is at the same position as the peak of the Qala'at sheep. This means that the inhabitants of Saar also had access to the larger sheep. Probably they were not only consumed but also kept at Saar, because the broad outline and the flat top of the size index curve for the Saar sheep might indicate some interbreeding between the different races. Nevertheless, this process had not been going on long enough to produce a uniform sheep population.

Sheep size indices (LSI)

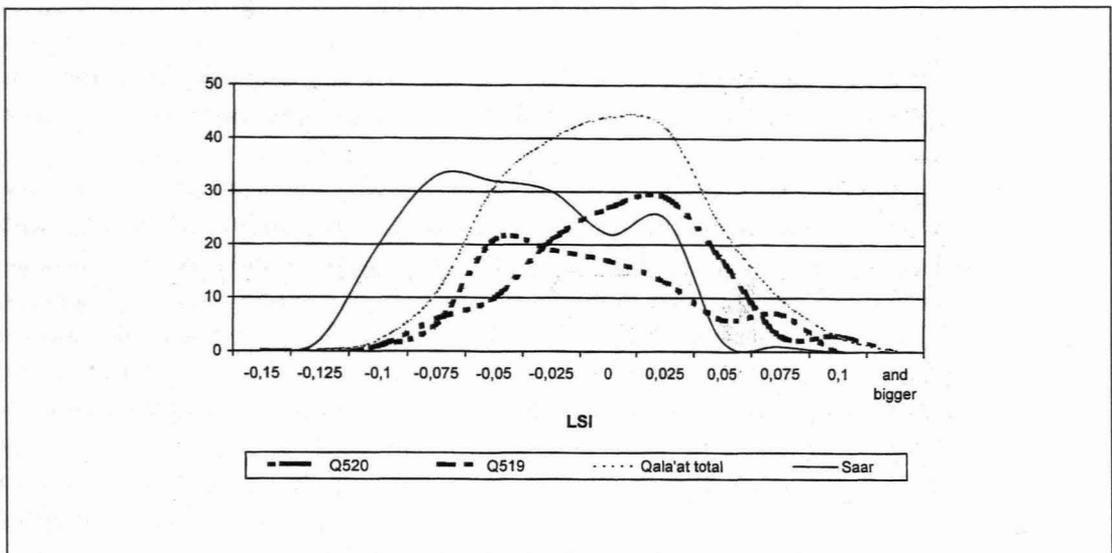


Fig. 2

Remains of the large sheep were not evenly distributed at Saar. In the houses studied in detail for their mammal remains (205, 207, 208, and 209) only the small type was found. The large breed was first encountered when studying a comparative sample from house 53, which according to its pottery is slightly later than the other houses¹³. Later sampling yielded additional specimens from other contexts of Saar. It remains an objective for further studies to find out, whether the uneven distribution of the large sheep is only due to chronological differences, or whether some sort of social stratification might be behind this observation.

¹³ According to Jane Moon and Rob Carter (pers. comm.) house 53 is phase IIc while 205, 208 and 209 are IIb.

The smaller sheep of Saar may represent the local stock, which is known from older sites in the general area like Tepe Yahya¹⁴ on the northern and Hili 8¹⁵ on the southern side of the Lower Gulf. It is possible that the small type still represented a hair-sheep while the large form most likely already had a woolly fleece. A dichotomy between large and small sheep at contemporary sites of the Harappa culture in the Indus Valley was already observed by Meadow¹⁶. With regard to sheep husbandry at Saar it should be added that there are several finds of horn cores which most probably represent castrated rams. Size-wise they are smaller than a single obvious ram horn-core. Their cross-section is semicircular and they are not twisted. At least the basal quarter is pneumatised, which is typical for wethers. As horn-size and body-size are not necessarily closely correlated, it is at present impossible to say whether these horn cores pertain to the large or the small breed of sheep.

The separate curves (Fig. 2) for the sizes of sheep bones from the two evaluated excavations at Qala'at al-Bahrain also provide interesting insights into the animal economy and its social background in the ancient capital of the island. Both curves have basically the same width and the same position on the X-axes, which indicates that they represent the same population. However, the peaks are shifted to the left in Exc. 519 and to the right in Exc. 520. This is explained by a different selection of the animals consumed in both areas. According to observations on epiphyseal fusion, generally younger sheep are represented in area 519 than in 520. Although only bones with fused epiphyses were measured, specimens from subadult animals are often included, because there are several skeletal elements where the epiphyses close at an early state before the animal has reached its final size. Thus, the selection of younger sheep for consumption by the inhabitants of the central area of ancient Qala'at al-Bahrain is also reflected by the sizes of the sheep bones found there. In the peripheral part of the ancient city the inhabitants had to contend with less tender mutton. Further evidence for such a social difference is provided by the general composition of the bone samples. More sheep seem to have been eaten in 519 than in 520, where the proportion of goats was higher. In addition, the sheep bones of 519 more often derive from body parts richer in meat than those of 520. This mirrors the same pattern as it was found in the cattle remains. Taken these lines of evidence together, the assumptions about a stratified society at Qala'at al-Bahrain can in fact be supported from the side of the osteoarchaeologist. Of course this statement depends on the existence of a common subsistence system of the whole site within which the different parts of slaughtered animals were distributed according to the wealth or status of the respective consumers.

Another interesting figure for socio-economic considerations is the ratio between cattle, sheep and goats at a site. To some extent all three species of domestic ruminants can replace each other, depending on the conditions at the respective sites. The ratio between these species is determined by the natural environment on one side and by social factors and the particular needs of the consumers on the other. Natural conditions in northern Bahrain during the early second millennium seem to have been under human control to a large extent – as mentioned above when dealing with cattle size at Qala'at al-Bahrain. Therefore only the socio-economic factors need to be discussed here:

¹⁴ Meadow RH 1986, *Animal Exploitation in Prehistoric Southeastern Iran. Faunal Remains from Tepe Yahya and Tepe Gaz Tavila-R37, 5500-3000 BC*. Ph. D. dissertation, Harvard University, Cambridge MA, 1986.

¹⁵ H-P. Uerpmann, in prep.

¹⁶ Meadow RH 1991, *Faunal Remains and Urbanism at Harappa*. In: Meadow RH (ed.) *Harappa Excavations 1986-1990. Monographs in World Archaeology 3*, Prehistory Press, Madison WI, 89-106.

The products of cattle are meat, milk, and labour. Thereof meat and milk can be replaced by the other two species. Goats are especially productive with regard to milk, sheep are more esteemed for their meat. The non-replaceable product of sheep is wool, although the hair of some goat breeds can also be used for textiles. As cow milk is usually preferred over goat milk, and mouton and beef over goat meat, the goat is normally the least represented animal among the three species. However, goats are well adapted to aridity. As unspecialised browsers they can exploit even sparse desert vegetation. In addition they do not require much health-care and are therefore sort of an insurance for the basic stability of human subsistence in a dry environment. Sheep are less well adapted to the conditions in the Gulf area, because they are grazers rather than browsers, and better defended against cold than against heat. Losses are higher, as also witnessed at the site of Saar by the whole skeletons of infantile and juvenile sheep disposed of in the rubble- and sand-fills of disused houses.

Among cattle, there are breeds which are well adapted to the heat. Their usefulness depends more on the social conditions among the consumers than on the biology of the animals. The big size of cattle requires big input and provides big output, to which the group size of the consumers must correspond. In an open market economy the number of potential consumers is almost unlimited. In self-contained household units, however, the sheer amount of meat provided by a single slaughtering event of an ox can be a severe problem. It must also be kept in mind, that animal husbandry always requires a certain herd size to keep reproduction going. The problem of large quantities posed by having cattle could therefore not be solved infinitely by keeping fewer individuals.

Animal bone finds from settlements reflect a long term average of how the former inhabitants balanced their animal economy according to the outlined requirements and conditions. Therefore, the relative quantities of different species can be used as parameters for certain aspects of human behaviour. The differences in the proportions of cattle, sheep and goats between Saar and Qala'at al-Bahrain can be interpreted with regard to social differences between the two settlements. Hence, the higher amount of cattle bones from Qala'at indicates a large enough population of consumers. At the same time, the differences between the two evaluated areas with regard to represented body parts and age classes of cattle and sheep reveal the existence of a value-based distribution system, which in other words means some sort of market economy. This may well have existed at Saar, too, but the size of the community does not seem to have created a large enough demand for beef to sustain a constant supply. Cattle may only have been slaughtered there on particular occasions – like festivities – which brought together the necessary number of consumers. Normally, sheep seem to have taken the place of cattle as providers of red meat at Saar.

The distinction between red and white meat is important at this point, because white meat was supplied in abundance by fish and shellfish. While these resources could satisfy the human need for protein and many other important nutrients, only red meat provided high concentrations of digestible iron already incorporated in bio-molecules. This was particularly important for parasite-infested and therefore chronically anaemic sedentary populations.

The lower proportion of goats at Saar should not be considered only within the framework of sheep-and-goat husbandry. With the sheep replacing cattle to some extent, their proportion would be higher without any connection to the economic role of the goat. Although goat bones are not frequent enough in the fully evaluated samples from Saar to make well-founded statements, it seems that goats got generally older than sheep

in this settlement as well. For Qala'at al Bahrain there is sufficient demographic evidence that goats were used for milking¹⁷, and the same can be assumed for Saar. At both sites goats, contrary to sheep, apparently represented a local breed. They are smaller than those from Mesopotamia and very similar to other early Arabian populations. According to a few complete metapodials from Saar and Qala'at al-Bahrain, their shoulder height can be calculated to around 60 cm, which is similar to unimproved local goats today. Both at Qala'at al-Bahrain and at Saar, the observations on the bone finds do not indicate any management of the goats beyond the requirements of individual households.

There are two other species of domestic mammals which need to be discussed: The use of donkeys in Dilmun is well attested by pictorial evidence. A seal showing a person riding an animal, which is best identified as a donkey, was found at Saar¹⁸. This is better evidence for the domestic status of this equid than can be derived from the morphology of the bone finds.

As wild asses were available for local domestication on the Arabian shores of the lower Gulf¹⁹, there was no need for long distance imports and adaptations of this species – contrary to the horse, which only appeared in the Southern Gulf area long after the Dilmun period²⁰. While in both excavated areas of Qala'at al-Bahrain several ass bones were found, they are very rare at Saar. Obviously this species was not regularly eaten.

The dog is only represented at Saar with a single bone, which in addition could not be identified with complete certainty. Whether dogs were really kept there remains questionable. There are no clear indications of dog-gnawing on the bone finds as well. This is somewhat astounding in a settlement where fisheries provided a lot of protein-rich offal. There might be a long standing aversion against keeping dogs in this area. This seems to be contradicted by the finds from Qala'at al-Bahrain, where dog bones – although scarce as well – bear traces of butchering²¹. Again, the butchering of dogs may be related to the Mesopotamian influx visible in Dilmun's ancient capital.

In conclusion, the Mesopotamian influence on the animal economy of Dilmun is remarkable. Especially the sheep husbandry of Qala'at al-Bahrain is based on animals which must have come from there. The fact that they are still found there in post-Dilmun times indicates that not only the animals but also the techniques of their maintenance were imported. At Saar the animal economy was different at the same time, being somewhat less "metropolitan" in several respects. The fact that the advanced husbandry techniques did only partly, if at all, spread out to Saar, which was only two hours walking distance away, may be evidence for the assumed connection of sheep husbandry to higher social ranks – apparently mainly present in the capital. However, even there the basic supply of protein came from fisheries, which clearly had a local root. This does not mean that every household unit indulged in its own subsistence fishing. At Qala'at al-Bahrain specialisation on fishing by parts of the population is indicated by the small houses in Excavation 520 where fish hooks are concentrated. At Saar, the uneven distribution of fish sizes in different houses indicates the possibility of

¹⁷ Uerpmann & Uerpmann 1994, Animal bone finds from Excavation 520: p. 438.

¹⁸ Fig. 18 in Woodburn MA & Crawford HEW 1994, London-Bahrain Archaeological Expedition: 1991-2 excavations at Saar. AAE 5, 89-105.

¹⁹ Uerpmann H-P 1987, The Ancient distribution of Ungulate Mammals in the Middle East. Beihefte zum TAVO, Reihe A Nr. 27, Dr Ludwig Reichert Verlag, Wiesbaden.

²⁰ Uerpmann H-P 1999, Camel and horse skeletons from protohistoric graves at Mleiha in the Emirate of Sharjah (U.A.E.). AAE 10: 102-118.

²¹ Uerpmann & Uerpmann 1994, Animal bone finds from Excavation 520 p. 424

choice by the consumers. This is best explained by a market situation and would not have been the case in self-made catches.²² Generally, local traditions and adaptations are clearly visible in the subsistence of Saar. They can also be detected at Qala'at al-Bahrain and obviously they had an influence on the animal economy of ancient Dilmun as a whole. It will be interesting to relate these considerations about the animal sector of the subsistence system in early historic Bahrain to its vegetal counterpart and to the other sectors of ancient economy²³ in the larger area extending from Mesopotamia to the Indus Valley.

²² Compare p. 112 ff. in: Belcher W 1998, *Fish Exploitation of the Baluchistan and Indus Valley Traditions: An Ethnoarchaeological Approach to the Study of Fish Remains*. Ph. D. dissertation, Univ. of Wisconsin, Madison WI.

²³ It is interesting that Saar was not connected to the same sources of bitumen as Qala'at al Bahrain: Connan J, Lombard P, Killick R, Højlund F, Salles J-F & Khalaf A 1998, *The archaeological bitumens of Bahrain from the Early Dilmun period (c.2200 BC) to the sixteenth century AD: a problem of sources and trade*. *AAE* 9: 141-181.